

A CONSIDERATION INTO WAYS BIOLOGY-BASED
STUDENT ORGANIZATIONS FACILITATE PARTICIPATION
IN STEM

by

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DECICATION

I dedicate this work to my family who has always been supportive of my academic pursuits. From a little boy in small town Alabama to the man that I am today in big town Texas, I would not be where I am today if not for their love and support. For that, I cannot thank them enough.

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ABSTRACT

Student involvement on their campus is a vital part of their experience in higher education. A lack of involvement and engagement can lead to a decreased sense of belonging on campus and in their chosen field of study. Researchers speculate that one reason students leave STEM is because students have not developed a strong perceived attachment to the field of science. One way that students may build this perceived attachment to science is through increasing their engagement and participation in science-based activities. By participating in science-based social organizations, students are exposed to new experiences they would not normally have during their coursework. The purpose of my study was to investigate how biology-based student organizations functioned as affinity groups and how these groups influenced individuals' perceived cohesion to science. I followed three biology-based student organizations, biological honor society, microbiology club, and wildlife club, over the course of one academic year to identify the extent they exhibited the characteristics of affinity groups. After collecting and analyzing data from field observations, I found that all three groups exhibited the criteria of affinity groups to various degrees. Through analyzing student responses to an open-ended questionnaire, I was able to uncover the motivations students had for joining their respective student organizations and what benefits they reported receiving from their participation. I found three major overarching themes for what motivated students to join their respective student organization: they liked the content the organization was based on, to have some form of social outlet, or the reputation of the organization drew

them into the organization. Students reported a wide range of benefits they received from their participation in these organizations. I grouped these benefits into five overarching themes: *Networking*, *Professional Development*, *Learning Opportunities*, *Community Involvement*, and *Prestige*. I found that there was some overlap between students' motivations for joining their student organization and what benefit they received from their participation. With this overlap, I speculate that a feedback loop exists where students join an organization for a specific reason that guides what events they choose to participate in which then leads into the benefit they receive from their participation. Now that we better understand how these organizations function, what motivates students to join content-based student organizations, and what they are getting from their experiences, we can further promote these groups to new students. By joining a content-based student organization, students will be better able to find their place in science through networking with others in their field and honing and developing skills that they can take into the workforce, ultimately making them more competitive on the job market.

I. INTRODUCTION

Feeling a sense of inclusion, acceptance, and fit improves academic and social adjustment in university settings (Hurtado et al. 2007; Ostrove & Long 2007). Furthermore, such a sense of belonging can promote involvement and intention to persist in STEM majors (Good, Rattan, & Dweck, 2012; Hausmann, Schofield, & Woods, 2007; Marra, Rodgers, Shen, & Bogue, 2012) and motivate engagement and involvement in STEM courses (Wilson et al., 2015). Engagement and involvement in academic activities is positively related to and strong indicator for persistence in STEM majors (Hughes & Pace 2003; Kinzie, Gonyea, Shoup, & Kuh, 2008; Nelson Laird, Chen, & Kuh, 2008). However, many students struggle to adjust to campus life while in college (Chemers, Hu, & Garcia, 2001; Fischer, 2007). This is the first time in many students' lives when they are away from home and have higher levels of independence and must develop self-regulation to be successful. Many students struggle to find a balance between their academic and personal lives due to greater levels of independence and new pressures on time-management (Chemers, Hu, & Garcia, 2001). How students establish this balance between an academic and personal life has been found to be a strong predictor of academic success throughout their higher education (Brandh, Penckofer, Solari-Twadell, & Velsor-Friedrich, 2015; English, Davis, Wei, & Gross, 2017).

One option to help students adjust to campus life is to increase opportunities for campus engagement (Mustafa, 2015). Students can increase campus engagement by participating in relevant student organizations (Robbins, Allen, Casillas, Peterson, & Le, 2006). Increased campus engagement and involvement has been linked higher GPAs regardless of pre-college backgrounds (Kinzie et al., 2008; Kuh, Cruce, Shoup, Kinzie, &

Gonyea, 2008), student learning (Austin, 1999; Zilvinskis, Masseria, & Pike, 2017), expanding their social circles (Park & Kim, 2013), and personal development (Trudeau, Hammond, Moser, Eversole, & Smith, 2019). Students' sense of belonging has been linked to positive social (Strayhorn, 2012), and academic (Pittman & Richmond, 2008) outcomes among college students, and a lack of sense of belonging has been identified as a reason students leave STEM fields (Won, Wolters, & Mueller, 2018). Sense of belonging has also been positively linked to emotional factors such as self-efficacy (Zumbrunn, McKim, Buhs, & Hawley, 2014). Through building a sense of belonging and self-efficacy, students build confidence that carries over into their careers leading to more productive workers (Strayhorn, Lo, Travers, & Tillman-Kelly, 2015). Building a sense of belonging not only helps students become more engaged on their campuses, but also helps them find their place in their chosen field of study.

Purpose Statement

The purpose of my dissertation was to investigate the experiences students have while participating in biology-based student organizations and how these experiences impact student sense of belonging. Biology-based student organizations allow students to be more involved in the specific content of the organization (i.e. biology, microbiology, wildlife) and expand their personal and professional networks. By better understanding the experiences students have in these types of organizations, we can better understand how students find their place in the field of science.

Research Questions

The research questions that guided my study are:

- 1) To what extent do biology-based student organizations exhibit the criteria of affinity groups.
- 2) Why do student members elect to join their respective student organizations?
- 3) How do students participate in their respective student organizations?
 - a. How often do students participate in organizational activities?
 - b. In what ways do students participate in organizational activities?
 - c. What are reasons students provide for their chosen level of participation?
- 4) What benefits do students receive from participating in biology-based student organizations?

List of Terms

Affinity – The attractive force that an individual has towards a specific topic.

Affinity group – A social group constructed of members that share an affinity for a specific topic.

Biology-based student organization – A student organization that is built around a specific topic in biology.

Cohesion – A term used to describe how groups of people tend to “stick” together to maintain social groups.

Feeling of morale – Sum of positive and negative emotional responses associated with belonging to a social group.

Overt, non-participating observer – A role where the researcher acts as a non-participant and makes their presence as a researcher known within a setting.

Perceived cohesion – A term used to describe how an individual perceives they are attached to a social group.

Persistence rates – The rate at which students continue their higher education at any institution.

Retention rates – The rate at which students continue their higher education at the same institution from year to year.

Sense of belonging – The feeling that an individual has about belonging to a specific group or situation.

STEM – The fields of Science, Technology, Engineering, and Math.

Student organization – A social group built around a specific topic that is generally found on the campus of an institution of higher education.

Trekkie – A member of the fan community built around the series *Star Trek*.

Literature Review

In recent years, there has been a strong research focus on ways of increasing the number of students entering the scientific workforce and improving pathways toward entering the science, technology, engineering, and mathematics (STEM) workforce (National Science and Technology Council, 2018). Student attrition at different educational levels and has been a major concern for years and many studies have focused on ways to improve retention in STEM (Van den Hurk, Meelissen, & Van Langen, 2019). Through these efforts, the United States has seen an upward trend in the number of students who are pursuing a higher education in STEM (National Science Board, 2018). Even though the number of students pursuing STEM degrees is increasing, there is still a large workforce demand for qualified individuals (Diekman & Benson-Greenwalk, 2018), thus there is still a strong need for ways of improving persistence and retention in STEM. Researchers have identified many factors that have been identified for why

students leave STEM fields (Aschbacher, Li, & Roth, 2010; Ortiz & Sriraman, 2015). One factor that contributes to students leaving STEM fields, is the lack of developing a feeling that they belong in science (Wilson et al., 2015; Won, Wolters, & Mueller, 2018). Student sense of belonging has been shown to contribute to educational persistence both in STEM and other fields (Wilson et al., 2015) at all academic levels from primary and secondary school (Anderman, 2002), to post-secondary (Freeman, Anderman, & Jensen, 2007; Hausman, Schofield, & Woods, 2007). Students who develop a stronger sense of belonging tend to have increased engagement in academic settings (Furrer & Skinner, 2003; Wilson et al., 2015) and persistence (Booker, 2016; Hausmann et al., 2007; Juvonen, 2006), while having lower rates of emotional distress (Pate, Maras, Whitney, & Bradshaw, 2017; Resnick et al., 1997).

In addition to helping students adjust to campus life, participating in a student organization can help improve a student's sense of belonging, both within the group community and on their campus (Bowman, Park, & Denson, 2015). Participating in student organizations can allow students to meet new people to expand their social circle (Park & Kim, 2013), and can increase engagement with their campuses (Robbins, Allen, Casillas, Peterson, & Le, 2006). Increased campus engagement has previously been linked to student learning and personal development and helped improve collegiate retention (Astin, 1999; Zilvinskis, Masseria, & Pike, 2017).

Currently, most of the literature focuses on non-discipline specific student organizations and shows there are many benefits students receive from participating in these organizations (Baker, 2008). Many of these benefits overlap with benefits that are provided by affinity groups (Anderson, 2015; Korobkova, & Black, 2014). Therefore, I

speculate that these organizations could be considered affinity groups and propose that biology-based student organizations can also fall into this category and offer the same benefits to students. In order to confirm this, we must first determine if biology-based student organizations fit the criteria of affinity groups (Gee, 2000).

Theoretical Frameworks

My investigation into biology-based student organizations was based on two aspects of each organization: the group and the individual. I investigated both aspects to see if and how they interact and influence each other. I used the affinity framework (Gee, 2000) to guide my investigation of the overall biology-based student organizations and the perceived cohesion framework (Bollen & Hoyle, 1990) to guide my investigation of the individual within the group. Both frameworks allowed me to investigate shared aspects and differences among and within the biology-based student organizations and their members while also exploring the experiences that students have through participating in these organizations.

Affinity

Individuals can develop an affinity towards anything that they feel an attraction to. When individuals join other individuals that share the same affinity, they form what is called an affinity group (Gee, 2000). The concept of affinity groups (Gee, 2000) is similar to the concept of communities of practice (Wenger, 1998) given that the only primary difference is communities of practice have a primary goal of learning whereas affinity groups have a primary goal of being social groups (Gee, 2000). Learning can and typically does occur in affinity groups. However, learning is not the focus of participating in an affinity group, but rather building self-identity. The focus of my investigation is on

student participation and understanding sense of belonging rather than student learning. Thus, I opted to base my project on the concept of affinity groups (Gee, 2000) to guide this investigation of three biology-based student organizations.

There are two main categories of affinity groups: popular culture (e.g. Trekkies, Whovians, languages, etc.) (Korobkova & Black, 2014) and professional (e.g. teachers) (Gilmartin, Denson, Li, Bryany, & Aschbacher, 2007; Luehmann, 2007; Settlage, Southerland, Smith, & Ceglie, 2009). The level of participation in popular culture affinity groups has been found to be dependent upon the level of fandom of the individual and can vary among group members (Taylor, 20015). These affinity groups allow for member interaction on a global scale which can increase culture literacy (Fukunaga, 2006). Additionally, these affinity groups serve as a creative outlet for members where members can share their work in a safe environment (DeLuca, 2018; Korobkova & Black, 2014).

Professional affinity groups can be formed within any profession, with the most commonly studied profession being teachers. Affinity groups with teachers have been formed with teachers at the same school (Weiner & Torres, 2016) and at different schools (Hanuscin, Cheng, Rebello, Sinha, & Muslu, 2014) at all educational levels. These affinity groups have been found to provide many benefits to group members. Teacher affinity groups provide an opportunity for professional development (Burridge & Carpenter, 2013) and build trust and credibility among group members through the development of positive attitudes towards colleagues (Anderson, 2015).

Both types of affinity groups provide a myriad of benefits to its members. I propose that the field of science can be viewed as a type of subculture that can allow for the formation of affinity groups. If we view science and its subfields (i.e. wildlife biology

and microbiology) as affinity groups that future scientists wish to assimilate into, then it is imperative to understand how individuals become affiliated or alienated with science and how they learn to negotiate the cultural norms within science to encourage science identity development (Carlone & Johnson, 2007).

Affinity groups are formed when individuals come together around a specific topic to share information, bond and build a sense of community (Gee, 2000). Affinity group members can be geographically dispersed thanks to current internet technology. Additionally, group members do not have to come from the same demographic background. If individuals share an interest in the specific topic, then they can be part of the same affinity group. This allows affinity groups to be diverse, which can lead to the breaking down of social barriers that can inhibit developing skills around the topic (e.g. learning a new language) (Fukunaga, 2006). There are three criteria that must be met for a group to be considered an affinity group. Affinity group members must share: 1) allegiance to the group and its members, 2) access to the specific topic, and 3) participation in practices specific to the group (Gee, 2000).

The first criterion of an affinity group is allegiance (Gee, 2000). There are two aspects to this allegiance criterion. First, the group must have a commitment to a set of practices and endeavors that is common to the topic or field of interest for the group. An individual is not considered part of the group if an individual does not share this commitment to the endeavors of the group. The second aspect of allegiance that is necessary for an affinity group is loyalty to the members of the group. Because of this concept of loyalty, affinity group members can serve as a support system for its members.

This support system can allow members to share their experiences while pursuing the endeavors of the group without fear of judgment.

The second criterion for an affinity group to be considered so is access to information that is relevant to the group (Gee, 2000). This could be accessing information from outside of the group that is relevant to the group, or it could be sharing access to information among group members. It is this access to information that allows for more trust to be built between group members, which can lead to stronger interpersonal bonds.

The third criterion that is required for an affinity group is participation in practices that are specific to the group (Gee, 2000). This is where group members act as part of the group and where they assist in events that further the goals of the group. Members also develop a way of acting and behaving (i.e. discourse) that is specific to the group. This can be through observing other group members and adjusting their behavior accordingly. Essentially, members begin to act and behave as they think members of the group should act. The classic example of an affinity group that is described by Gee (2000) is “Trekkies” or fans of the Star Trek series. Members of the Trekkie affinity group meet all criteria as outlined by Gee (McCorkle, 2016). They share allegiance to the ideas presented in the series, as well as allegiance to other Trekkies. They also collect and share information through online forums and conventions, which allow for the Trekkie affinity group to have members that are dispersed across the planet in many different countries. Additionally, Trekkies also fulfill the final criterion of affinity groups through their actions. Many members of the group collect items from and about the series, dress as their favorite characters, and attend conventions and other large gatherings to socialize (McCorkle, 2016). While any group could potentially be an affinity group, it is only

through participating in groups meeting all three of defined criteria and helping shape an individual's identity that a group is considered an affinity group (Gee, 2000). An example of a group that would not qualify as affinity groups would include roommates who come together to plan activities (e.g. group outings and meals) but self-identity is not driven based on affiliation with that group.

I used the framework of affinity groups to guide my investigation of biology-based student organizations to determine if and how these organizations exhibited the qualities of affinity groups. I choose to investigate three organizations within the biology department that were potential affinity groups (i.e. biological honor society, wildlife club, microbiology club). I proposed that these groups qualified as affinity groups based on Gee's criteria (Gee, 2000). First, each of these groups had allegiance to the practices and goals of their specific scientific topic (i.e. wildlife club members were interested in wildlife). Additionally, I investigated how these groups shared information with other group members and how members participated in the specific practices of the group.

Perceived Cohesion

Cohesion is a term frequently used in chemistry and physics to describe the properties of an item that allows it to stick together with other items. Cohesion is also a construct that is common in the fields of sociology and psychology that is used to determine how groups of people tend to "stick" together and maintain social groups. In the context of these two fields, cohesion is a very broad term that can have several subdivisions such as social cohesion and perceived cohesion. Both terms are commonly applied to social groups, such as friend groups or groups of students that come together to socialize.

There are many ways to define cohesion (Maher, Cobigo, & Stuary, 2013). I used perceived cohesion, a specific type of cohesion that was originally coined by Bollen and Hoyle (1990) as a response to there being no “true” definition of cohesion. Bollen and Hoyle (1990) wanted to form a definition of cohesion that applies to individuals and how they feel a part of a specific social group rather than how they are viewed by others. They define perceived cohesion as, “encompass[ing] an individual’s sense of belonging to a particular group and his or her feelings of morale associated with membership in the group,” (Bollen & Hoyle, 1990, p.482). Essentially, perceived cohesion is the extent to which individuals feel like they belong to a particular social group. An important quality of perceived cohesion is that it is determined solely by an individual’s own perceptions of how they fit into a group, rather than how they are perceived by others. I chose this definition of perceived cohesion over others because it focuses on an individual’s perceptions of their role within the social group rather than the perceptions of others about the individual.

The construct of perceived cohesion contains two dimensions: *sense of belonging* and *feelings of morale* (Bollen & Hoyle, 1990). Sense of belonging includes both cognitive and affective elements of the judgment of an individual’s relationship to a specific social group. Cognitive processes are defined as being based on specific information or mental processes, whereas affective processes are driven primarily by emotions. The cognitive judgment of sense of belonging includes information about an individual’s experiences with other group members as well as the group. The affective judgment of sense of belonging includes reflections on an individual’s experiences within the social group. This affective reflection funnels into feelings of morale in that it is a

sum of the positive and negative emotional responses associated with belonging to a social group. Because there is an established link between cognition and affect (Zajonc & Markus, 1984), it is speculated that there is a positive correlation between sense of belonging and feelings of morale to a social group (Bollen & Hoyle, 1990). This could be because, primarily, individuals are able to select their preferred social groups. Therefore, they are only associated with those groups to which they have strong perceived cohesion.

I utilized the concept of perceived cohesion (Bollen & Hoyle, 1990) to guide my investigation of how active biology-based student organizations function and what experiences students have from being a part of these organizations. Specifically, I followed the biological honor society, wildlife club, and microbiology club. These student organizations are social groups that are comprised of individuals that have an interest in the specific biology topics that the club promotes. Membership in these student organizations is not a formal requirement for completing a degree in biology. Therefore, it was expected that students would only maintain active membership in an organization that they felt a high sense of perceived cohesion towards. If an individual did not have a high sense of belonging and overall positive feelings of morale toward their student organization, it was not likely that they would have continued to be active members of that organization. In this case, the individual would self-exclude themselves from the organization. The groups one chooses to include or exclude themselves can help them identify themselves as the type of person they choose to present themselves as (Gee, 2000).

Dissertation Style

My dissertation is structured like a portfolio with three publications serving as my individual chapters each guided by different research questions (Table 1). I choose this non-traditional style of dissertation to create a set of tangible evidence to display what I have learned throughout the Ph.D. process.

Table 1.

Data sources for each research question.

Research Question	Field Notes	Organizational Artifacts	Perceived Cohesion Questionnaire	Focus Groups
RQ1. To what extent do biology-based student organizations exhibit the criteria of affinity groups?	X	X		X
RQ2. Why do student members elect to join their respective student organizations?			X	
RQ3. How do students participate in their respective student organization?				
RQ3a. How often do students participate in organizational activities?	X	X		
RQ3b. In what ways do students participate in organizational activities?	X		X	X
RQ3c. What are reasons students provide for their chosen level of participation?			X	
RQ4. What benefits do students receive from participating in biology-based student organizations?			X	

I conceived this project based on my interest in understanding the experiences students have while participating in student organizations. I crafted research questions to help guide my investigation into the behavior students display at group meetings and events. By determining student behavior at group activities, I can extrapolate how students come to develop an attachment to science. Due to the nature of my study, I felt a

portfolio style dissertation was more appropriate over a traditionally structured dissertation. This project was approved and conducted in accordance with the Texas State University IRB guidelines (Project #2017752; Appendix A).

Chapter 2 of my dissertation consists of my first publication that covers my first research question. This chapter will focus on investigating how biology-based student organizations exhibit the criteria of affinity groups as described by Gee. Chapter 3 consists of my second publication covering my second and third research question. This chapter focuses on what motivates students to join and participate in biology-based student organizations. Chapter 4 consists of my third publication covering my last research question. This chapter focuses on what benefits students receive from participating in biology-based student organizations. Chapter 5 discusses my findings as a whole and provides implications for future student organizations.

Research Tradition

For my investigation, I followed the research tradition of constructivism (Patton, 2002). The fundamental question that drives this research tradition is how people in a specific setting construct reality. The first assumption that constructivism relies on is that the human world is different than the natural, physical world as humans have developed the capacity to construct and adjust their reality based on their personal experiences. In terms of research, there are five major assumptions of constructivism (Patton, 2002). 1) “Truth” is derived from a consensus of informed constructors rather than correspondence with objective reality. 2) “Facts” only have meaning within a valued framework. 3) “Causes” and effects exist by imputation. 4) Phenomena are only able to be understood within the studied context and findings are not able to be generalized to other situations.

5) Data derived from constructivist research do not have a special status and only represent another construction to be considered towards the consensus development of truth.

Within the confines of my investigation, I utilized the ideals of constructivism to guide my research. I entered my research with the assumption that each student participant constructs their own experiences based on what organizational activities they chose to participate in. Students come to develop their “truth” based on their individual experiences and the collective experiences of others in the organization. The “facts” that I observed only had meaning to the participants within the framework of the organization and had meaning to me within the framework of affinity (Gee, 2000). Finally, the data I collected have no special status and contributes to our further understanding of student experiences in biology-based student organizations.

Trustworthiness

In order to establish a rigorous qualitative study, there are several components that must be addressed. These include Credibility, Dependability, Confirmability, and Transferability. Collectively, these criteria create Trustworthiness in qualitative research (Lincoln & Guba, 1985). For my study, I maintained credibility through adhering to standard protocols that are typically used in qualitative research. I utilized field observations of events that I attended to capture the experiences of students who participated in these student organizations. I maintained dependability in my investigation by using standard protocols during each of my observations and focus groups. I created confirmability through the analysis of my data with my advisor. When coding my data, I would discuss my coding decisions and whenever a conflict arose, we

would discuss the issue until 100% interrater reliability was reached. The transferability of any qualitative study is how findings can be applied to different settings. My research focused on biology-based student organizations, but my findings can be applied to any academic student organization to explore the experiences students have will they participate in these groups.

Biology Based Student Organizations

For my investigation, I followed three biology-based student organizations that were currently active within the biology department at a large regional southwestern public university: biological honor society, microbiology club, and wildlife club (Table 2). I selected these three organizations for several reasons. First, each student organization aligned with one of the undergraduate majors within the biology department (general biology, microbiology, and wildlife biology) and was a local chapter of a national organization. Second, each student organization held some form of event or meeting at least once a month. Additionally, each student organization required a membership fee to become a member and offered group specific shirts for members to purchase. Finally, each student organization met the university required levels of membership with at least five members in order to be recognized as an official student organization with the university. Though one organization, wildlife club, was larger than the other two groups, I focused my investigation on individual experiences within each organization which allows me to still compare the experiences. By included organizations of different sizes, I am also able to identify impacts from organization size on individual experiences. In instances when a student was involved with multiple organizations, I asked them to complete a questionnaire for each organization.

Table 2.

Student organization demographics.

	Biological honor society	Microbiology club	Wildlife club
Gender			
Male	24	31	198
Female	71	45	307
Membership Type			
Leader	4	5	5
Member	91	71	500
Total Members on Roster	95	76	505
Biology Majors (Fall/Spring)	54/52	55/51	198/183
Avg Meeting Attendance (%)*	23%	22%	11%

*Based on biology majors.

Biological Honor Society

The biological honor society is an honor society that promotes interest in the biological sciences. There are two levels of membership within this organization: associate and regular. Any undergraduate or graduate student can become associate members of this student organization regardless of their major and GPA. Only undergraduate biology majors with a GPA of at least 3.0 can become regular members. Both associate and regular members can participate in organizational events, but only regular members can pursue a leadership position in the organization. To join this organization, students paid national dues of \$40 to become an associate member and \$50 to become a regular member. If a student was already an associate member and wanted to become a regular member, they would just pay the difference (\$10) to upgrade their

membership. Students were also able to purchase optional t-shirts for \$20. The society encouraged students to wear them at the research conference hosted by the organization in the spring but allowed students to wear any other black shirt in its stead if students elected not to purchase a t-shirt. This student organization is an honor society and the prestigious title could lead to students joining this organization with no intentions of participating. This student organization had 54 members during the fall semester and 52 members during the spring semester on their roster during my investigation.

Microbiology Club

The microbiology club is a student organization that promotes interest in the field of microbiology. Though the organization promotes traditional aspects of microbiology, such as laboratory research, they also promote non-traditional aspects of microbiology, such as how microbiology is important in the brewing industry. By including non-traditional aspects of microbiology, members are exposed to new aspects of the field they may not have known about. Membership in this student organization is open to graduates and undergraduates of any major, though most members are undergraduate microbiology majors. To join this organization, students had to pay dues of \$25 which included a t-shirt. This student organization had 55 members during the fall semester and 51 members during the spring semester on their roster during my investigation.

Wildlife Club

The wildlife club is a student organization that promotes interest in wildlife and conservation and building professional networks among wildlife studies majors. Among wildlife majors, this student organization is heavily marketed as being a requirement for career success in the field of wildlife biology. Membership in this student organization is

open for both graduate and undergraduate students regardless of major, though most students are majoring in wildlife sciences. To join this organization, students had to pay dues of \$10 per semester (\$20 per year). Additionally, the wildlife club sold optional sweatshirts for \$25 each starting at the end of the fall semester. The wildlife club holds a special event at the end of the spring semester, and only the top ten students who participated in organizational activities throughout the year are invited to attend. Students striving to be invited to this event could be an important factor in their participation throughout the year. This student organization had 198 members during the fall semester and 183 members during the spring semester on their roster during my investigation.

Role of Researcher

For my investigation, I acted as an overt, non-participating observer (Patton, 2002). Patton describes participation as being more than just a simple choice and that participation occurs on a continuum. While I was not an active participant during my observations, there were times that I could be viewed as participating in group activities by attending group events. I also choose to be an overt rather than a covert observer (Patton, 2002). The major concern with being an overt observer is the potential for participants to behave differently if they know they are being observed. However, to avoid any potential ethical concerns this form of observation was the most practical. By being an overt, non-participating observer, I was able to remain focused on capturing how each organization functioned.

Delimitations

Prior to the start of this research, I identified several delimitations that impacted my investigation. The first delimitator was the number of events that I would be able to

attend for each student organization. The biological honor society and microbiology club held one general group meeting each month and the wildlife club held biweekly general group meetings. To maintain consistency across organizations, I choose to attend one general group meeting per month for each student organization. I felt that this would be enough meetings to give me an adequate picture of what was occurring at these meetings. I also knew prior to starting my investigation that each biology-based student organization held many events outside of general meetings. I knew that I would be unable to attend every event held by each organization, either due to timing of event, or the number of individuals allowed to attend each event. With events that I was unable to attend, I collected artifacts (e.g. sign-in lists) and spoke with the student leaders about these events during focus groups. The final delimitator was the number of students that responded to my questionnaire. I administered the questionnaire through Qualtrics and distributed it to members of each biology-based student organization through their email listserv. The number of students who respond to online questionnaire is known to be very low, but this was the most logistical method for distributing my questionnaire to members of the organizations.

II. ACADEMIC AFFINITY: ASSESSING THE CHARACTERISTICS OF BIOLOGY-BASED STUDENT ORGANIZATIONS

Abstract

Researchers speculate that fewer students are pursuing science careers because many lack a sense of belonging to the field of science. Existing research shows that students can build a sense of belonging through participating in social organizations or affinity groups. We investigated three biology-based student organizations to determine to how they met the criteria of affinity group. We found that the three groups exhibited the criteria of affinity groups by: displaying allegiance to the group, sharing access to relevant information, and participating in group specific activities. Further investigation is needed to determine how these groups impact members' development of a sense of belonging. By investigating the benefits of biology-based affinity groups, we can improve student persistence in STEM.

Introduction

Since the turn of the century, there has been a strong push for research on how to increase the number of students entering the scientific workforce (National Science and Technology Council, 2018). These efforts have led to an upward trend in the number of students who are pursuing a higher education in STEM (National Science Board, 2018), though it is still not enough to meet the workforce demand (Diekman & Benson-Greenwalk, 2018). As such, the scientific community is always looking for more ways of improving persistence and retention in STEM. Researchers have identified many factors that have been identified for why students leave STEM fields (Aschbacher, Li, & Roth,

2010). Developing a sense of belonging has been found to be a contributing factor to persistence in education both in STEM and in other fields (Wilson et al., 2015) and has been investigated at all academic levels, including primary and secondary (Anderman, 2002), and college levels (Freeman, Anderman, & Jensen, 2007; Hausmann, Schofield, & Woods, 2007). Student sense of belonging has recently emerged as a pivotal factor for student learning in academic settings (Won, Wolters, & Mueller, 2018) because it correlates with higher engagement (Furrer & Skinner, 2003) and lower rates of emotional distress (Bowman, 2010).

One way that students can improve their sense of belonging in college is through joining a student organization. By participating in a student organization, students meet others who share similar interest and are exposed to opportunities that they may not otherwise have (Park & Kim, 2013). Additionally, student organizations allow for individuals to increase their engagement with their college campus (Kilgo, Mollet, & Pascarella, 2016), which has been linked to student learning and personal development (Astin, 1999; Webber, Krylow, & Zhang, 2013).

Most of the current literature dealing with student organizations focuses on non-discipline-specific student organizations and shows that there are many benefits for students who participate in these organizations (Baker, 2008; Bowman & Holmes, 2017; Griffin & McIntosh, 2015). Many of these benefits overlap with the benefits reported by participation in affinity groups (Anderson, 2015; Korobkova & Black, 2014). Affinity groups are formed when individuals come together around a specific topic to bond and build a sense of community among group members (Gee, 2000). It seems plausible that discipline-specific student organizations can provide a similarly wide range of benefits to

students as those gained from participation in non-discipline-specific student organizations. Participation in science-based social organizations can further benefit students by leading to the development of science identity (Merolla, Sherpe, Stryker, & Shhultz, 2012), which can encourage retention and persistence in STEM (Nyamwange, 2016). In order to explore the impact of discipline-specific affinity groups on college students, we must first determine whether discipline-based student organizations can be considered affinity groups. The purpose of this investigation was to determine if, and to what extent, three biology-based student organizations meet the criteria of affinity groups.

Theoretical Framework

We used the theoretical framework of affinity groups (Gee, 2000) to guide this investigation into biology-based student organizations. Affinity groups are composed of individuals that share a common interest in a specific topic. Group members can be geographically dispersed and can come from a variety of different backgrounds and experiences. This geographic dispersion can increase the diversity of the affinity group, which can lead to social barriers being broken down. By breaking down social barriers, affinity groups can promote skill development around the topic of the group (e.g., learning a new language) (Fujimoto & Yap, 2016; Fukunaga, 2006). Individuals can experience personal growth from participating in the affinity group that they can carry into other aspects of their lives.

Gee describes affinity groups as the driving factor for affinity identity, one of his four domains of identity (Gee, 2000), and has established three criteria groups must meet to be considered an affinity group. In an affinity group, members must: 1) share an

allegiance to the group and its members, 2) share access to information relevant to the group and group practices, and 3) participate in group-specific practices with other group members. If a group meets these three criteria, then the group can be considered an affinity group. Affinity groups have been found to provide many benefits to members (Anderson, 2015; Korobkova & Black, 2014).

The first criterion of affinity groups is that members feel allegiance to the group (Gee, 2000). Gee describes two aspects of allegiance: members must have a commitment to the endeavors of the group, and members must feel loyalty to other group members. If an individual does not have this allegiance to the group and its members, then they are not considered part of the affinity group. Because of this loyalty among group members, affinity groups can be used as support systems and can allow members to share their experiences without fear of judgement while pursuing the endeavors of the group (Mota, Morais, Moreira, & Paiva, 2017).

The second criterion of affinity groups is shared access to group practices and information relevant to the group (Gee, 2000). This includes sharing resources and information about the groups' activities among group members. Additionally, members share information they find outside of the group that is relevant to the group (Fujimoto & Yap, 2016). Through sharing information, group members build trust in each other and improve interpersonal bonds (Anderson, 2015).

The third and final criterion of affinity groups is that members participate in group-specific practices (Gee, 2000). Group-specific practices can include attending regular group meetings, attending special events focused on the topic of the group, and behaving in ways that are specific to the group (e.g., wearing costumes of favorite

characters). By participating in these practices, members develop ways of behaving (e.g., discourse, wearing group-specific attire) that are unique to the specific affinity group. Current members of the group serve as an example to new or potential group members of how to participate in group practices so that these new members can begin to conduct themselves as members of the affinity group.

The most commonly described example of an affinity group is “Trekkies,” or fans of the television series *Star Trek* (Garcia-Roca, 2016; Gee, 2000). Trekkies serve as a perfect example of an affinity group. Trekkies share an allegiance to the television show *Star Trek* and its core principles such (e.g., the Prime Directive) as well as being welcoming and supporting other Trekkies. Many Trekkies also communicate in online discussion boards where they can share information and learn new information about the series and about events occurring within the group (e.g., conventions). Finally, Trekkies participate in group-specific practices by collecting artifacts and memorabilia from the series, attending conventions and events to socialize with other group members, and frequently dressing as their favorite characters from the series (McCorkle, 2016).

In this study, we use the framework of affinity groups (Gee, 2000) to investigate the extent to which three biology-based student organizations exhibit the criteria of affinity groups. We theorize that these student organizations qualify as affinity groups based on Gee’s criteria and will be collecting data on how members display allegiance to the group, share access to information, and participate in group-specific practices. By evaluating how these student organizations meet Gee’s criteria, we will establish how these groups act as affinity groups and investigate what benefits students receive from their participation in these groups.

Methodology

We used a naturalistic qualitative methodology (Patton, 2002) to address our research question of determining if and to what extent three biology-based student organizations meet the criteria of affinity groups as described by Gee (2000). We treated each of these three organizations as individual case studies for our investigation (Patton, 2002) and report rich descriptions of how each organization represents an affinity group. Case studies are comprised of the stories of specific individuals and organizational units and allows for a thematic analysis within and across cases (Patton, 2002). During our investigation, we acted as overt, non-participating observers (Patton, 2002), which allowed us to remain focused on capturing how each organization exhibited the criteria of affinity groups.

Organizational Context

For our investigation, we followed three biology-based student organizations that are currently active in the biology department at a large regional public university in the southwest United States: biological honor society, microbiology club, and wildlife club. We selected these three organizations because they each aligned with one of the undergraduate majors (general biology, microbiology, and wildlife biology) that were offered within the department. Each of these are local chapters of national organizations and held some form of event at least once a month, had been active for at least five years, and met the university required levels of membership of at least five members.

Biological Honor Society. The biological honor society is an honor society that promotes interest in the biological sciences. In addition to the basic membership requirements of paying dues (\$40 for associate membership, \$50 for regular membership)

and participating in organizational events, this organization requires members to maintain a GPA of 3.0 or above to continue their membership. This organization is an honor society and due to the prestigious title, students could choose to join and not participate in this organization. This organization had 54 members during the fall semester and 52 members during the spring semester of our investigation.

Microbiology Club. The microbiology club is an organization that promotes interest in the field of microbiology. Though this organization is open to students from all majors, most students in this organization were microbiology majors. To join this organization, students had to pay dues of \$25. This organization had 55 members in the fall semester and 51 members during the spring semester of our investigation.

Wildlife Club. The wildlife club is a group promoting interest in wildlife and conservation. The group is heavily marketed among wildlife studies majors, where the group is presented as being a requirement for success in the field of wildlife biology. To join this organization, students had to pay dues of \$10 per semester (\$20 per year). This group was the largest of the three groups in this investigation, with 198 members during the fall semester and 183 members during the spring semester of our investigation.

Data Collection

We collected data over the course of one academic year, starting at the beginning of the fall semester and continuing through the end of the spring semester ending in May. We captured field notes from observing organizational meetings and events. We also collected organization artifacts and conducted focus groups with the student leadership of each organization.

Field Notes. For each student organization, we attended one general chapter meeting each month as well as many special events. The biological honor society and microbiology club student groups held general meetings once each month; the wildlife club held general meetings twice each month, but data were gathered at only one monthly meeting for consistency with the other groups. Due to each student organization starting their meetings at different times each semester, we had observations from six meetings for the biological honor society, six meetings for the microbiology club, and seven meetings for the wildlife club. There were some events (e.g., special facility tours) that we were unable to attend due to restrictions in the number of individuals allowed by the facilities. We collected field notes using unique protocols specific for general meetings and special events that we developed to capture evidence of the three aspects of affinity groups. Specifically, we looked at how students showed their allegiance to their student organization, how meetings and events were conducted, and how student members participated in these meetings and events.

Organizational Artifacts. We collected organizational artifacts (e.g., flyers, sign-in lists, emails) for all meetings and events from each student organization. These data collection artifacts allowed us to determine how each organization communicated within the organization and to track the overall student attendance at meetings and events.

Focus Groups. Each semester we held a focus group for each organization's student leaders. These focus groups lasted for approximately one hour and were semi-structured. The number of participants in each focus group ranged from four to five depending on the organization, with the biological honor society having four student leaders, and the microbiology club and the wildlife club having five student leaders each.

Through these focus groups we were able to assess how student leaders plan and execute organizational activities and encourage member retention.

Data Analysis

Prior to analysis, we digitized all observational data and artifacts and stored all files on a secure laptop. We transcribed recordings from all focus groups verbatim and then imported all collected data into NVivo software for analysis. We used a deductive approach to coding wherein we sorted each piece of data into one of three categories: Allegiance, Access, and Participation, to align with the criteria of affinity groups (Gee, 2000). We report rich descriptions of the extent to which each student organization meets each criteria of affinity groups.

The first criterion that Gee describes is allegiance to the endeavors and goals of the group (Gee, 2000). Allegiance is defined as, “devotion or loyalty to a person, group, or cause;” and Gee (2000) describes the allegiance of affinity group members as being, “primarily to a set of common endeavors or practices and secondarily to other people in terms of shared culture or traits,” (p. 105). Loyalty can be displayed through the way one talks or dresses. We classified allegiance as either to the individual group members, or to the group members and practices. We measured allegiance through a content analysis of emails that were sent through each organization’s listserv. When conducting our field observations, we looked for how members encouraged each other at group meetings and events. We also recorded how often members purchased and wore group-specific attire (e.g., club t-shirts) at group meetings and events. The apparel that individuals choose to wear has been linked to social identity and what groups one wishes to support (Park &

Park, 2007). Based on these findings, we choose to use the frequency of wearing group-specific attire as a minor measure of allegiance to the group.

The second criterion of affinity groups is member access to information that is relevant to the group. We first determined what methods members of the student organization use to communicate with each other. We then conducted a content analysis of these communications to look for what type of information was shared among members. During our content analysis, we classified information as being either from a source outside of the organization or from within the organization in order to capture both aspects of sharing access to information as described by Gee (2000).

The final criterion of an affinity group is member participation in group-specific practices. We assessed this criterion by collecting field notes at group meetings and events as described above. We then determined what practices were similar and different among the three student organizations and looked at how often members participated in these practices by summarizing our field notes.

Findings

We present our findings for each organization below and describe how they met each criterion of affinity groups: Allegiance, Access, and Participation.

Biological Honor Society Affinity Group Characteristics

During our focus group with the student leaders of the biological honor society, the leaders spoke about their vision for guiding the organization and how they had been working to improve the organization. Several leaders spoke at length about how they wished to create a, “social dynamic group,” that students would want to actively participate in, rather than, “a simple meeting and having something to put on your

resume.” The student leaders described how they wanted to, “build a community,” among their members and promote interpersonal relationships among group members, which aligns with how affinity groups can be established (Zhu, 2017). These values were seen when analyzing how the officers communicated with group members. We found that statements such as, “I hope to see you there,” were included in most emails about upcoming events. These statements aligned with their view that, “[biological honor society] is really about community,” and showed they were trying to foster community among group members. During our observation of group meetings for the biological honor society, we found that student leaders wore their group-specific shirts regularly. However, we did not observe any forms of communication among group members other than those initiated by student leaders, and only a few members wore group-specific attire during group meetings.

When looking at the communication methods utilized by the student leaders of the biology honor society used to communicate with their members, we found that weekly emails through the organization listserv were the primary form of communication. The biological honor society’s student leaders provided several examples of sharing information from outside of the group with group members during the year. We found that 19% of communications dealt with upcoming events hosted by other student organizations, for example science fairs at local high schools. The student leaders sent out emails about these events and encouraged group members to participate. They also shared information about upcoming academic opportunities such as study abroad courses and scholarships, which consisted of 3% of total group communications. We found that

most communications (59%), dealt with information about the group itself, such as reminders for upcoming events.

During the fall semester, the biological honor society struggled with member participation in events, with very few students (average of six members at group events) regularly participating in group events and attending group meetings. Meetings held in the fall semester were disorganized and often included large group discussion about specific event details (e.g. setting a specific time of day for events) that could bog the discussion down; student leaders appeared unprepared for the meetings, and many members attending the meeting were often seen being distracted on their phones during meetings. At the start of the spring semester, the organization had a change in student leadership. The new student leaders were better prepared for meetings and meetings were more organized. Fewer group members were also seen on their phones during meetings during the spring semester. However, the efforts of the new student leaders did not lead to a significant change in member attendance with an average of six members still attending each event.

Microbiology Club Affinity Group Characteristics

Through actively participating in meeting activities, discussions, and wearing group-specific attire, members of the microbiology club were able to grow and display their loyalty to the group at monthly meetings. The microbiology club had a method of demonstrating and building allegiance that was unique among the three organizations studied. At the start of each group meeting, the student leaders led some form of ice breaker. Some of the ice breakers included simply introducing one's self to the group with a fun fact; others were microbiology related, such as everyone sharing their favorite

microbe. Members were very eager to participate in these activities and would pay attention to other members of the group who were sharing information. This form of sharing information with a group has been found to help foster allegiance (Abdullah, Karpowitz, & Raphael, 2016). In addition to these ice breakers, the student leaders mingled with other group members prior to the start of each meeting to discuss experiences in microbiology courses such as upcoming exams or projects. These behaviors aligned with the student leaders' goal of being perceived by group members as approachable and carried over into their communications with group members in statements such as, "I hope everyone had a good week," or, "come out and [de-stress] from studying." During our observations, we found that the faculty advisor wore an organization shirt at all meetings for which he was present, and at least one student leader wore an organizational shirt at each group meeting.

Like the biological honor society, the microbiology club used email as the most common form of communication among members outside of group meetings. The student leaders communicated somewhat frequently, roughly twice a week, though sending a group-wide email about once a week, with 81% of communications serving as reminders for upcoming meetings and events. The organization also had a social media account where members occasionally posted pictures of group events. The microbiology club regularly invited microbiologists from the biology department to speak to the group about their research. These speakers also discussed research opportunities and various possible career paths in the field of microbiology.

During the focus group with the student leaders of the microbiology club, they spoke about the importance of the faculty advisor for the club. The faculty advisor has

advised the microbiology club for many years and has helped establish some of the group-specific practices. The advisor has been teaching for many years and has made many connections within the field of microbiology. Through these connections, the advisor was able to arrange for the microbiology club to tour several local lab facilities and breweries. These tours provided an opportunity for members to view facilities and learn about potential career paths in microbiology. During the spring semester, the faculty advisor had to take a reduced role in the microbiology club for personal reasons and his absence resulted in the student leaders being unable to schedule new tours. Though the organization had a substitute advisor during this time, the student leaders reported he only, “helped us with scheduling the meeting room,” during the semester. The club was able to continue with a few facility tours that had been scheduled during the fall semester but were not able to schedule any new tours or events. Additionally, overall attendance went down at group meetings leading to fewer students participating in group practices.

Wildlife Club Affinity Group Characteristics

The wildlife club was the largest group in this investigation, with 198 members in the fall semester and 183 members in the spring semester. During focus groups, the student leaders emphasized that students’, “future in this field literally does depend on honestly kind of being in the society,” and several professors marketed it to students during their courses. This career relevance encouraged students to join and participate in this organization. By attending events, students were able to meet other students and foster allegiance by building support networks. Additionally, the wildlife club held a special event at the end of the spring semester, and only the top ten students who participated in organizational activities throughout the year were selected to attend.

Students striving to be invited to this event could be an important factor in their participation throughout the year. During the focus group with the student leaders, they spoke about how they wanted to make sure they were planning events that members would find rewarding and would often have discussions during meetings about what events the group would start planning. The student leaders discussed how they were open to members suggesting event ideas for the group (e.g., “We have some members that will like bring ideas forward”). During the focus group, the student leaders also described how they moderated a group-specific chat room that, “decently works,” on the group site on the university’s course management system where members discussed a variety of topics such as upcoming group events, and wildlife course experiences. In email communications to the group about upcoming events, the student leaders included statements demonstrating that they cared about member attendance at events, such as, “I look forward to seeing everyone there.” These statements aligned with the student leaders’ goal of, “mak[ing] them feel as comfortable with the people that are going to be going.” Club members’ interactions also demonstrated allegiance. Prior to the start of each group meeting members were observed talking with each other about coursework and concerns (e.g., upcoming exams and projects). Upper-level students in the group who had already completed these courses provided encouragement and advice to those currently struggling with coursework. Bonding over shared experiences is a common characteristic seen in affinity group (Heineke & Cameron, 2013) and we found that displayed in the wildlife club. In addition, we found that at least one student leader wore an organizational shirt at six of the nine meetings and events we attended and at two meetings multiple leaders wore organizations shirts. Finally, at the end of each semester

the wildlife club hosted a potluck dinner during their last meeting. During these dinners, group members shared a meal and participated in activities such as raffle drawings, watching video highlights of the semester, and presentation of awards to recognize individual group members. These activities helped to further build allegiance among group members.

When investigating how the wildlife club shared information from within and outside of the group, we found the most common forms of communication were email and announcements sent through the group site on the university's learning management system. The student leaders of the wildlife club also described the clubs' social media presence on Facebook and Instagram where group members would share pictures and stories from group meetings and events. The frequency of communication among group members was higher than the frequency seen in the other two groups. During our content analysis of the wildlife club's communications, we found 62% of communications dealt with group meetings and events, such as reminders and logistical planning (e.g., event locations, member sign-ups, and arranging carpooling). In addition to group information, a large amount of information was shared from sources outside of the group. We found that 18% of group communications dealt with research or job opportunities that members could apply for. There were also academic opportunities (17% of group communications) shared with group members such as study abroad courses, scholarships, internships, and job postings.

At monthly meetings of the wildlife club, groups members always participated and did not appear to be distracted by being seen on their phones during meetings. wildlife club meetings were generally semi-formal and led by the student leaders, who

discussed upcoming group business (e.g., events and deadlines). In addition to the business portion of group meetings, the club regularly hosted guest speakers from the campus and the local community. These speakers presented interactive programs and often brought live specimens (e.g., birds or bats) to show off to group members. In addition to monthly group meetings, the wildlife club hosted educational and off-campus events throughout the year, including hiking trips around local areas to allow members to hone their skills in identifying local flora and fauna; camping trips to practice “leave no trace” principles; and traveling to areas impacted by natural disasters to help with clean-up efforts. Finally, the wildlife club held a large-scale range shooting competition for the local community near the end of the spring semester. Members of the wildlife club helped plan and execute this event, which served as a major fundraiser and marketing event for the wildlife club scholarship fund.

DISCUSSION

Though there were many differences among the three biology-based student organizations, we found several similarities. We found that in each student organization, the student leaders were a major driving force in fostering allegiance among group members and organizing group meetings and events. Student leaders were also the most active in each student organization compared to students who were not leaders in the group. When student leaders take steps to foster allegiance among group members it can lead to increased participation rates, as we found in the case of the wildlife club. However, increasing allegiance is not guaranteed to increase member participation. Other factors, such as how the organization is marketed, can also influence the participation rate. We found that the wildlife club had the highest participation rates for their events,

with an average of 11% of members attending meetings and 5% of members attending each event. Though 5% attendance seems low for events, it is important to note that the wildlife club held many events and would often have overlapping events so members would not be able to attend every event held by the organization. Having low attendance at events is not an indication of the success of the event. It has been shown that students interact and learn more in small group settings compared with large group settings (Cartney & Rouse, 2006), and build stronger interpersonal bonds (Masika & Jones, 2016). Based on these established links, it would appear to be more beneficial to individuals to participate in small group events. Another important factor for student participation that emerged from our data was the role of the faculty advisor. Of the three biology-based student organizations, the microbiology club had the most involved advisor. The faculty advisor was a major presence in the microbiology club and when he had to reduce his role, the organization was not as active. For the biological honor society and the wildlife club, the faculty advisors were not as involved and only worked behind the scenes to handle logistical issues such as gaining access to campus rooms and facilities.

Now that we have established that all three biology-based student organizations meet the criteria of affinity groups, we can investigate what benefits students receive from participating in these organizations. Affinity groups have been shown to help group members meet new people to expand their social circle (Park & Kim, 2013) and learn new skills (Shanahan, McVee, Slivestri, & Haq, 2016). University-affiliated affinity groups help increase student engagement on their campuses; student engagement has been linked to increased academic achievement (Anderson, 2015; Baker, 2008). Affinity

groups have also been shown to provide professional development opportunities for group members (Burrige & Carpenter, 2013) and to improve trust, credibility, and positive attitudes among group members (Anderson, 2015). We speculate that these three biology-based student organizations provide many of the same benefits as seen in other affinity groups; further investigation is needed to explore this.

Understanding how discipline-specific student organizations function and the benefits they provide to their members can provide insight into ways we can improve student persistence in STEM majors. There are multiple factors that influence undergraduate retention rates, many of which stem from how successful students are at establishing balance between their personal and academic lives (English, Davis, Wei, & Gross, 2017; Gerdes & Mallinckrody, 1994). One-way students can achieve this balance is by participating in student organizations to foster personal development (Zilvinskis, Masseria, & Pike, 2017) and sense of belonging, which can lead to better rates of persistence in STEM (Nyamwange, 2016). In our future work, we will investigate what motivations students have for joining and participating in these organizations as well as what benefits students report receiving from their participation. By better understanding what motivates students to participate in student organizations and what they get out of their participation, we can better understand how these biology-based student organizations influence student persistence in STEM.

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III. HOW PARTICIPATING IN BIOLOGY-BASED STUDENT ORGANIZATIONS INFLUENCES UNDERGRADUATE SENSE OF BELONGING IN STEM

Abstract

Improving retention rates in STEM has been a concern for institutions of higher learning for decades. Researchers have identified many factors that contribute to student persistence in STEM. One factor identified as why students leave STEM, is they do not develop a sense of belonging in STEM. Students can develop a stronger sense of belonging through participating in a student organization. The purpose of our investigation was to determine what motivates students to join and participate in one of three biology-based student organizations. After administering an open-ended questionnaire, we found three overarching themes for why students joined their respective organization: *Relevant Content*, *Social Outlet*, and *Reputation*. We also observed a small percentage of each organizations' members participated in each event, ranging from 4% to 29% depending on the type of event and organization. Though a small number of students participated in each event, they were still beneficial for promoting learning and developing a sense of belonging. By better understanding what motivates students to join and participate in content-based student organizations, organizational leadership can make better decisions when marketing their organization to potential members. By encouraging more students to participate in content-based student organizations, more students will have a stronger sense of belonging in STEM.

Keywords: student organizations, sense of belonging, participation, biology

Introduction

Retention rates have been a concern of institutions of higher learning for decades (Aschbacher, Li, & Roth, 2010). As such, much research has focused on identifying factors that can improve retention rates (Matusovich, Streveler, & Miller, 2010). Some of the factors that have been identified as predictors of student retention and collegiate success include gender (Voyer & Voyer, 2014), and high school performance (Komarraju, Ramsey, & Rinella, 2013). Additionally, it has been suggested that emotional factors such as self-efficacy (Chemers, Hu, & Garcia, 2001), self-esteem (Nordstrom, Goguen, & Hiester, 2014), and self-control (Wolf & Johnson, 1995) play a large role in academic performance and retention.

Students often struggle to adjust to campus life when first entering college (Chemers, Hu, & Garcia, 2001; Gerdes & Mallinckrody, 1994). Many students struggle adjusting to campus life due to having increased levels of independence and self-regulation (Chemers, Hu, & Garcia, 2001). Students' ability to adjust to campus life has been found to be a strong indicator of academic success (English, Davis, Wei, & Gross, 2017). Students who struggle to adjust to college life tend to have poor academic performance (Brandy, Penckofer, Solari-Twadell, & Velsor-Friedrich, 2015).

One way that can help students adjust to campus life is through joining a student organization. Participating in student organizations allows students to meet other students who share similar interests they may not otherwise meet (Park & Kim, 2013). Another benefit to being involved in student organizations is increased campus engagement (Robbins, Allen, Casillas, Peterson, & Le, 2006). Increased campus engagement has been linked to higher GPAs and retention rates (Bergen-Cico & Viscomi, 2012). The increased

GPA's could be due to multiple factors such as: development of time management skills or building support networks through participating in student organizations. Additionally, student involvement is directly proportional to student learning and personal development (Trudeau, Hammond, Moser, Eversole, & Smith, 2019).

Participating in student organizations allows students to increase their sense of belonging, both within the student organization and on campus (Bowman, Park, & Denson, 2015). Sense of belonging has been found to be a contributing factor to persistence in education both in STEM and other fields (Wilson et al., 2015). Recently, student sense of belonging has emerged as a pivotal factor in student learning and academic success (Strayhorn, 2012; Won, Wolters, & Mueller, 2018). There are many benefits to having a strong sense of belonging, such as higher academic engagement (Furrer & Skinner, 2003), academic persistence (Hausmann et al., 2007), and self-efficacy (Zumbrunn, McKim, Buhs, & Hawley, 2014), while low sense of belonging has been linked to higher rates of emotional distress (Pate, Maras, Whitney, & Bradshaw, 2017). By improving student sense of belonging, students build confidence that can lead to more productive students (Strayhorn, Lo, Travers, & Tillman-Kelly, 2015).

Theoretical Framework

Cohesion is a term in the fields of physics and chemistry used to describe a molecular property that allows molecules to stick to other molecules. Cohesion is also a sociological construct that describes how groups of people tend to, "stick together and maintain social groups," (Piper et al., 1983). In the context of sociology, cohesion is a broad term that is further divided into subdivisions such as social cohesion and perceived cohesion. Both terms are commonly applied to social groups, groups of individuals that

come together in social settings. These groups can be groups of friends or students that share a common interest in a topic that come together with the purpose of socializing.

Thought there are many ways to define cohesion (Mahar, Cobigo, & Stuart, 2013), we used a specific type of cohesion, perceived cohesion, that was originally coined by Bollen and Hoyle (1990). Bollen and Hoyle (1990) formed a definition of cohesion that applies to individuals and how they feel a part of a specific social group and not how they are viewed by others. They define perceived cohesion as, “encompass[ing] an individual’s sense of belonging to a particular group and his or her feelings of morale associated with membership in the group,” (Bollen & Hoyle, 1990, p.482). In other words, perceived cohesion is the extent to which individuals feel like they belong to a particular social group. An important quality of perceived cohesion is that it is determined solely by an individual’s own perceptions of how they fit into a specific group, rather than how they are perceived by other members of the social group. We choose Bollen & Hoyle’s definition of perceived cohesion over others because it focuses on an individual’s perceptions of their role within the social group rather than the perceptions of others about the individual.

The construct of perceived cohesion has two dimensions: *sense of belonging* and *feelings of morale* (Bollen & Hoyle, 1990). Sense of belonging includes both cognitive and affective elements of an individual’s relationship to a specific social group. Cognitive processes are based on specific information or mental processes, whereas affective processes are primary emotions. The cognitive elements of sense of belonging include information about an individual’s experiences with group members as well as the whole group. The affective elements of sense of belonging include reflections on an individual’s

experiences with the social group. This affective reflection funnels into feelings of morale, the sum of the emotional responses, both positive and negative, to belonging to a social group. Because there is an established link between cognition and affect (Zajonc & Markus, 1984), there may be a positive correlation between sense of belonging and feelings of morale to a social group (Bollen & Hoyle, 1990). This could be because, for the most part, individuals are able to select their preferred social groups.

We utilized the framework of perceived cohesion (Bollen & Hoyle, 1990) to guide this investigation of how active biology-based student organizations function and what experiences students have from being a part of these organizations. Specifically, we followed the biological honor society, wildlife club, and microbiology club to investigate how individuals expressed their sense of belonging and feelings of morale. These student organizations are social groups comprised of individuals that share a common interest in the specific biology topics that the club promotes. As membership in these student organizations is not a formal requirement for completing a degree in biology, it is expected that students would only maintain active membership in an organization that they feel some attachment to, such as receiving specific benefits (Fusco, Prescott, & Prescott Jr, 2015).

Research Questions

We used the framework of perceived cohesion as described above to address the following research questions:

1. Why do student members elect to join their respective student organizations?
2. How do students participate in their respective student organizations?
 - a. How often do students participate in organizational activities?

- b. In what ways do students participate in organizational activities?
- c. What are reasons students provide for their chosen level of participation?

Methods

Organizational Context

For our investigation, we followed three biology-based student organizations: biological honor society, microbiology club, and wildlife club, which were active within the biology department of a large southwestern university. We selected these student organizations based on several criteria. First, each of these student organizations aligned with one of the three undergraduate degree paths: biology, microbiology, and wildlife science, that was offered by the department and were local chapters of national organizations. Secondly, each of these student organizations had been active for at least five years prior to our investigation. Finally, each student organization held at least one event or meeting each month and met the university required levels of membership with at least five members. Each student organization started holding meetings at different times each semester, which effected the number of meetings for each organization we were able to attend. We attended six meetings for the biological honor society, six meetings for the microbiology club, and seven meetings for the wildlife club.

The biological honor society is a student organization promotes interest in the biological sciences. There are two levels of membership within this organization: associate and regular. Any undergraduate or graduate student can become associate members of this student organization regardless of their major and GPA. Only undergraduate students majoring in biology and have a GPA of at least 3.0 can become regular members of the organization. During our investigation, the biological honor

society had 54 members in the fall semester and 52 members in the spring semester of our investigation. The microbiology club and wildlife club do not have formal GPA requirements for membership like the biological honor society. Both organizations are open to any student, undergraduate and graduate, regardless of major and work to promote interest in their respective fields (i.e. microbiology and wildlife science). The microbiology club had 55 members in the fall semester and 51 members in the spring semester of our investigation. The wildlife club was the largest with 198 members in the fall semester and 183 members in the spring semester of our investigation.

Data Collection Instruments

Perceived cohesion questionnaire. We constructed the perceived cohesion questionnaire to target specific aspects (i.e. students' reasons for joining student organizations and benefits students felt they were receiving from participating in student organizations) (Appendix B). We revised questions for clarity as needed. The questionnaire allowed us to capture the unique experiences each student had through being a part of their respective organization and assessed individual's feelings about their respective organization. We included four demographic questions, seven open-ended questions for all members, and four additional open-ended questions for student leaders within the questionnaire. The open-ended questions allowed individual students to report how long they had been a part of their respective organization, what made them want to join the organization, if and why they had thought about leaving the organization, and what benefits if any they felt they were receiving from being a part of the organization. After creating the questionnaire, we distributed it to all members of the three organizations through both email and the university learning management system, and 55

students (9 from microbiology Club, 17 from the biological honor society, and 29 from the wildlife Club) completed the questionnaire. We distributed the questionnaire to each biology-based student organization at the beginning of the fall semester and the end of the spring semester to capture perceptions of students who joined each organization in different semesters.

Organizational Artifacts. We collected artifacts (i.e. sign-in lists) for all meetings and events from each student organization. These artifacts allowed us to track individual member attendance at organizational events to determine how often students participated in the organization.

Field Notes. For each student organization, we attended one general chapter meeting each month as many of the special events as possible. During each meeting or event, we collected field notes using a unique protocol for general meetings (Appendix C) and a unique protocol for special events (Appendix D). We developed these protocols to capture specific aspects of each organization according to Gee's criteria of affinity groups (Gee, 2000). Specifically, we were looking at how students participated in these meetings and events and how these meetings and events were structured and conducted. These notes allowed us to capture how students participated in their respective student organizations in order to understand their perceived cohesion.

Data Analysis

To address our first research question, why students join their respective student organization, we examined student responses to the perceived cohesion questionnaire to identify common themes that emerged using an inductive approach to coding. Specifically, we looked at responses to the question, "What made you want to join this

organization over other student organizations,” to determine what about these organizations made students want to become a member. We first started by using in vivo codes to student responses to capture the specific voice of our participants (Saldaña, 2016). Some examples of our in vivo codes included, “I am a microbiology major,” “I am a wildlife major,” and, “Relevant to my degree.” We then began to group our in vivo codes into categories based on similar ideas. For example, we grouped the three previously mentioned codes into the category of *Major Related* as they all included statements about being related to the student’s major or degree plan. We then grouped our categories into themes based on related content. For example, we grouped the categories *Content Based*, *Liked Content*, and *Major Related* into the theme of *Knowledge Based* as all the categories dealt with some form of knowledge. We report rich descriptions of each emergent theme.

To address our second research question of how students demonstrate their perceived cohesion to their respective student organizations, we analyzed field notes, organizational artifacts, and student responses to the perceived cohesion questionnaire, specifically the questions, “What about the organization has made you want to continue being a member?” and, “What benefits do you feel that you are received from being a member of the organization?”

In order to determine how often students participated in organization activities, we collected sign-in lists from group meetings and events that we were able to attend. We were also able to collect sign-in lists from events that we were not able to attend from each organization’s leaders. We divided organizational activities into two groups: meetings and events and then calculated the average percentage of members that attended

each type of event based on total membership for each organization. In order to determine in what ways students participated in organizational activities, we provide a summary from our field notes of ways that students participated. Finally, to determine what reasons students had for their chosen level of participation, we analyzed questionnaire data using in vivo codes (see research question one analysis) and determining themes that naturally arose from the data.

Findings

Why student members elect to join their respective student organizations.

Some students (n=21; 38%) reported multiple reasons for joining their respective student organizations which we coded separately, resulting in 86 different codes across nine categories. From these 86 codes, there were three emergent themes: *Relevant Content*, *Social Outlet*, and *Reputation* (Table 3).

Table 3.

Major themes for student reported reasons for joining student organizations.

Theme	Category	Example
Relevant Content (n=39)	Liked Content (n=17)	“I love wildlife”
	Major Related (n=16)	“It pertains to my major”
	Content-Based (n=6)	“Biology based”
Social Outlet (n=26)	Networking (n=13)	“I wanted to make some friends”
	Interested In (n=10)	“It sounded interesting”
	Fun (n=3)	“I thought it would be fun to join”
Reputation (n=21)	Advertised Events (n=11)	“[I] like[d] the volunteer events”
	Prestige (n=7)	“It was an honor society”
	Recommended (n=3)	“A friend invited me”

Note. n represents the number of students whose response fell within the theme or category.

Relevant Content. Relevant Content is defined as content that is applicable to the student in some capacity ($n=39$; 45%). Responses that are under the theme of *Relevant Content* ($n=39$) dealt with some form of knowledge, either the chance to gain more knowledge, “I like learning new things,” or that the student organization allowed the student to express their knowledge, “I love microbiology,” and they wanted to meet individuals with similar interests. We included three categories under this overarching theme: *Liked Content* ($n=17$), *Major Related* ($n=16$), and *Content-Based* ($n=6$). We included responses such as, “I love microbiology,” and, “I love wildlife,” in the category of *Liked Content* as they showcased the individual liked the content that the student organization was based around. We found that several students gave responses such as, “It pertains to my major,” or, “I am a microbiology major,” and we grouped these responses into the category of *Major Related*. These responses show that the student felt that participating in the student organization would help them complete their major area of study. The final category was *Content Based*, and included responses like, “Biology and science based,” where students stated that the content the organization was based on drew them to the organization. These three themes connect to the overarching theme of *Relevant Content* by showing that students what to connect to the content the organization is based on to further their own knowledge about the content.

Social Outlet. Social Outlet is defined as wanting to make some form of social connection to other people or the content of the organization ($n=26$; 30%). We grouped responses such as, “I wanted to make some friends,” under the theme of *Social Outlet* ($n=26$) because they expressed wanting to meet some form of social need for the student. We included three categories under this major theme: *Networking* ($n=13$), *Interested In*

($n=10$), and *Fun* ($n=3$). We grouped responses such as, “It was primarily to network with likeminded people,” as *Networking* because they focused on students wanting to meet other students who have similar interests. The next category we had included responses such as, “It sounded interesting,” that we labeled as *Interested In*. These responses included statements where students reported being interested in the student organization as the main reason for joining their respective student organization. Finally, there were three students who provided responses such as, “I thought it would be fun to join,” which expressed they thought joining their respective student organizations would be a fun experience. We grouped these responses under the category of *Fun* as all responses included how the student thought they would have fun being a part of a student organization.

Reputation. Reputation is defined as the belief about the organization ($n=21$; 25%). We grouped responses that focused on some aspect of the reputation of the student organization under this theme. We further divided this theme into three categories: *Advertised Events* ($n=11$), *Prestige* ($n=7$), and *Recommended* ($n=3$). Responses such as, “Get[ting] involved in wildlife [and] nature activities,” and, “[I] like the volunteer events,” that indicated events that were advertised by the student organization were the major draw for why the individual wanted to join the specific student organization. There were several students who provided responses such as, “It was an honor society,” and, “[It] would look good on my resume,” that reflected there was some prestige about the organization that drew them to the student organization. We grouped these responses together under the category of *Prestige*. Finally, we had three students provide responses such as, “A friend invited me,” and, “Professor [Smith] highly suggested it,” which

indicated that a third party recommended they join their respective student organizations. We grouped these responses under the category of *Recommended* because someone thought the student may enjoy being a part of the student organization based on what they knew of the organization.

How do students participate in their respective student organizations?

For our investigation, we focused on three aspects of how students participate in student organizations: how often students participated in organization activities, how students participated in their respective organizations, and what reasons students reported for their level of participation.

How often do students participate in organizational activities? We found that each student organization had a low percentage of attendance (Table 4). We found that all three organizations had less than 25% of their members attend monthly group meetings. We also found that all three organizations had an average of less than 20% of their members attend non-meeting events. We found that the biological honor society had an average of 12% of their members attend non-meeting events, the microbiology club had an average of 19% of their members attend non-meeting events, and the wildlife club had an average of 4% of their members non-meeting attend events (Table 4). Though the wildlife club had a lower average percentage of members attending, based on overall group size, they had the largest average number of students attending meetings.

Table 4.

Number of students attending meetings and events for each student organization.

Organization	Sept	Oct	Nov	Jan	Feb	Mar	April	May	Avg. Meeting	Avg. Events
Biological honor society	N/A	29	16	16	10	11	12	N/A	23% (n=12)	12% (n=6)
Microbiology club	25	15	8	N/A	4	10	5	N/A	22% (n=11)	19% (n=10)
Wildlife club	29	32	41	N/A	17	11	13	9	11% (n=20)	4% (n=7)

In what ways do students participate in organizational activities?

The biological honor society held general meetings once each month. These meetings were formal in nature and include one or more of the student leaders leading the presentation of organizational business such as upcoming events and deadlines to pay membership dues. Members that attended these meetings participated by being paying attention to the information that was presented through focusing on the individual that was presenting information, and voicing opinions during the discussion of various topics such as planning outreach and social events. The biological honor society also held or participated in several events outside of general meetings. Many of these were science-based at local primary schools. Members would serve as judges for local science fairs where they would evaluate projects being presented by students. At other events such as science days, members would work at a table where they would demonstrate basic science techniques to spark interest in science for younger children that would be attending the event. They also participated in the Adopt-A-Spot national initiative by selecting a local area where members were responsible for cleaning and beautifying

throughout the year. In addition to these small events throughout the year, they hosted a research conference for students within the biology department during the spring semester. The purpose of this annual event was to allow students in the department present their research to attendees of the conference. Members helped in all aspects of this event, from helping set up before the event to introducing speakers and keeping time.

The microbiology club held general meetings once a month. These meetings were semi-formal where the student leaders would present current business such as upcoming events to members. Additionally, at every meeting, the student leaders would start with some form of ice breaker activity. These activities included things such as introducing yourself to the group and describing your favorite microbe or sharing something that you had accomplished during the week. Members appeared eager to participate in these activities and would pay attention to other members when they were sharing information. During meetings, members would pay attention to the information being presented and would participate in group discussions about the various topics. In addition to general meetings, the microbiology Club held a few special events throughout the year. Most of these events included touring various medical or forensics labs and local breweries. During these tours, members would learn about the purpose of the facility and how it operates as well as learn about different career paths that are available in the field of microbiology.

The wildlife club held general meetings every other week. Some of these meetings would be formal and other meetings would be semi-formal in structure. During semi-formal meetings, the student leaders would present current business such as upcoming events and research opportunities students could get involved in. During these

meetings, members would pay attention though focusing on the individual that was presenting and taking notes and discussing the logistics of each item of business being discussed. During formal meetings, the wildlife club would host a speaker that would share a presentation to the group. These presentation topics ranged from lowering our carbon footprint, to local conservation groups work with birds or bats. During these presentations, it was common for the speaker to bring in live specimens (i.e. birds and bats) to the meeting that members could interact with. During these meetings, members would take notes about the topic and interact (i.e. hold and take pictures) with various animals that were brought. In addition to biweekly general meetings, the club would hold multiple small events weekly. Some of these included camping at various locations across the state, traveling to areas impacted by natural disasters to assist with clean-up, and helping graduate students with research projects. During these events, members would get to learn more about wildlife and practice low-impact environmental skills.

What reasons did students provide for their chosen level of participation?

Though we did not explicitly ask students about their motivation for participation, we were able to learn about student motivation from their responses to other items in our questionnaire. Some of these motivations overlap with why the students wanted to join the student organization (described above). Some of these motivations included professional development where students reported gaining, “leadership experience,” and developing, “time management,” skills that will help them in their selected field of study. Students also reported many opportunities for learning (i.e., “learning more about wildlife”) that they were able to have through their participation. Students reported they were able to make, “contacts for future jobs,” that would help them in their future careers.

Discussion

Our findings give some insight into the experiences of students who participate in biology-based student organizations. Students generally join academic-based student organizations to develop skills, to network with other professionals in their field, and to have access to internships and other professional opportunities (Holzweiss, Rahn, & Wickline, 2007; Munoz, Miller, & Poole, 2016). Our findings align with the current literature where students reported wanting to join these three biology-based student organizations for professional reasons, either to gain experience or to network with others in their field. Additionally, we also found that students wanted to join and participate in these biology-based student organizations for social reasons such as making new friends. These motivations have previously been reported in non-academic student organizations rather than academic organizations (Holzweiss, Rahn, & Wickline, 2007). Our findings indicate that there may be many factors that motivate students to participating in content-based student organizations. Additionally, students who joined these student organizations for social reasons could indicate a motivation to develop a stronger sense of inclusion within their organization and their chosen field. By developing this sense of inclusion, students can have better academic performance (Hurtado et al. 2007; Ostrove & Long 2007) which can ultimately lead to more students remaining in STEM. When looking at the rates of participation among the three biology-based student organizations, it first appears that the percentages are all very low – ranging from 4% to 23%. However, these numbers translate to a moderate range of student participation when looking at the overall members for each organization. For example, the wildlife club only had an average meeting attendance of 11%, but this translates to an average of 20 members

attending their meetings. However, when looking at special events, low percentages are indicative of a small number of students participating in these events, ranging from an average of nine to fourteen members at each event. These low numbers of students participating in events are not indicative of the success of the event. Previous studies have found that participating in small group activities allows students to learn more (Cartney & Rouse, 2006) and build a stronger sense of belonging (Masika & Jones, 2016). As many of the events had a focus on learning, such as learning about potential career opportunities at a lab or learning how to identify wildlife while camping, it is advantageous to have a smaller number of students participate.

Students enter college for a variety of reasons, but many students pursue higher education to get a better job, make more money, and become more cultured (Twenge & Donnelly, 2016). In order to reach these goals, students must develop skills that will transfer into the workplace in addition to increasing their content knowledge. Therefore, students are increasingly seeking out opportunities to develop skills outside of the classroom. Our findings show that a large portion of students (45%) are joining and participating in biology-based student organizations because of the content the group is based around. However, it is possible that students are able to develop field specific skills through their participation in these groups. Though we have uncovered the motivations students have for participating in these types of organizations, further investigation is needed to uncover what benefits students receive from their participation.

Now that we know what motivates students to seek out and participate in content-based student organizations, student leaders can tailor how they market their organizations to potential members. By knowing what potential members are looking for,

organization leaders can help students recognize the value of participating in their organizations. If new members have a buy-in from the time they join an organization, they are more likely to participate and become more involved not only with their organization but also with their campus (Kilgo, Mollet, & Pascarella, 2016). By becoming more involved in science-based student organizations, students not only are better able to adjust to life on campus but are able to build a stronger sense of belonging in their chosen field of study (Bowman, Park, & Denson, 2015). As students improve their sense of belonging, they are more successful in their academic pursuits (Won, Wolters, & Mueller, 2018) and are more likely to persist in the education (Wilson et al., 2015). This will lead to students improving their confidence which will ultimately lead to them becoming more productive members of the workforce (Strayhorn, Lo, Travers, & Tillman-Kelly, 2015). With more productive members of the scientific workforce, it will allow the United States to remain competitive on the global scientific stage.

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IV. THE BENEFITS OF PARTICIPATING IN CONTENT-BASED STUDENT ORGANIZATIONS

Abstract

Many students pursue higher education to gain skills needed to obtain a career they find fulfilling. Students can potentially gain these skills outside of the classroom through participating in content-based student organizations. Our investigation focused on members of three biology-based student organizations to determine what benefits students reported receiving from their participation. By understanding what benefits students receive from participating in student organizations, we can better understand what motivates students to participate in these organizations.

Introduction

There are many factors that affect students' decisions to enter higher education and what field of study they plan to pursue (Mullen, 2014; Twenge & Donnelly, 2016). One of the main reasons students pursue a higher education is to gain the skills and experiences they need in order to pursue a career they find fulfillment in (Twenge & Donnelly, 2016). Several emotional factors such as self-control (Wolf & Johnson, 1995), self-efficacy (Chemers, Hu, & Garcia, 2001), self-esteem (Nordstrom, Goguen, & Hiester, 2014), and sense of belonging (Strayhorn, 2012) have been found to influence academic performance and retention in college students (Pate, Maras, Whitney, & Bradshaw, 2017).

There has been a strong push for research into ways of increasing the number of students entering the scientific workforce over the past few decades (National Science

and Technology Council, 2018), which has led to an upward trend of students pursuing a higher education in science, technology, engineering, and mathematics (STEM) (National Science Board, 2018). Even though the number of students pursuing STEM degrees is increasing, there is still a large workforce demand for qualified individuals (Diekman & Benson-Greenwalk, 2018). One factor identified as to why students leave STEM fields is the lack of developing a feeling that they belong in science (Wilson et al., 2015; Won, Wolters, & Mueller, 2018). Student sense of belonging has been found to contribute to educational persistence both in STEM and other fields (Anderman, 2002; Freeman, Anderman, & Jensen, 2007; Hausman, Schofield, & Woods, 2007; Wilson et al., 2015). Students with a stronger sense of belonging tend to have increased engagement in academic settings (Furrer & Skinner, 2003) and have higher rates of persistence (Hausmann et al., 2007; Juvonen, 2006), and have lower rates of emotional distress (Resnick et al., 1997).

Literature Review

A common theme seen among students who first enter college, is how students struggle to adjust to campus life (Connolly, Flynn, Jemmott, & Oesteicher, 2017). Students struggle with establishing balance between their academics and personal lives (Chemers, Hu, & Garcia, 2001). How a student establishes this balance between their academic and personal lives has been shown to be a predictor of academic success (Brandy, Penckofer, Solari-Twadell, & Velsor-Friedrich, 2015; English, Davis, Wei, & Gross, 2017; Won, Wolters, & Mueller, 2018). One way that can help students establish this balance is through participating in a student organization (Montelongo, 2002). Joining a student organization allows students to meet other students who share similar

interests outside of an academic setting (Park & Kim, 2013). Another benefit of joining a student organization is increased campus engagement (Robbins, Allen, Casillas, Peterson, & Le, 2006) which has been linked to higher GPAs and retention rates regardless of pre-college background (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008), and higher levels of psychosocial development (Foubert and Urbanski, 2006). Students also develop leadership and other professional skills such as time management through student organizations which can further improve academic performance (Fisher, Bagiati, & Sarma, 2017; Soria, Werner, Chandiramani, Day, & Asmundson, 2019).

Participating in a student organization allows students to increase their sense of belonging not only within the organization, but also to their campus (Bowman, Park, & Denson, 2015). Students' sense of belonging has been found to be a contributing factor for retention both in STEM and other fields (Wilson et al., 2015). The benefits of having a strong sense of belonging have led to this construct emerging as a pivotal factor for student learning and academic success (Strayhorn, 2012; Won, Wolters, & Mueller, 2018). Some of the benefits of having a strong sense of belonging include higher campus engagement (Furrer & Skinner, 2003), academic persistence (Hausmann, Schofield, & Woods, 2007), academic achievement (Pittman & Richmond, 2008), and self-efficacy (Zumbrunn, McKim, Buhs, & Hawley, 2014). Additionally, students with low sense of belonging are more likely to drop out of school (Foubert & Urbanski, 2006; Suhlmann, Sassenberg, Nagengasts, & Trautwein, 2018) and have higher rates of emotional distress (Pate, Maras, Whitney, & Bradshaw, 2017). By improving sense of belonging, students build confidence that they carry into the classroom and into their career which can lead to more productive students (Strayhorn, Lo, Travers, & Tillman-Kelly, 2015).

Theoretical Framework

Social cohesion is a sociological construct that describes how groups of people tend to, “stick together and maintain social groups,” (Piper, Marrache, Lacroix, Richardsen, & Jones, 1983). The construct of social cohesion can be further divided into several subdivisions such as sense of belonging and perceived cohesion (Mahar, Cobigo, & Stuart, 2013). This construct is commonly applied to social groups where individuals come together in a social setting. These social groups can be friend groups or groups of students who share a common interest in a topic who come together to socialize.

For our investigation, we used the construct of perceived cohesion (Bollen and Hoyle, 1990). The idea of perceived cohesion was coined as a response to there being no “true” definition of social cohesion (Bollen and Hoyle, 1990). Bollen and Hoyle (1990) define perceived cohesion as, “encompass[ing] and individual’s sense of belonging to a particular group and his or her feelings of morale associated with membership in the group,” (p. 482). One important quality of perceived cohesion is that is determined solely by an individual’s own perceptions of how they fit into a specific group, rather than how they are perceived by other members of the social group.

The construct of perceived cohesion has two dimensions: *sense of belonging* and *feelings of morale* (Bollen & Hoyle, 1990). Sense of belonging includes the cognitive and affective elements of judgment about an individual’s relationship to a specific social group. Cognitive processes are based on information and mental processes, whereas affective processes are based on emotions. Cognitive judgment of sense of belonging includes information about an individual’s experience with group members. Affective judgment of sense of belonging includes reflections on individual experiences within the

social group. This affective reflection funnels directly into feelings of morale which is the sum of both positive and negative emotions related to belonging to the social group. Essentially, cognitive judgement is based on experiences while affective judgment is based on emotions. As there is an established link between cognition and affect (Zajonc & Markus, 1984), it is strongly suggested that there is a positive correlation between sense of belonging and feelings of morale to a social group (Bollen & Hoyle, 1990). For the most part, individuals can select their preferred social groups and therefore, they choose to be associated with groups which they have a strong perceived cohesion to.

We utilized the framework of perceived cohesion (Bollen & Hoyle, 1990) to guide our investigation into how biology-based student organizations function and what experiences students have as part of these organizations. Membership in these student organizations is not a formal requirement for completing a degree in biology. Therefore, we expect that students would only maintain active membership in an organization where they feel a high sense of perceived cohesion. If individuals do not have a high perceived cohesion to their student organization, it is not likely they would continue their membership and it is possible that these feelings could lead to them leaving the fields of STEM.

Materials and Methods

The purpose of this investigation is to better understand the experiences of students who participate in biology-based student organizations and how these experiences influence students' perceived cohesion to science. To accomplish this, we used a qualitative methodology to determine what benefits students receive from participating in biology-based student organizations.

Context

For our investigation, we followed three biology-based student organizations, biological honor society, microbiology club, and wildlife club, that were active within the biology department at a large regional public university in the southwestern United States. The biology department at this university has three main undergraduate degree plans that students can pursue: general biology, microbiology, and wildlife biology. We selected the three biology-based student organizations because they aligned with one of these three undergraduate degree paths. Additionally, these student organizations held at least one event a month, had been active for at least five years, and met the university required levels of membership with at least five members. Each student organization started holding meetings at different times each semester. Because of this, we attended six meetings for the biological honor society, six meetings for the microbiology club, and seven meetings for the wildlife club.

The biological honor society is a student organization that promotes interest in the biological sciences. Within this organization, there are two levels of membership: associate and regular. Associate membership is open to any student, undergraduate and graduate, regardless of major and GPA. Regular membership is open to undergraduate students who are majoring in biology and have a GPA of at least 3.0. At the time of this investigation, the biological honor society had 54 members during the fall and 52 members during the spring on their roster. The microbiology club and wildlife club do not have a formal GPA requirement for membership like the biological honor society. Both clubs strive to promote interest in their respective fields (i.e. microbiology and wildlife science respectively) and are open to any student regardless of major. At the time

of this investigation, the microbiology club had 55 members in the fall and 51 members in the spring on their roster, while the wildlife club had 198 members in the fall and 183 members in the spring on their roster.

Perceived Cohesion Questionnaire

We constructed an open-ended questionnaire to assess what perceptions students had about their respective student organization (Appendix B). This questionnaire included four demographic questions, seven questions for all members about the organization, and four questions for the student leaders. We administered this questionnaire through Qualtrics and distributed it through email at the beginning of the fall semester and end of the spring semester in order to capture as many different students as possible.

Data Analysis

To address our research question, “What benefits do students receive from participating in their respective student organizations,” we analyzed student responses to the perceived cohesion questionnaire using a qualitative methodology. Specifically, we used students’ responses to the question, “What benefits do you feel that you are receiving from being a member of the organization?” We started our analysis by applying in vivo codes (Saldaña, 2016) to student responses to capture the specific voice of our participants. Some examples of our in vivo codes included, “I feel that I am obtaining connections with those with similar interests in the field of biology,” “meeting people with shared experiences,” and, “networking with faculty and other students.” After creating our in vivo codes, we began to sort and group the codes into categories based on related ideas. For example, we grouped our previously listed in vivo codes together under

the category of *Professional* as they all dealt with making professional connections within the field of science. We then continued shorting and grouping our categories together based on related ideas until we found our emergent themes. For example, we grouped the categories *Research Opportunities*, *Access to Information*, *Resume and Curriculum Vitae*, and *Skill Building* into the theme of *Professional Development* as they all dealt with the development of some form of professional skill. We report our findings through rich descriptions of each emergent theme and category.

Findings

We had 55 students respond to our questionnaire: 17 from the biological honor society, 9 from the microbiology club, and 29 from the wildlife club. Our questionnaire was sent out to each student organization by the student leaders and students had to choose to complete the questionnaire on their own time. This could have led to some selection bias, where only the highly active members completing our questionnaire. We removed one response, “I wish I didn’t work so much so I could say that I have received a lot of benefits,” as it did not align with any other codes and reflected a student’s belief that there was some benefit to being in an organization but they were unable to take full advantage of their membership. Many students reported multiple benefits they felt they were receiving from participating in their respective student organizations which we coded separately and looked for emergent themes and categories. We found five emergent themes within our data: *Networking Opportunities*, *Professional Development*, *Learning Opportunities*, *Community Involvement*, and *Prestige* (Table 5). For each theme, we reported the number of students (*n*) who reported benefits within that theme.

Table 5.

Emergent themes for student reported benefits of participating in student organizations.

Theme	Category	Example
Networking Opportunities (n=40)	Personal (n=20)	“I am gaining new friends”
	Professional (n=20)	“Networking with future employment opportunities”
Professional Development (n=26)	Resume and Curriculum Vitae (n=9)	“Helps build my resume”
	Access to Information (n=7)	“Access to resources like job and volunteer opportunities”
	Research Opportunities (n=5)	“Proper scientific research that I wouldn’t of otherwise known [about]”
	Skill Building (n=5)	“Skill-building opportunity”
Learning Opportunities (n=26)	Knowledge Development (n=16)	“Gaining knowledge about animals, nature, and conservation skills”
	New Activities (n=10)	“Experiences that you don’t get in everyday life”
Community Involvement (n=21)	Volunteering (n=9)	“Provides volunteering opportunities”
	Community Outreach (n=8)	“There is a lot of outreach experience that I find personally rewarding”
	Personal Involvement (n=4)	“It benefits me by being involved”
Prestige (n=3)		“The title of being in an honor society”

Note. n indicates the number of students who reported a benefit within the theme or category

Networking Opportunities

Responses in the theme of *Networking Opportunities* (n=40) referenced some form of networking opportunity that the individual felt the student organization provided. Within this theme we had two categories: *Personal* and *Professional*. We included responses such as, “I am gaining new friends,” where individuals stated they were making new personal connections and expanding their social circles in the category of *Personal* (n=20). Our second category of *Professional* (n=20) within the theme included responses such as, “Networking with future employment opportunities,” where individuals reported making professional connections through their student organization.

Professional Development

We group responses that dealt with development of some form of skill that would be applicable in their professional careers in the theme of *Professional Development* ($n=26$). Within this theme we found four categories: *Resume and Curriculum Vitae*, *Access to Information*, *Research Opportunities*, and *Skill Building*. The *Resume and Curriculum Vitae* ($n=9$) category included responses where students reported participating in their student organization improved their resume or curriculum vitae, e.g., “helps build my resume,” and implies the student is using the organization to boost their future professional career. Responses in the *Access to Information* ($n=7$) category include students reporting they gain access to information they may not otherwise be able to access to if they were not part of their organization, e.g., “access to resources like job and volunteer opportunities.”. The next category, *Research Opportunities* ($n=5$), included responses where students reported being exposed to research opportunities and information on current ongoing research within the department, e.g., “proper scientific research that I wouldn’t have otherwise known [about].”. The final category in this theme was *Skill Building* ($n=5$) and included responses where students reported building general skills, e.g., “skill-building opportunity,” that would be applicable to their careers.

Learning Opportunities

We grouped responses that described some form of opportunity to learn something new within the theme of *Learning Opportunities* ($n=26$). Within this theme we found two categories: *Knowledge Development* and *New Activities*. We sorted responses that described the student expanding specific content knowledge, e.g., “gaining

knowledge about animals, nature, and conservation skills,” or general learning, e.g., “Learning more,” into the category of *Knowledge Development* (n=16). The second category of *New Activities* (n=10) included responses such as, “experiences that you don’t get in everyday life,” where students reported having the chance to participate in new activities.

Community Involvement

We grouped responses where students described being involved in a specific type of activity with their student organization into the theme of *Community Involvement* (n=26). We found three categories within this theme: *Volunteering*, *Community Outreach*, and *Personal Involvement*. The category of *Volunteering* (n=9) included responses such as, “provides volunteering opportunities,” where students reported they were able to volunteer with their respective student organization. However, the responses in this category did not include specific activities that students were volunteering for. The next category within this theme was *Community Outreach* (n=8) and included response such as, “there is a lot of outreach experiences that I find personally rewarding,” where students reported specific types of volunteering they were participating in (e.g. community outreach). Additionally, students also reported that they found these types of activities personally rewarding. The final category in this theme, *Personal Involvement* (n=4), included responses such as, “it benefits me by being involved,” where students reported that being involved in their student organization benefited them personally, but were not specific in how they were being benefited.

Prestige

We grouped response that dealt with the student feeling like their professional or social standing was being improved by being a part of the student organization, e.g., “the title of being in an honor society,” in the theme of *Prestige* ($n=3$). Responses in this theme displayed that the individual thought being a part of a prestigious organization could potentially increase their social or professional standing.

Discussion

Our findings display a myriad of benefits students receive from participating in biology-based student organizations that align with the current literature about student organizations. The themes of Networking Opportunities, Learning Opportunities, and Professional Development are themes that align with benefits that students receive from other types of student organizations (Anderson, 2015; Baker, 2008; Burridge & Carpenter, 2013; Munoz, Miller, & Poole, 2016a). Additionally, some students reported being able to be more involved on their campuses and in their communities through their participation in their student organization. Being more involved on their campuses has been found to increase students’ sense of belonging (Vaccaro & Newman, 2016). Campus involvement has also been positively correlated with psychological well-being throughout all years of higher education regardless of precollege psychological well-being (Kilgo, Mollet, & Pascarella, 2016). Previously, these types of benefits have been seen in non-academic student organizations rather than academic student organizations (Holzweiss, Rahn, & Wickline, 2007). This suggests that academic organizations may provide more meaningful experiences for students than previously thought.

Our findings fit within the framework of perceived cohesion (Bollen & Hoyle, 1990) and its two dimensions: *sense of belonging* and *feelings of morale*. The dimension of sense of belonging includes the cognitive and affective elements around an individuals' experiences with the group. The cognitive elements include information about experiences with the group and were seen within the themes of *Networking Opportunities*, *Professional Development*, and *Learning Opportunities*. The benefits that fell within these themes included examples where individuals reflected on their experiences with their biology-based student organization but did not include any form of affective elements. The affective elements were seen within the category of *Community Outreach* with statements such as, "...I find personally rewarding," where individuals reflected on their feelings about their experiences with their biology-based student organizations. These affective elements funnel into the feelings of morale and include the category of *Personal* where individuals reported they were able to make friends through their student organization. Because individuals included these affective elements in their responses, it is indicative that they had overall positive feelings towards their student organization and a strong sense of perceived cohesion. Our findings help further our understanding of academic student organizations through uncovering the affective elements students have regarding their membership in academic-based student organization. Previously only affective elements in non-academic based student organization have been reported (Holzweiss, Rahn, & Wickline, 2007). By better understanding the emotional impacts of participating in academic-based student organizations, we can better understand how these organizations are shaping the experiences of students.

Participating in student organizations has been found to improve perceived cohesion among group members (Anderson, 2015) and promote knowledge development (Fujimoto & Yap, 2016). Our findings align with the current literature where most students reported being able to deepen their knowledge about science and becoming more engaged in their communities. By increasing perceived cohesion to these three biology-based groups, students will be better able to understand and find their place in the field of science. Once students come to understand where they fit in the field of science, they are more likely to continue participating in science and will begin to view themselves as scientist (Carlone & Johnson, 2007). This can cause students to find more enjoyment and fulfillment in pursuing scientific endeavors (Adams, Perkins, Podolefsky, Dubson, Finkelstein, & Wieman, 2006), and will be more likely to pursue scientific careers (Nyamwange, 2016). By producing more qualified scientists, then the United States will be able to remain competitive on the global scientific stage and remain a major source of scientific discoveries.

Our findings help shed light on the experiences that students have through participating in content-based student organizations. However, further investigation should focus on what motivates students to join these types of organizations in order to capture a broader image of their experiences in these types of organizations. As students typically join academic organizations to better prepare for their future (Holzweiss, Rahn, & Wickline, 2007), future investigations should determine how student motivations for joining content-based student organizations align with the benefits they receive from their participation. By understanding the relationship between student motivations and reported benefits, we can further establish the benefit of participating in content-based

student organizations. Participating in student organizations can lead to better academic performance (Pittman & Richmon, 2008) and persistence (Hausmann, Schofield, & Woods, 2007) and it would be worthwhile to determine if these trends hold true with biology-based organizations to further improve retention in STEM.

Implications for Practice

As many students enter college to acquire the skills and knowledge, they need to pursue a fulfilling career (Twenge & Donnelly, 2016), they will seek out opportunities that will allow them to accomplish these goals. Students are bombarded on their campuses with many student organizations they can join. Though students may be interested in joining many different organizations, a major consideration they use to guide their choice is what benefits they feel they can receive from their participation (Fusco, Prescott, & Prescott Jr, 2015). The idea of becoming more competitive on the job market can be a major selling point that student organizations can use when recruiting new members. By better understanding what motivates students to join these types of student organizations, student leaders can plan group activities and marketing strategies to appeal to these motivations to entice new students to join their organization. Though students may initially join a student organization to become more competitive on the job market through professional development (Holzweiss, Rahn, & Wickline, 2007), they will also develop socially which will lead to more productive and better adjusted students. As more students participate in these types of academic student organizations, we can generate a larger pool of qualified scientists to keep up with the demand of more qualified positions from employers (Munoz, Miller, & Poole, 2016b).

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V. DISUCSSION

Summary of Findings

The purpose of my dissertation was to investigate the experiences students have while participating in biology-based student organizations. Participating in student organizations has been found to increase student engagement on campus (Robbins, Allen, Casillas, Peterson, & Le, 2006) which can increase students' sense of belonging (Vaccar & Newman, 2016).

In Chapter 2, I demonstrated how the three biology-based student organizations, biological honor society, microbiology club, and wildlife club, exhibited the criteria of affinity groups (Gee, 2000). Through my observations, I determined how members of these groups display allegiance to their group and its members, shared access to information that was relevant to the group, and participated in group specific practices. I concluded that the biological honor society, the microbiology club, and the wildlife club all exhibited the criteria of affinity group in various ways. There are many benefits that have been linked to participation in affinity groups such as expanding members' social circles (Park & Kim, 2013), increasing campus engagement (Anderson, 2015), and providing opportunities for professional development (Burrige & Carpenter, 2013). Affinity groups can also foster a sense of community among group members (Anderson, 2015), which can lead to the development of a sense of belonging within the specific context of the group (Bowman, Park, & Denson, 2015). Within STEM fields, it has been found that sense of belonging is a contributing factor to persistence (Hausmann, Schofield, & Woods, 2007; Nyamwange, 2016). As I have established these groups as

affinity groups, it is expected that members can experience these benefits and be more likely to remain in STEM.

In Chapter 3, I investigated what motivated students to join their specific organization and how they participated within the group. After analyzing responses from 55 students, I found three emergent themes explaining why students choose to join their specific biology-based student organization: *Building Knowledge*, *Social Outlet*, and *Reputation*. Two of these themes, *Building Knowledge* and *Reputation* aligned with reported motivations students join academic-based student organizations (Holzweiss, Rahn, & Wickline, 2007; Munoz, Miller, & Poole, 2016a). However, the motivational theme of *Social Outlet* has previously only been reported in non-academic student organizations (Holzweiss, Rahn, & Wickline, 2007). Because students reported joining biology-based student organizations to some form of social outlet, there may be more benefits to content-based student organizations than previously thought.

Through my observations at organizational meetings and special events, I was able to determine some patterns for each organization. All three organizations held a mix of formal and semi-formal group meetings. At these meetings, the student leaders of each organization would lead a discussion about the current business of the organization such as upcoming events and deadlines for projects. Each group also held special events that included participating in science-based community outreach, traveling to areas impacted by natural disasters to assist with clean-up efforts, and visiting local lab facilities to learn about career opportunities. Many members participated in these events by attending and assisting with the goal of the event and served as an ambassador for their specific organization. Many students enter college to gain the skills and experience needed to

acquire a better career (Twenge & Donnelly, 2016) and will seek out opportunities to help them meet these goals (Fusco, Prescott, & Prescott Jr., 2015). By participating in content-based student organizations, students will gain valuable skills and experiences that they can carry into the classroom leading to more productive students (Strayhorn, Lo, Travers, & Tillman-Kelly, 2015) which ultimately leads to being more competitive on the job market.

In Chapter 4, I investigated what benefits students reported receiving from their participation in their respective student organizations. After analyzing responses from 55 students, I found five emergent themes from my data: *Networking Opportunities*, *Professional Development*, *Learning Opportunities*, *Involvement Experiences*, and *Prestige*. These findings align with the current literature for what benefits students receive from other types of student organizations (Anderson, 2015; Baker, 2008; Burridge & Carpenter, 2013; Munoz, Miller, & Poole, 2016a). Students reported being more involved on campus and in the community through their participation in their student organization. Being more involved on campus has been shown to increase sense of belonging (Vaccaro & Newman, 2016) and psychological well-being (Kilgo, Mollet, & Pascarella, 2016) among students. Participating in biology-based student organizations allow for students to better understand their place within science. As students find their place in science, they are more likely to find fulfillment pursuing scientific careers (Adams, Perkins, Podolefsky, Dubson, Finkelstein, & Wieman, 2006) and are more likely to pursue scientific careers (Nyamwange, 2016). By encouraging more students to pursue scientific careers, we can further improve the leaky STEM pipeline and allow the United States to remain a major source of scientific discoveries.

Discussion

From my data and analysis, I found many different overlaps between my chapters. When looking at the motivations for why students joined their respective student organizations and what benefits they reported receiving from their participation, there is a nearly perfect overlap between the emergent themes that also aligns with the current literature about non-discipline specific student organizations (Table 6).

Table 6.

Overlap between motivation and benefit themes and existing literature.

<i>Motivation</i>	<i>Benefits</i>
Building Knowledge	Professional Development (BurrIDGE & Carpenter, 2013)
	Learning Opportunities (Zilvinskis, Masseria, & Pike, 2017)
Social Outlet	Networking Opportunities (Holzweiss, Rahn, & Wickline, 2007; Park & Kim, 2013)
	Involvement Opportunities (Furrer & Skinner, 2003; Robbins, Allen, Casillas, Peterson, & Le, 2006)
Reputation	Prestige (Fusco, Prescott, & Prescott Jr., 2015)

The motivational theme of *Building Knowledge* overlaps with the Benefit themes of *Professional Development* and *Learning Opportunities* as response within these themes deal with the development of some form of knowledge. Within teacher affinity groups, those who participate have access to more professional development opportunities that allow them to be more successful teachers (BurrIDGE & Carpenter, 2013). Professional development can lead to the development of content knowledge (Dalgarno & Colgan, 2007) and I found that within my data as students reported being

able to learn more through participating in their respective organization. Additionally, many of the events hosted by these biology-based student organizations can be viewed as service-learning experiences (Wolfson, Mathieu, Tannenbaum, & Maynard, 2019). Students who participate in service-learning activities have been found to have higher levels civic responsibility, interpersonal skills, and academic development (Heber & Hauf, 2015), as well as developing a stronger sense of belonging within the group they participate with (Mitchell, 2015). My findings align with the literature where students report joining student organizations to improve professional skills.

Within the current literature, students generally join academic student organizations for the opportunity to grow professionally and choose to join non-academic student organizations to meet some form of social need (Holzweiss, Rahn, & Wickline, 2007). My findings show that students can also join content-based student organizations to meet social needs. The theme of *Social Outlet* overlaps with the themes of *Networking Opportunities* and *Involvement Experiences* as these responses showcased how individuals wanted to use the organization to meet a form of social need through either meeting new people or getting more involved in their campus and community. This aligns with the literature that reports students can meet social needs through participating in student organizations (Park & Kim, 2013).

Establishing social relationships and networks are a key factor towards maintaining student well-being (Kerr, Waters, Adler, & White, 2015). Students can build their social networks through interacting with other students in their classes and participating in on campus activities (Turton, Nauta, Wesselmann, McIntyre, & Graziano, 2018). A common way that students are encouraged to meet new people is to participate

in a student organization and my findings highlight that students seek out biology-based student organizations to help meet their social needs. By meeting their social needs, students will have an overall better sense of well-being (Webber, Krylow, & Zhang, 2013) which can lead to increased academic performance (Plutt, Curseu, & Ilies, 2015; Taylor, Oberle, Durlack, & Weissberg, 2017), which ultimately leads to better career success (Villares & Brigman, 2018).

Finally, the theme *Reputation* overlaps with the theme *Prestige* as responses indicated that there was something the student heard about the specific organization that drew them in and made them want to continue their participation. As the number of students pursuing higher education increases, the job market has become more competitive (Finch, Peacock, Levallet, & Foster, 2016). As competition increases, employers are increasingly using skills to differentiate between similarly qualified candidates (Cole, Rubin, Field, & Giles, 2007). Though there is debate on the extent that participating in student organizations influences employers hiring decisions, it is generally accepted that participation does play some role (Kim & Bastedo, 2017). Therefore, many students seek to join professional organizations to help them stand out from the crowd on the job market (Fusco, Prescott, & Prescott Jr., 2015). These motivations are seen in my findings through the themes of *Reputation* and *Prestige* where students reported being able to build their resumes as a motivation and benefit from participating in their respective student organization.

I also found that the motivations and benefits students reported were independent to the extent that the group exhibited criteria of affinity groups. However, I did notice the larger group was able to provide more numerous experiences for their members. These

experiences were not necessarily better, there were more opportunities for members to participate. Through participating in these biology-based student organizations or affinity groups, students reported being more engaged with on their campus, i.e., “there is a lot of outreach experiences,” which has been linked to greater academic performance (Johnson & Stage, 2018). Based on my findings, I can conclude that if a student organization meets the criteria of affinity groups, even minimally, then they can provide meaningful experiences to their members that can increase their perceived cohesion to the group and to the field of science.

Due to the large overlap between student motivations and benefits, I speculate that there exists a kind of feedback loop wherein a student joins an organization for a specific reason and then focuses their participation on activities that align with that reason which leads to them receiving that as a benefit for their participation. This form of feedback loop has been seen in organizations that promote civic engagement where students join because of their interest in getting more involved in their communities and through their participation become more engaged in their communities not only during college but also after (Bowman, Park, & Denson, 2015). My findings suggest that this feedback loop can be present in content-based student organizations. For example, if a student were to join the microbiology club to learn more about potential career opportunities in microbiology, then they would try and attend all events that would expose them to different career paths such as touring local lab facilities. Because they are focused on learning about different career paths, they would be more likely to report receiving career information or professional networking as a benefit from their participation in the club. Although they would focus on this one aspect of the group, they

would not be limited to having experiences that aligned with other themes found in my data.

Overall, my findings contribute to furthering our knowledge of how content-based student organizations function and what experiences students have participating in these groups. I confirm that many of the benefits seen in other professional affinity groups are seen in content-based affinity groups, such as the development of professional skills and knowledge (Burridge & Carpenter, 2013), and building of trust among group members (Anderson, 2015). Additionally, I found that students who participated in these biology-based student organizations had a sense of perceived cohesion which helps build a sense of belonging within the group and within science. As students develop this sense of attachment to science, they begin to understand their place in science and will start to view themselves as scientists and find more enjoyment in pursuing scientific careers (Adams, Perkins, Podolefsky, Dubson, Finkelstein, & Wieman, 2006; Nyamwange, 2016).

In addition to adding to our understanding of how content-based student organizations function and benefit group members, I also help push our understanding of these types of groups by showing motivations that have previously been reported in non-academic student organizations (Holzweiss, Rahn, & Wickline, 2007). By showing how academic-based student organizations provide some of the same benefits seen in non-academic organizations, we can encourage more students to participate in organizations that are related to their major. Through becoming more engaged with students in the same major, students will be able to start building professional networks that will allow them to acquire a meaningful career (Yun, Baldi, & Sorcinelli, 2016).

Now that I have documented the experiences students have while participating in biology-based student organizations, future research can investigate how these organizations influence academic performance and retention in STEM. Research shows that participating in non-academic student organizations can lead to better academic performance and retention rates (Anderson, 2015; Baker, 2008; Fisher, Bagiati, & Sarma, 2017; Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008; Soria, Werner, Chandiramani, Day, & Asmundson, 2019; Wilson et al., 2015). It would be meaningful to determine if these trends are seen in content-based student organizations. If these trends hold true in content-based organizations, as we encourage more students to participate, we would be encouraging them to remain in STEM throughout their career.

Limitations

In addition to the delimitators that I described in Chapter 1, there were minor limitations to my study. I had 17 students from the biological honor society (30% of majors on roster), 9 students from microbiology club (17% of majors on roster), and 29 students from the wildlife club (15% of majors on roster) in these student organizations respond to my perceived cohesion questionnaire. Though I was able to capture unique voice of students who selected to complete my questionnaire, it is always better to have more participants. With more responses, it is possible that I would reinforce my reported themes of motivation and benefits and uncover additional factors that influence student participation in these student organizations. I also was only able to verify members on the group's roster if they were biology majors. I was not able to verify if members on the roster were not biology majors or if they had graduated. In future investigations, I would strive to reach out to students who dropped out of the organization between semesters to

determine their reasons for leaving. I would also utilize a check in system at group meetings and events where members would swipe their student ID to be counted rather than relying on a paper sign-in list. This type of system would also allow me to track individual attendance at group events. For future analyses, I would look at differences based on demographic factor (i.e. gender, major, membership type) to identify any trends that exists within the data. It is possible that there was a selection bias within my data, as students had to voluntarily complete my questionnaire. This would mean that they had to really want to complete it during their own time and could skew my findings due to only active students completing the questionnaire. In the future, I would like to have the questionnaire incorporated into a group activity which would provide more student responses to analyze.

Implications

The findings from my research has several implications for biology-based student organizations. Student leaders and faculty advisors of these organizations can adjust how they market their organization to potential members based on what motivates students to join these types of organizations. Students are more likely to join content-based student organizations if they perceive some benefit to their participation (Petersen, Wascher, & Kier, 2017). Knowing this, organization leaders can highlight the aspects of their organization that align with what potential members are looking for. Student leaders can also adjust what events their organization holds based on what motivations their members have. For example, if many students are interested in learning more about potential career opportunities then student leaders should make arrangements to have speakers come present to the group about potential careers and travel to local facilities that allow

members to see firsthand what opportunities are available within their field of study. In my study, when the wildlife club would host guest speakers, these meetings would tend to have a higher attendance than meetings that did not. This will allow members to perceive greater value in their participation as they will get more from their student organization making them more likely to participate (Farina, 2016). My findings help show how the experiences students have through content-based student organizations helps them find their place in STEM in ways that are similar to other non-academic student organizations.

APPENDIX SECTION

APPENDIX A

IRB Approval Letter



In future correspondence please refer to 2017752

June 8, 2017

Zachary Nolen
Texas State University
601 University Drive.
San Marcos, TX 78666

Dear Mr. Nolen:

Your IRB application 2017752 titled "A consideration into ways biology-based student organizations facilitate participation in STEM" was reviewed and approved by the Texas State University IRB. It has been determined that risks to subjects are: (1) minimized and reasonable; and that (2) research procedures are consistent with a sound research design and do not expose the subjects to unnecessary risk. Reviewers determined that: (1) benefits to subjects are considered along with the importance of the topic and that outcomes are reasonable; (2) selection of subjects is equitable; and (3) the purposes of the research and the research setting is amenable to subjects' welfare and producing desired outcomes; that indications of coercion or prejudice are absent, and that participation is clearly voluntary.

1. In addition, the IRB found that you need to orient participants as follows: (1) signed informed consent is required; (2) Provision is made for collecting, using and storing data in a manner that protects the safety and privacy of the subjects and the confidentiality of the data; (3) Appropriate safeguards are included to protect the rights and welfare of the subjects.

This project is therefore approved at the Exempt Review Level

2. Please note that the institution is not responsible for any actions regarding this protocol before approval. If you expand the project at a later date to use other instruments please re-apply. Copies of your request for human subjects review, your application, and this approval, are maintained in the Office of Research Integrity and Compliance. Please report any changes to this approved protocol to this office.

Sincerely,

A handwritten signature in cursive script that reads "Monica Gonzales".

Monica Gonzales
IRB Regulatory Manager
Office of Research Integrity and Compliance

CC: Dr. Kristy L. Daniel

APPENDIX B

Perceived Cohesion Questionnaire

1. Name:
2. What is your self-identifying gender?
3. What is your current class level?
4. What student organization are you currently a member of?
5. Do you currently hold a leadership position within the organization?
 - a. Please list the position that you currently hold.
 - b. What made you want to pursue this position?
 - c. What are the responsibilities of this position?
 - d. How do you balance the responsibilities of this position with your other commitments?
6. How long have you been a member of the organization?
7. What made you want to join this organization over other student organizations?
8. What about the organization has made you want to continue being a member?
9. How do you feel about the leadership of the organization?
10. Have you ever thought about discontinuing your membership in the organization?
 - a. Why have you thought about discontinuing your membership in the organization?
11. What benefits do you feel that you are receiving from being a member of the organization?

APPENDIX C

General Meeting Observation Protocol

Host Organization

- Biological honor society
- Wildlife club
- Microbiology club

Meeting type

- General meeting
- Special meeting
- Other: _____

Event name: _____

Event date: _____

Observer: _____

- Completed Start a meeting sign-in list
- Completed Attach the meeting sign-in list

Allegiance

Count	
	Student leaders wore organizational attire (e.g. hat, shirt, etc.)
	Student members wore organizational attire (e.g. hat, shirt, etc.)
	Faculty advisor(s) wore organizational attire (e.g. hat, shirt, etc.)
	Student leaders wore university attire (e.g. hat, shirt, etc.)
	Student members wore university attire (e.g. hat, shirt, etc.)
	Faculty advisor(s) wore university attire (e.g. hat, shirt, etc.)

Yes	No	
		General members appeared interested in meeting
		General members engaged in meeting (e.g. asked questions, paid attention, etc.)

Additional comments (e.g., How were members encouraged to participate)

Communication

Yes	No	
		Did student leaders have an agenda for the meeting?
Notate Agenda here (or attach agenda to observation and notate alterations here)		
		Faculty advisor(s) present?

Additional comments about communication styles/procedures here

Group Specific Practices

Describe what happened during the meeting beyond agenda issues (e.g. who spoke, what it formal, etc.)		
During the meeting, what did each of the following participants do?		
Student Leaders	Faculty Advisor(s)	General Members

Yes	No	
		Were any special guests recognized during the meeting?
Describe what they did during the meeting		

Additional comments about the meeting here:

APPENDIX D

Special Event Observation Protocol

Host Organization

- Biological honor society
- Wildlife club
- Microbiology club

Meeting type

- Fundraiser
- Outreach
- Other: _____

Event name: _____

Event date/location: _____

Observer: _____

- Completed Start an event sign-in list
- Completed Attach the event sign-in list

Allegiance

Count	
	Student leaders wore organizational attire (e.g. hat, shirt, etc.)
	Student members wore organizational attire (e.g. hat, shirt, etc.)
	Faculty advisor(s) wore organizational attire (e.g. hat, shirt, etc.)
	Student leaders wore university attire (e.g. hat, shirt, etc.)
	Student members wore university attire (e.g. hat, shirt, etc.)
	Faculty advisor(s) wore university attire (e.g. hat, shirt, etc.)

Yes	No	
		General members participated in event (i.e. not just sitting there)

Additional comments about member participation:

Communication

Yes	No	
		Was the event publicized to the general public?
How? (attach fliers or emails if applicable)		

Additional comments about how the group advertised the event:

Group Specific Practices

Describe the intended/communicated purpose and structure of the event (if different identify each)		
Describe what the following participants did during the event:		
Student Leaders	Faculty Advisor(s)	General Members
Describe how participants interacted with non-members (if applicable)		

Additional comments about the event:

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