

Community for a University Online Statistics Course:

A Quantitative Quasi-Experimental Study

by

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## Abstract

Since the advent of the internet, more professors and administrators from colleges and universities have been putting more classes online. These educators have been able to serve more students at a relatively lower cost. Educators have expressed concerns in online classes due to a lack of community. The study reveals gaps in the literature, which are assessing a sense of community for an online statistics class while assessing the sense of community within a mixture of different ages and genders in an online class. The theories of sense of community and servant leadership were the framework for the research. Research questions in the study reflect a concern about whether statistically significant differences exist in the sense of community in an online statistics class between different age groups and genders. The purpose of the quantitative quasi-experiment was to determine the possible differences between the levels of age and gender for the sense of community. The population was comprised of students taking an online statistics class at a university in Idaho, where a sample of 465 students was surveyed concerning the sense of community. All students taking the online statistics class were eligible to take a survey assessing the sense of community. A two-way Analysis of Variance (ANOVA) was conducted to assess the sense of community between age groups, genders, and age/gender groups. No statistically significant differences in the mean differences in the sense of community between age groups, genders, and age/gender groups surfaced. Educators seeking to improve the sense of community in either statistics classes and/or online classes might benefit from the research.

## Dedication

The dissertation is dedicated to my beautiful wife, Heather. When I had periods where I thought I could not finish the dissertation, Heather was there to give the unconditional love, comfort, and support I needed to complete the dissertation. I want to dedicate the dissertation to my five wonderful children Blake, Bonnie, Nathan, John, and Emma, as well as my children-in-law, Andreas, and Jessica. My children and children-in-law have been an inspiration to start and keep going with the doctorate. I want to dedicate my dissertation to my awesome parents, Bruce and Helga Cromar. I am grateful for my parents for teaching the importance of having great values, working hard, and leaving a great legacy.

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I would like to thank my colleagues and friends at Brigham Young University-Idaho. Many helped with some assignments, provided humor when I needed a laugh, and gave encouragement to keep going when at times I wanted to stop. I would like to thank my wife for editing almost all my assignments throughout the doctoral and dissertation process. Finally, much of the inspiration of the dissertation is to current and future students at Brigham Young University-Idaho. These students have a bright future, and I hope the research I did in the dissertation helps contribute to improved teaching and learning at Brigham Young University-Idaho.

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## Chapter 1: Introduction

More faculty members from colleges have been using the advances of digital technology and the internet to create more classes to benefit students at a relatively lower cost (Dobbs, Waid-Lindberg, & del Carmen, 2017). The number of online university course offerings is likely soon to be greater than the number of university campus offerings (Nash, 2015). Even with the growth of online courses, some college and university educators have been concerned about the strength and quality of online courses compared to campus courses (Nash, 2015). As part of the issue, educators have been concerned about the lack of collaboration and community building taking place in online classes. Addressing the need for online courses to have greater collaboration and community building could help influence other factors, such as attitudes and performance, which could help improve the quality of online classes (Serdyukov & Sistik-Chandler, 2015). Along with addressing the need for building a sense of community, educators from universities should consider the needs of different types of groups in the class involving such factors as age and gender (Dobbs et al., 2017).

As part of the university community, educators at a university in Idaho (the pseudonym of the university where the study took place) have been creating more online classes to benefit more students at a lower cost. A challenge at a university in Idaho has been to help students have a sense of community in an online class. Trying to build a sense of community has been the primary goal of the online learning experience at a university in Idaho. Educators at the university have been trying to facilitate an online community where students and teachers love, serve, and teach each other (C. Henrie, personal communication, September 3, 2019). Based on the mission statement of the university, the faculty members and administrators of the school have wanted to provide a quality education for students of diverse backgrounds and interests.

Appreciating the diversity of each individual while helping all to have a sense of community could be competing goals, but striving for interdependence could help the university meet the goals of both diversity and community (Neal, 2017). Conducting research on building a sense of community involving different types of students is key to promoting quality education in the online environment (Serdyukov & Sistik-Chandler, 2015). The sections of Chapter 1 include the following for the research study: Background of the Study/Problem, Statement of the Problem, Purpose of the Study, Significance of the Study, Research Questions, Hypotheses, Theoretical Framework, Definitions of Terms, Assumptions, Scope and Delimitations, and Limitations.

### **Background of the Study/Problem**

McMillan and Chavis (1986) developed the sense of community theory, where McMillan and Chavis discussed four key elements of creating community: membership, influence, integration/fulfillment of needs, and a shared emotional connection. Each of the four elements of the sense of community theory is interrelated and could build off the others (McMillan, 1996). In many different areas, the sense of community has been measured, such as addressing civic government, tribal communities, digital communities, and education (Chavis, Lee, & Acosta, 2008).

If the sense of community has been important for education, then having a sense of community in an online class could be more important (Phirangee, 2016a). Students in an online class might not be as connected to others compared to campus courses. Despite the growing popularity of online learning in higher education, students in distance education have often suffered from high dropout rates, which have been attributed to the physical separation of students. Such separation tended to give rise to feelings of isolation and disconnection

(Phirangee, 2016b). Developing a sense of community online encouraged students to make relationships with fellow students (Oliphant & Branch-Mueller, 2016), which have helped diminish ideas of isolation. Along with minimizing feelings of isolation, promoting a sense of online community has helped with retention and student learning.

Recent research at a university in Idaho has shown online students did not have a strong sense of support from teachers and peers, even with the primary goal at the university of building a sense of community in an online environment. The former president at a university in Idaho stressed the importance of not relying heavily on technology for pedagogical purposes, but technology should complement and support more effective teaching (Bednar, 1998). Educators at the university have been striving to serve more students a quality education at a lower cost (Eyring, 2017), but having a lack of community has hindered the faculty members and administrators at the university from reaching the goals of providing quality education in the online environment.

To add complexity to the sense of community issue, another challenge has been working with many different types of students with different factors such as age and gender. Different types of students have had different learning needs. Generation Z students are students who were born in 1995 and later. Those in the other age group are students who were born before 1995 (Vallone et al., 2016). Millennial and older students have been more autonomous, have used prior experience for learning, and have preferred self-directed learning (Zipp, Maher, & Olson, 2017). Generation Z typically has preferred learning in groups and being regularly active and engaged (Ebert, 2016).

Different genders have had different learning characteristics as well. Females have had both a better sense of community online (Yang, Cho, & Watson, 2015) and superior self-

regulation online than males (Chumbley, Haynes, Hainline, & Sorensen, 2018). Male students generally have had better confidence in mathematics and statistics, compared to female students (Ellis, Fosdick, & Rasmussen, 2016). Promoting the sense of community in an online class across different types of students could help improve the quality of the online class.

### **Statement of the Problem**

The problem explored in the research study was online classes have been serving more students, but the implications on the sense of community across a mixture of different age groups [Millennials (and older) vs. Generation Z] and different genders were unknown. Administrators and faculty at a university in Idaho have been increasing the number of online classes to serve more students at a lower cost (Eyring, 2017). Due to less support from peers and instructors within the class, the overall quality of online courses has been a concern (C. Henrie, personal communication, September 3, 2019). Across the different types of students, educators at the university have been concerned about the sense of community in the online courses, which could help improve university retention. The faculty members of the mathematics department at a university in Idaho, have had similar concerns with the online offerings of the department, including the introductory statistics class, which has been rapidly growing. For the winter 2020 semester, the online sections and the campus sections were equal in number (15 each). About half of the online statistics students were fully-online students (mostly older than Generation Z students), and the other half were campus students (mostly Generation Z students), and the online statistics courses had slightly more females than males total in all of the sections of the online classes.

Previous research indicated the sense of online community helped promote quality education and a sense of belonging for students in an online environment (Beeson et al., 2019;

Wu, Chen, & Yang, 2017). Attitudes with statistics were generally poor while taking a statistics class (Prayoga & Abraham, 2017), particularly an online statistics class (DeVaney, 2010), but could be improved through collaboration (Björnsdóttir, Garfield, & Everson, 2015). Younger Generation Z students, who typically preferred working with groups, had a greater need for support and were usually engaged in the latest technology (DeAngelo, 2014; Romsa, Bremer, & Lewis, 2017). Students older than Generation Z students were usually more self-directed, applied prior experience, and required less-structure for learning new knowledge (Howell, Simos, & Starcher, 2016; Zipp et al., 2017). Most evidence showed males had greater confidence and attitudes in math (Ellis et al., 2016), but females had a greater sense of community in an online environment (Yang et al., 2015).

A gap in the literature was located in evaluating the sense of community across a mixture of heterogeneous students by age [generation Z vs. millennials (or older)] and gender. The research showed the role of the sense of community in an online statistics class on how a sense of community helped benefit each different type of group (Björnsdóttir et al., 2015; Phirangee, 2016b). Those affected by the problem were those students who eventually took the introductory statistics course online at a university in Idaho with a mixture of generation Z students and millennial (and older) (DeAngelo, 2014) students along with a mixture of different genders (Yang et al., 2015). This effect could apply to other online classes at a university in Idaho with a similar makeup of students.

### **Purpose of the Study**

The purpose of this quantitative quasi-experiment was to determine the possible differences between the levels of age and gender for the sense of community. The study was necessary to discover the sense of community for different types of students working together in



the online class. Not conducting the research could limit the understanding of the faculty members of the mathematics department in determining how well the professors of the department have been serving different types of students and which instructional methods to employ for certain groups of students. A composite sense of community score was the dependent variable by summing all scores from each question from a sense of community survey, which had four different types of attributes being measured: membership, influence, integration/fulfillment of needs, and a shared emotional connection (Chavis et al., 2008). From all 24 sense of community questions, the dependent variable was the sum of scores in the survey, and the variable was a continuous score ranging from 0-72. Age and gender were the two independent variables, where age was categorical (born after 1996 vs. at or before 1996) as defined by Vallone et al. (2016), and gender was categorical (male vs. female). Based on the recommendations of the university, the categories reflected the admissions data at a university in Idaho (C. Henrie, personal communication, January 3, 2020).

The study was connected primarily to the sense of community theory (McMillan & Chavis, 1986) where improving community could affect many different factors such as performance (Davis, Hanzsek-Brill, Petzold, & Robinson, 2019), a sense of belonging (Beeson et al., 2019), and perceived learning (Trespacios & Perkins, 2016). The results of the study could be added to the knowledge base by assessing the sense of community for an online class and how age groups and gender groups influence the sense of community. For the study, the target population was students at a university in Idaho taking the introductory statistics class online where the course required students to have weekly peer-group discussions to go over new statistical material and work on a semester project as a way of building knowledge and promoting community in the online class. Evaluating the sense of community in an online

statistics class was a gap in the literature. Assessing the sense of community while comparing differences across different age groups and genders was another gap to address, which could help provide further information toward improving online statistics courses.

### **Significance of the Study**

As a result of the study, the faculty members in the mathematics department could recommend changes to meet the needs of different students taking the online statistics class to address the sense of community. Results from the research could show improving the sense of community not only helps with online statistics classes at a university in Idaho but other online classes as well. Given the sense of community has been the heart of online learning at a university in Idaho (A. Young, personal communication, August 3, 2019), the educators at a university in Idaho could find the study helpful with other online classes.

The results of the research could be shared with the faculty at a university in Idaho and possibly other online faculty teachers who have a similar makeup of students (a combination of generation Z and older students along with different genders). The study could be added to the research to help provide evidence in addressing the need to improve the sense of community and make sense of community a primary focus on online course development. Those students with a greater sense of community have had stronger feelings about issues of social justice (Torres-Harding, Diaz, Schamberger, & Carollo, 2015), which could help students who have been typically marginalized. Having an improved sense of community in the online class has helped improve college student retention and has helped students who have been marginalized have feelings of inclusion rather than isolation (Oliphant & Branch-Mueller, 2016).

## Research Questions

The sense of community was investigated in an online statistics class at a university in Idaho across different age/gender groups. From the problem and purpose of the study, three research questions were created. To perform an analysis, the study was guided by the following research questions:

**Research Question One:** Does a statistically significant difference exist in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho?

**Research Question Two:** Does a statistically significant difference exist in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho?

**Research Question Three:** Does a statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) exist with the sense of community scores in the online introductory statistics course at a university in Idaho?

## Hypotheses

To perform the statistical tests for research questions, each research question required a set of hypotheses. For the study, the hypotheses were derived from the research questions. The three research questions were addressed by the following hypotheses:

$H_{10}$ : A statistically significant difference does not exist in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho.

H1<sub>α</sub>: A statistically significant difference exists in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho.

H2<sub>0</sub>: A statistically significant difference does not exist in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho.

H2<sub>α</sub>: A statistically significant difference exists in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho.

H3<sub>0</sub>: A statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) does not exist on the sense of community scores in the online introductory statistics course at a university in Idaho.

H3<sub>α</sub>: A statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) exists on the sense of community scores in the online introductory statistics course at a university in Idaho.

### **Theoretical Framework**

The framework for the research for the sense of community in an online environment were two theories: the sense of community theory (McMillan & Chavis, 1986) and servant leadership theory (Greenleaf, 1970). Sense of community theory was the foundational theory of the research. Servant leadership theory was the leadership theory to effectively support the principles of the sense of community theory.

### **Sense of Community Theory**

The study was directed by the attributes associated with the sense of community theory (McMillan & Chavis, 1986). Components of the sense of community theory include membership, influence, integration/fulfillment of needs, and a shared emotional connection (McMillan & Chavis, 1986). Membership is defined as having an investment one puts as part of a group and has a right of belonging. The first definition has five different elements: “boundaries, emotional safety, a sense of belonging and identification, personal investment, and a common symbol system” (McMillan & Chavis, 1986, p. 11). The spirit of membership is the ability of people in a group to create connections and friendships (McMillan, 1996). With influence, each person should have some impact on what the group cohesiveness should look like and the capability to impact what all in the group do. Having influence within the group requires trust for each member of the group and trust with the group meeting the proper goals and outcomes (McMillan, 1996).

Integration/fulfillment of needs means encouraging the strengthening of the members in the group. Strengthening of the members of the group could come by obtaining success for the group and getting help from the capacities and strengths of other members. Shared emotional connection means the members in the group have had shared experiences, and the experiences have meaning for each member. Each of the four elements of the sense of community theory is interrelated and could build off each other (McMillan, 1996).

### **Servant Leadership Theory**

To complete the framework for the research, the study was guided by the theory of servant leadership. If the sense of community theory provided the fundamentals to help build a community, then the servant leadership theory was a positive motivation to build a community.

The sense of community was ingrained in the top features of Greenleaf (1970) about servant leadership (van Dierendonck & Patterson, 2015). Some of the attributes to servant leadership theory are key to facilitate the sense of community. Some of these attributes include humility, the ability to empathically listen, building trust, providing service, empowering others, esteeming people, humility, uprightness, unconditional love, and learning (Focht & Ponton, 2015).

Developing a sense of community in an online environment has helped students to make social relationships with peers (Oliphant & Branch-Mueller, 2016), which have helped remove thoughts of isolation (Phirangee, 2016b). Applying these traits of servant leadership could help one have a great capacity to improve student satisfaction in an online environment (Sahawneh & Benuto, 2018).

### **Definitions of Terms**

The following definitions are listed to help the reader in understanding the certain vocabulary used in the analysis. A few of these definitions were the independent and dependent variables of the analysis. Some of these terms could be unfamiliar to the reader, or other terms could define the use within the background of the analysis.

**Age.** Age was one of the independent variables of the analysis. The variable was divided into two categories, students born before 1996 (Millennials and older) and students born in 1996 and after (Generation Z) (Vallone et al., 2016).

**Gender.** Gender was one of the independent variables in the analysis. The administrators at a university in Idaho wanted to use the two possible categories of gender, as reflected in the admissions data at a university in Idaho, which were male and female (C. Henrie, personal communication, January 3, 2020).

***Influence.*** Influence was one of the components of building a sense of community and was defined as one having an impact on what a group does and how the group meets the needs and objectives of the group (McMillan & Chavis, 1986).

***Integration.*** Integration was one of the components of building a sense of community and was defined as one wanting to encourage and strengthen group members and getting help from the strengths and abilities of other members (McMillan & Chavis, 1986).

***Membership.*** Membership was one of the components of building a sense of community and was defined as one having invested time as part of a group and having developed a sense of belonging (McMillan & Chavis, 1986).

***Sense of Community.*** The sense of community theory was the primary framework for the analysis. Having a sense of community addresses the value of human relationships with four different components: membership, influence, integration, and shared emotional connection (McMillan & Chavis, 1986).

***Sense of Community Score.*** The composite score was from the Sense of Community survey (Chavis et al., 2008) combining all four sense of community components and was the dependent variable.

***Servant Leadership.*** Servant leadership theory was the secondary framework for the analysis, which complemented the sense of community theory. A servant leader is primarily a servant and starts with natural feelings of wanting to serve others (Gandolfi & Stone, 2018).

***Shared Emotional Connection.*** Shared emotional connection was one of the components of building a sense of community and was defined as a group having shared experiences and the experiences having meaning to each of the members of the group (McMillan & Chavis, 1986).

### **Assumptions**

The Sense of Community Index 2 (SCI-2) was used in the study (Chavis et al., 2008) (see Appendix A). A major assumption was the students in the study answered the questions in the survey truthfully and provided accurate information for the study (Simon & Goes, 2013). Assuring anonymity and confidentiality helped to ensure the students gave accurate information. Having an informed consent at the beginning of the survey, which was clear and succinct, could have helped students understand the purpose of the survey and the role of the student in taking the survey. Students were given extra credit for completing the survey to provide benefit in completing the survey (McInroy, 2017).

Another assumption was the data were analyzed with impartiality and objectivity. Assessing the possible biases in a study helped to minimize any dangers to objectivity (Creswell & Creswell, 2018). People could have been subject to bias when analyzing and interpreting the data (Sullivan, 2016). To help with objectivity, online teachers teaching the course did not analyze the data. A couple of faculty members from the mathematics department at a university in Idaho reviewed and analyzed the results independently to promote objectivity in the analysis.

### **Scope and Delimitations**

The focus of the study was on students taking an online introductory statistics course at a university in Idaho and the sense of community of these students. Access to the students at a university in Idaho was a delimitation. Students received information about the study and the role of the student within the study and were given an informed consent to allow access to the questions given in the survey (Antonacopoulos & Serin, 2016). Using an online Qualtrics survey, the survey was conducted at the end of a semester. Qualtrics is a digital tool used where:



(a) a survey was created, (b) students completed the survey, and (c) the results from the survey were obtained from a retrievable database.

Given 465 students were part of the sample, the study was generalizable across different online introductory statistics courses at a university in Idaho and could be useful to those classes and students with similar characteristics taking an online introductory statistics course at a university in Idaho (L. V. Hedges, 2018). Students who were still part of the online course during the time of the survey were eligible to take the survey. The study was limited to students who were required to take a statistics course as part of a degree. Only students aged 18 or older were a part of the analysis. Students who did not complete the survey were removed from the study.

### **Limitations**

The generalization of the study was restricted due to certain external validity issues (Creswell & Creswell, 2018). Almost all of the students in the online statistics courses at a university in Idaho are members of the Church of Jesus Christ of Latter-day Saints. Religious homogeneity made generalizing of the study difficult because of the unifying effect of a shared religion (Neal, 2017). Making a similar study for different classes other than online statistics classes, such as humanities or physics classes could provide dissimilar results. Performing the analysis with upper-level courses or face-to-face courses could have different outcomes compared to this analysis. Two limitations to the quasi-experimental design of the study were (a) the factors or independent variables, age, and gender, were not randomized, and (b) any causation could not be determined between gender and age with the sense of community.

The study had several possible threats to internal validity, which affected the usefulness of the quasi-experimental study (Creswell & Creswell, 2018). Most campus students, who were

mostly younger students, preferred taking campus classes than online classes. Campus sections of the introductory statistic class typically reached capacity before the online classes because most students favored campus classes (Tichavsky, Hunt, Driscoll, & Jicha, 2015). Some who signed up for an online section were prone to sign up late and could have been afraid to take a statistics class, given the reputation a statistics class has had with students (Prayoga & Abraham, 2017). The registration process at a university in Idaho could have generated selection bias where a greater number of the better campus students have taken the face-to-face statistics classes versus the online statistics classes. Students who initially signed up for an online section could have eventually taken a campus section, which would have helped reduce selection bias but could have impacted the effect of students dropping out of the online sections, which would have affected mortality validity. Being able to recruit a large sample size of students (465 students) was enough data across different ages and genders to minimize the effect of mortality validity.

### **Chapter Summary**

Because of the advent of the internet, more educators at colleges and universities have been putting more courses online (Dobbs et al., 2017). The concern has been the lack of quality in online offerings compared to campus offerings. A lack of sense of community in an online class has affected the quality of the course (Serdyukov & Sisteck-Chandler, 2015) and made students have feelings of isolation and had a greater likelihood of dropping out (Oliphant & Branch-Mueller, 2016). Added to the concern of the sense of community in the online environment, statistics courses have had a negative reputation amongst many college students (Prayoga & Abraham, 2017). The material in Chapter 1 provided the background of the problem, the problem of the study, the purpose of the study, the significance of the need for the

study, the research questions/hypotheses, a brief explanation of the framework of the analysis, the assumptions, a list of key definitions, the scope/delimitations of the study, and the assumptions need to perform the analysis for the study. Chapter 2 begins with a short description and restatement of the problem and reveals the literature research strategy, provides more on the theoretical framework, and reveals a review of the literature supporting the need for the study.

## **Chapter 2: Literature Review**

The problem explored in the research study was online classes have been serving more students, but the implications on the sense of community across a mixture of different age groups [Millennials (and older) vs. Generation Z] and different genders were unknown. The purpose of this quantitative quasi-experiment was to determine the possible differences between the levels of age and gender for the sense of community. More faculty and administrators in colleges have been using the invention of the internet to create courses to work with more students and lessening the relative education expense (Dobbs et al., 2017). The number of online course offerings could someday be the majority of course offerings for college students (Nash, 2015). Even with the growth and convenience of online college courses, some educators have been concerned about the quality of the course offerings compared to campus courses (Nash, 2015). As part of the quality of an online course, some educators have been concerned with the limited collaboration between students and teachers in the online setting.

Determining the sense of community and the possible results such as attitudes and a sense of belonging could help define the value of the online classes (Serdyukov & Sistek-Chandler, 2015). Along with having valuable online classes with a sense of community, educators at colleges should determine how to address these concerns with diverse groups of students in courses involving such factors as age and gender (Dobbs et al., 2017). The study was necessary to assess the sense of community for different types of students working together in the online class. Major sections of Chapter 2 are the following: Literature Search Strategy, Theoretical Framework, Review of the Literature, and Summary of the Literature Review. The theoretical framework section is divided into two sections, Sense of Community Theory and Servant Leadership Theory. The literature review is divided into several different sections: Sense of

Community in Education, Sense of Community in Online Education, Sense of Community in Statistics Classes, Differences between Age Groups, and Differences between Genders.

### **Literature Research Strategy**

The research strategy for the literature review involved several different aspects. All the aspects helped to form the outline and content of the literature review. These aspects included databases/search engines, key search terms, review references in cited articles, and review statistics educational journals.

### **Library Database and Search Engines**

The primary method to find relevant research articles was to use the Open Athens/EBSCO database. The literature review search started with a keyword search of *sense of community*. Open Athens/EBSCO data were the first primary source because the database has access to many other databases. Many of the searches resulted in finding many applicable research articles for the study. Along with access to many other databases, Open Athens/EBSCO is a paid resource provided by the American College of Education. Educational Resource Information Center (ERIC) was another database to find key research articles. Google Scholar was used to find new research articles, which referenced relevant research articles. Using Google was limited but was used to find journal articles by Digital Object Identifier (DOI) or title.

### **Key Search Terms**

Finding key search terms originated from the keywords in research articles related to the study. The search terms included the names of the writers in the research articles, along with keywords found in the dissertation inquiry. For the literature review, the following key terms were used to locate research articles: cognitive presence, community of inquiry, gender

differences, gender differences in confidence, the gender gap in math, generational differences, instructor interaction, online learning, school retention, sense of community, servant leadership, social presence, statistics education research, and teaching presence.

### **Review References in Cited Articles**

After finding articles using the keywords, the articles were a starting point in two ways. The first way was to see the sources the writers used in creating the article. Any of the sources which seemed pertinent to the study would potentially be another cited article. From those cited articles, more references were found. The other way the initial articles were used as a starting point was to see which sources used these initial articles as resources. Finding sources who cited the initial articles was done using Open Athens/EBSCO and Google Scholar. When going both directions from the initial source articles, a pattern happened where research articles reappeared, and the number of new relevant research articles diminished. The method was used for each keyword, starting with the initial articles found.

When finding new key references, finding the research articles was done using three methods. The first method was performing a search using the URL or the DOI listed in the article. If the URL or DOI was not listed, then Open Athens/EBSCO was used to search using the title. In a few situations, Open Athens/EBSCO did not work. Then Google was used to find the articles. The articles having important information relevant to the study were purchased if necessary. If the article was somewhat applicable to the study, then the article was not purchased, and other articles were used instead.

### **Review Statistics Education Journals**

Two statistics education journals had many relevant articles for research concerning the sense of community. Most of these articles were published in the *Statistics Education Research*

*Journal* and the *Journal of Statistics Education*. When starting with some articles in each journal, other articles were detected to be relevant for the study.

### **Theoretical Framework**

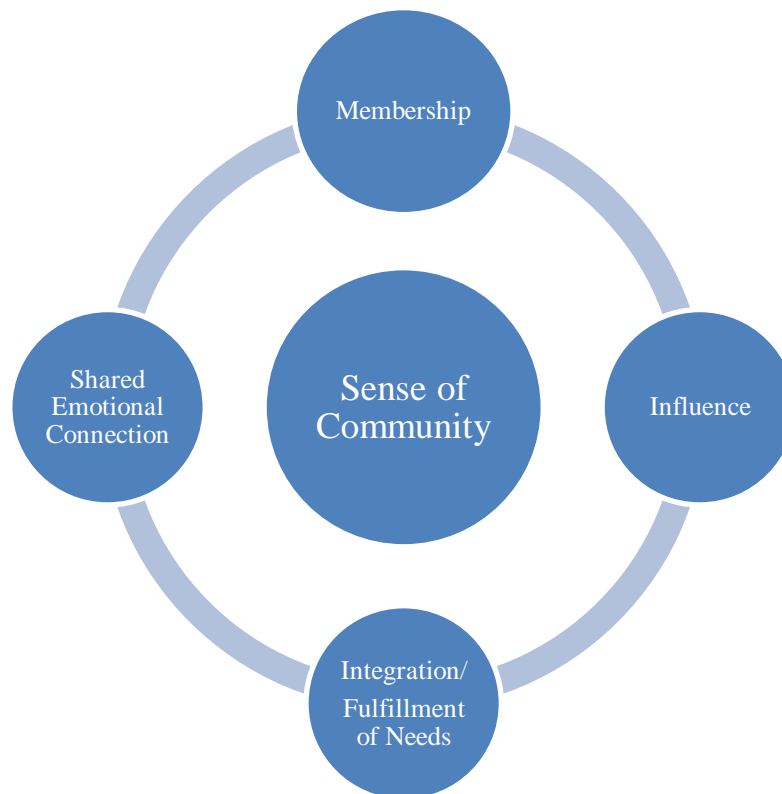
The full theoretical framework for the research in developing the sense of community in an online class were two theories: Sense of Community Theory (McMillan & Chavis, 1986) and Servant Leadership Theory (Greenleaf, 1970). The Sense of Community Theory was the foundational theory of the research. Servant Leadership Theory was the leadership theory, which effectively supported the principles of the sense of community theory.

#### **Sense of Community Theory**

The study was guided by the attributes associated with the Sense of Community Theory (McMillan & Chavis, 1986). Elements from the sense of community include membership, influence, integration/fulfillment of needs, and a shared emotional connection (McMillan & Chavis, 1986). Membership is defined as having an investment one puts as part of a group and having a right of belonging. The trait of membership has five different elements: having boundaries, emotional security, belonging and identity, personal commitment, and a common icon (McMillan & Chavis, 1986). The spirit of membership is the ability of group members to create connections and friendships (McMillan, 1996). With influence, each member should have some impact on what the group cohesiveness should look like and the capability to impact what each member does. Having influence within the group requires trust for each member of the group and trust the group meets the proper goals and outcomes (McMillan, 1996).

Integration/fulfillment of needs means to encourage the strengthening of members in the group. The strengthening of the group members could come by obtaining success for the group and getting help from the capacities and strengths of other members (McMillan, 1996). Shared

emotional connection means the members in the group have had shared experiences, and the experiences have meaning for each member. Each of the four elements of the sense of community theory is interrelated and could build off each other (McMillan, 1996), and the relationship is illustrated in Figure 1.



*Figure 1.* Diagram illustrating the integrated elements of the Sense of Community Theory.

The challenge of building a sense of community has been the need to appreciate diversity when community and diversity have appeared to be competing goals (Townley, 2017).

Considering the philosophy of interdependence, members in the group appreciated differences but understood the need to rely upon and work together with others with completing goals and objectives (Neal, 2017). In the social science aspect, scientists have sought to measure the sense of community in many different areas, such as addressing issues in civic government, tribal communities, digital communities, and education (Chavis et al., 2008).



Recent studies have shown the effects of the sense of community in different cultures and contexts and involve all four principles of the Sense of Community Theory (McMillan & Chavis, 1986). The shared emotional connection of the sense of community appeared to affect the level of acceptance. When evaluating the sense of community with religion, the sense of community was correlated with the level of acceptance. Belonging to the same religion seemed to have a moderating influence on the correlation. While evaluating the dynamic with Christians and Muslims, the sense of community was positively correlated within a religious group but negatively correlated between religious groups (Mana, Sagy, & Srour, 2016).

The integration and fulfillment of needs affected the issue of seeking to eliminate malaria in Africa. In Ghana, the sense of community played an important role in helping in the eradication of malaria. The more a person had a sense of community, the greater chance the person was willing to provide labor, time, and money, in part because of the connection between the sense of community and public trust (Atiglo et al., 2018). When addressing the health of neighborhoods, integration helped where having a sense of community increased feelings of safety, mental health satisfaction, community identity, and civic involvement (Farahani, 2016). Membership was a key role when evaluating people in retirement homes. Having a sense of community was a predictor of the students who volunteered, which meant people were likely to make connections and relationships with each other (Omoto & Packard, 2016).

The influence applied to suicide prevention programs, where participants who felt a sense of community developed relationships of trust with others within the program (Holden, McNeill, Shipley, & McDonald, 2018). The positive aspect of influence helping those with addictions was evaluated to determine who had the greatest likelihood of recovery. Both hope and sense of community were strongly correlated with recovery rates. These results showed the need for

recovery treatment plans to include the sense of community as a factor in the plan (Stevens, Guerrero, Green, & Jason, 2018).

### **Servant Leadership Theory**

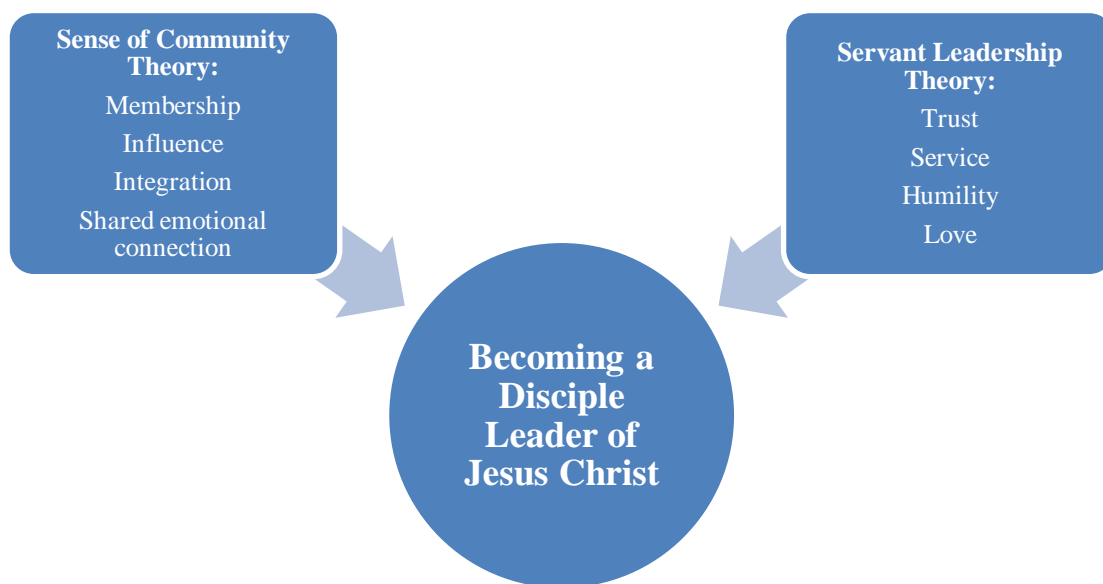
To complete the framework for the research, the study was guided by the theory of servant leadership. If the Sense of Community Theory provides the fundamentals to help build a community, then the Servant Leadership Theory is a positive motivation to build a community. The sense of community was ingrained in the top features of theory originated by Greenleaf (1970) about servant leadership (van Dierendonck & Patterson, 2015). Many of the attributes of Servant Leadership Theory help facilitate the sense of community. Some of these attributes include humility, the ability to empathically listen, building trust, providing service, empowering others, esteeming people, humility, uprightness, unconditional love, and learning (Focht & Ponton, 2015).

Servant leadership could contribute to the motivation and growth of others and to commit to building a positive community (Gandolfi, Stone, & Deno, 2017). This type of leadership starts with a desire to serve first before becoming a servant leader. Having service as a priority could help develop relationships within an organization (Crippen, 2010). With the assumption leaders are made and not born, people have the capacity to learn and provide servant leadership to others (Gandolfi & Stone, 2018). These traits of leadership seem to exemplify what Jesus Christ taught about leading and serving others (Black, 2010). The example and teachings of Jesus Christ on being humble, serving others, and putting the needs of others ahead of personal needs seem to be reflected in the theory of servant leadership (Thompson, 2015). Living the teachings and examples of Jesus Christ has been a primary part of the mission of a university in Idaho, where the research was conducted (Eyring, 2017).

Promoting servant leadership in education provides many different benefits. Applying servant leadership has helped teachers use approaches, which were more active and communal rather than authoritative. Using servant leadership has helped students have feelings of respect and value rather than feelings of marginalization and repression (Fitzgerald, 2015). With servant leadership, teachers have helped students handle the daily challenges and struggles of education. At the school level, using servant leadership has helped provide a positive climate at school (Black, 2010). Along with the general positive school climate, other factors or variables were related to servant leadership. When teachers apply servant leadership in the classroom, indicators of student learning and engagement increased (Noland & Richards, 2015). Having the characteristics of servant leadership helped teachers increase student satisfaction when advising (Paul & Fitzpatrick, 2016).

Applying servant leadership in the online classroom is important because of the issue of students feeling disconnected while taking an online class. Using servant leadership has helped with community building in an online environment (van de Bunt-Kokhuis & Sultan, 2012). When educating students online, using servant leadership has enhanced certain online activities. Some of these activities where servant leadership has worked well included initiation meetings with students, creating group discussions, developing trust with students within small groups, setting-up exercises, and encouraging students to take risks and reach out to others (van de Bunt-Kokhuis & Sultan, 2012). Student satisfaction has been correlated with altruism, healing, wisdom, and organization (Sahawneh & Benuto, 2018). These traits matched with characteristics of servant leadership (Focht & Ponton, 2015). Using these traits of servant leadership has helped one have a greater capacity to improve student enjoyment in an online class (Sahawneh & Benuto, 2018).

Putting together the Sense of Community Theory and the Servant Leadership Theory is the perfect complement and support to help students at a university in Idaho fulfill the primary purpose within the mission statement of the university, which is becoming disciple leaders of Jesus Christ (Eyring, 2017). The four elements of the Sense of Community Theory (membership, influence, integration/fulfillment of needs, and a shared emotional connection) (McMillan & Chavis, 1986) could help students teach and learn from each other (Eyring, 2017). Servant Leadership Theory (Greenleaf, 1970) could help students provide the motivation needed to serve, teach, and learn from each other (Eyring, 2017). Some of these servant leadership traits to promote students serving others include trust, service, humility, and love (Focht & Ponton, 2015). Figure 2 illustrates the connection between the two theories and the primary purpose within the mission statement of a university in Idaho.



*Figure 2.* Diagram illustrating the connection between the Sense of Community Theory and the Servant Leadership Theory with the mission statement for a university in Idaho.

## **Research Literature Review**

More educators at colleges and universities have been creating courses online since the advent of the internet to serve more students at a relatively low cost (Dobbs et al., 2017). Online college courses could someday exceed the number of face-to-face courses (Nash, 2015). Even with the growth of online courses, some educators have been concerned with the effectiveness of online courses compared to campus courses (Nash, 2015). The problem explored in the research study was online classes have been serving more students, but the implications on the sense of community across a mixture of different age groups [Millennials (and older) vs. Generation Z] and different genders were unknown. The purpose of this quantitative quasi-experiment was to determine the possible differences between the levels of age and gender for the sense of community.

Determining the sense of community and the possible results such as attitudes and a sense of belonging could help define the value of the online classes (Serdyukov & Sistik-Chandler, 2015). Along with having valuable online classes with a sense of community, professors at colleges should determine how to address these concerns with diverse groups of students in courses involving such factors as age and gender (Dobbs et al., 2017). The review of the sense of community for the study is divided into five categories: Sense of Community in Education, Sense of Community in Online Education, Sense of Community in Statistics Classes, Differences between Age Groups, and Differences between Genders.

### **Sense of Community in Education**

Applying the theory of the sense of community (McMillan & Chavis, 1986) has reaped benefits in many venues, which include volunteerism, connectedness, hope, and capacity to share more information (Farahani, 2016; Neal, 2017; Stevens et al., 2018). These benefits and others

have been realized when addressing the sense of community in education. Student retention has become a key issue with colleges and universities (Travers, 2016). Having an effective freshman retention policy, which includes increasing the sense of community, has helped students and increased the rate of student success. Many freshmen have had a better chance of staying in school if students have a sense of connection (Tinto, 2007). Reaching out to freshmen has had a positive impact on school performance and a sense of belonging. Performance and sense of belonging were correlated with retention rates and student perseverance (Davis et al., 2019).

Providing a sense of community has helped students have a sense of belonging when starting college and working through the challenges of becoming an upperclassman (VanValkenburg, 2013). With a stronger sense of community and belonging, students have been less likely to depart from school prematurely (Berry, 2019a). The result of developing communities of learning has been increased graduation rates even in challenging majors such as engineering (Ricks, Richardson, Stern, Taylor, & Taylor, 2014). Because of the need to develop a sense of community for college students, particularly for freshmen, faculty have applied digital tools such as YouTube for lectures and Facebook for student collaboration (Ferguson, Brown, & Piper, 2015). Students have had a greater propensity to connect with other students when allowed to use digital tools to make connections (Barczyk & Duncan, 2017).

The sense of community has been found in educational research to be correlated with other positive attributes to help with student education. Gaining strong interpersonal knowledge was related to having a sense of community as well as having the capacity to share knowledge (Nistor, Daxecker, Stanciu, & Diekamp, 2015). Developing a democratic school climate where students had an equal voice in the classroom as teachers and were involved in the policymaking

process helped in developing a sense of community (Karakuş, 2017). In a college biology class, the sense of community was correlated with high achievement and enjoyment (Yapici, 2016).

Even factors outside the classroom have affected students when students have a sense of school community. Karaman and Tarim (2018) found a sense of belonging and community correlated with the general well-being of college students at a university in Turkey. In Columbia Public Schools, students were allowed to develop course syllabi and to make decisions about the course. Students had a stronger sense of community and were empowered in real-life situations (Gomez & Cortes-Jaramillo, 2019). Students who were part of the California Healthy Kids Program were surveyed to assess ways to develop prevention and intervention. These students participating in the California Healthy Kids Program who felt strong teacher support and sense of community had the feeling of being safe (Lenzi et al., 2017)

Encouraging a sense of community has provided benefits to traditionally marginalized students. Having a sense of community has worked for rather than against marginalized students. A sense of community brought context to the cultural experience of each student in an urban high school where students believed each student was part of one big community or family, which helped students have a sense of cultural wealth (Gosine & Islam, 2014). Even at an infant stage of building community, urban multicultural schools provided benefits to the educational community. Building a strong community with marginalized students required leadership, patience, strong connections, and addressing change (Watson & Bogotch, 2016). Creating a sense of community, such as teachers mentoring females at an African American college, helped these students believe college was a safe environment, which allowed the students to persist (Booker, 2016).

A strong sense of community has benefitted traditionally marginalized students because of the support these students could receive from peers. The sense of community was strongly correlated with student agreement with the mission of the university to promote social justice and activism (Torres-Harding et al., 2015). Developing learning communities for freshmen in college helped to develop greater leadership and multicultural competence (Soria & Mitchell, 2015). Encouraging integration in social and academic activities was key to creating a sense of community and belonging, especially with international students (García, Garza, & Yeaton-Hromada, 2019).

### **Sense of Community in Online Education**

If encouraging the sense of community is significant for education, developing a sense of community in online courses could be more significant (Phirangee, 2016b). Students could not be as connected to others in an online class. Getting a better understanding of student expectations and encouraging a greater sense of community have helped students to form greater connections (Blackmon & Cullen, 2016). Despite the growing popularity of online learning in higher education, distance education often has suffered from high dropout rates, which have been credited to the physical separation of students. Such separation has tended to give rise to feelings of isolation and disconnection (Phirangee, 2016b). Developing a sense of community online encouraged students to make relationships with fellow students (Oliphant & Branch-Mueller, 2016), which helped diminish ideas of isolation. Creating a significant sense of community online promoted retention and student learning. Students have learned and were retained because of having a sense of belonging, feeling important, having similar values, and having common goals (Beeson et al., 2019; Wu et al., 2017). Having a sense of community



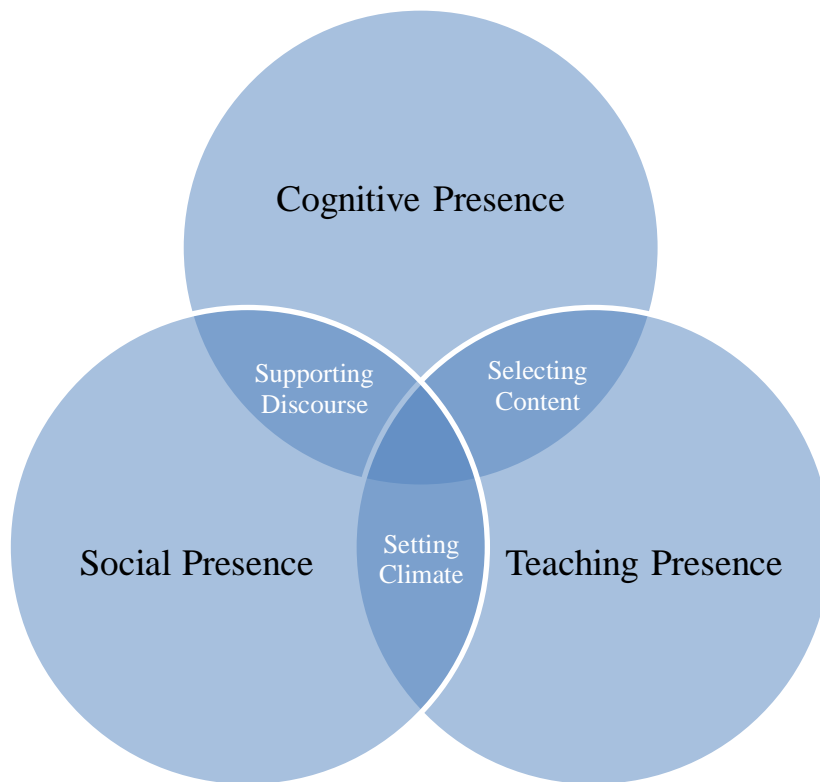
required educators to facilitate the sense of community at every stage of the course (Aydin & Gumus, 2016).

Studies from different online venues have shown the online sense of community was correlated with different factors. When analyzing two undergraduate courses in Turkey, the sense of community, along with self-efficacy, strongly predicted sharing behaviors. (Ergün & Avci, 2018). In an online graduate course, Trespalacios and Perkins (2016) determined perceived learning correlated with a great sense of community. Perceived learning and a sense of belonging helped with an improved sense of community in an online college course (Diep, Cocquyt, Zhu, & Vanwing, 2017). For an online undergraduate course, Spohn (2016) found the sense of community positively correlated with perceived learning while the sense of community negatively correlated with perceived incivility. With an online doctoral program, Byrd (2016) found the sense community was related to online student engagements as well as helping students overcome stress in difficult situations.

When students belong to the same culture, Spohn (2016) found students had a strong sense of community in an online class. With students from different cultures, the results concerning the sense of community were mixed (Spohn, 2016). Sense of community and cultural diversity had a negative association with each other and seem to be two competing issues (Spohn, 2016). Promoting interdependence could bridge the two issues and help with learning in the online environment (Neal, 2017). Establishing online learning communities to promote connectedness has had a significant democratizing effect to benefit students from all cultures (Blayone, van Oostveen, Barber, DiGiuseppe, & Childs, 2016). Creating an environment to promote the sense of community could benefit all students (Byrd, 2016).

When evaluating prior research concerning the development of the online sense of community, three general themes emerged: social presence, cognitive presence through experiential learning, and teaching presence (Dunlap, Verma, & Johnson, 2016). These types of presence are part of the community of inquiry model and go together to promote a positive online educational experience. To build a strong online class, an instructor should consider the social presence of both the instructor and the students, which have been important for students to have a sense of community (Dunlap et al., 2016). Several studies found the benefits of all three types of presence to encourage the sense of community.

Oliphant and Branch-Mueller (2016) found in a master's degree program, the sense of community, was affected positively by building relationships, effective project structure and content, and initiation into the program. For another graduate program, Wendt and Nisbet (2017) discovered having a sense of community with all three presences in the community of inquiry model were related to course grades and perceived learning. Having a sense of community was found to be statistically similar between campus and online classes (Kaur, 2016; Wiest, 2015), but educators should provide a greater instructor presence and promote student-centered learning and participation in an online class (Kaur, 2016). Figure 3 reveals how the three types of presence interact with each other to create a complete educational experience. Teaching and cognitive presence help with the selection of content for the course. Social and teaching presence help with setting a proper educational climate. Cognitive and social presence encourage discourse for students and teachers (Dunlap et al., 2016).



*Figure 3.* Diagram demonstrates the Community of Inquiry model. Adapted from “Presence+Experience: A Framework for the Purposeful Design of Presence in Online Courses,” by J. C. Dunlap, G. Verma, and H. L. Johnson, 2016. *TechTrends*, 60, p. 146.

**Student Interaction.** Creating a social presence has been one of the biggest issues in an online class. Students interacting with others could provide more social presence (Cunningham, 2015). The process of creating a social presence, according to Laing and Laing (2015), involves four different elements: initiation, developing social relationships, the sense of community, and increased enjoyment and retention. Many online teachers have put students into groups to create a social presence. When students have strived to work together to reach goals, the team likely has experienced the five phases of team development, which are forming, storming, norming, performing, and adjourning (Warrick, 2016). To help with the five phases of team growth, online educators could provide a social discourse for students to start the course by providing an initiation meeting. In a study with online college students, Lowenthal, Dunlap, and Snelson

(2017) found having optional synchronous meetings at the start of the class helped students have a good first impression of the course and started building trust with others within the course. After the first meeting, online instructors held informal social meetings using digital tools like Zoom to build from the initial trust (Lowenthal et al., 2017).

Studies from different online venues have shown the social presence was correlated with different factors. At an undergraduate college, creating an interactive and collaborative environment in developing the sense of community helped with overall online learning (Serdyukov & Sistek-Chandler, 2015). In an online nursing program, DeCelle (2016) found having a strong social presence was strongly related to a sense of community as well as perceived learning. For a midwestern community college, Cunningham (2015) found more interaction between teachers and students provided a great social presence in an online class.

Online teachers have played a significant role in developing a sense of community. Teachers have facilitated online forums with quality questions to develop a sense of community (Mohamad & Shaharuddin, 2014). When creating effective online discussions, teachers have put students into smaller groups for group discussions and showed examples of how to have effective group discussions (Kebble, 2017). Johnson (2017) found teachers using collaborative learning and social exchanges with students were effective in engaging students with learning. To help teachers better understand the positive effect of creating an online sense of community, teachers have created a community of fellow teachers by discussing key issues happening in the online classes (Ferencz, 2017).

In promoting a sense of community, several methods have emerged as being effective and correlated with positive educational indicators. When performing a meta-analysis of determining effective collaborations, having a mixture of informal discussions and anchored

discussions both within a week and throughout the semester created camaraderie between the students and provided deep learning discussions (Gao, Zhang, & Franklin, 2013). Creating and building a sense of community throughout the course was done using introductions, sharing experiences, having class discussions, and exchanging resources. All of these methods were strong predictors for creating a sense of community (Shackelford & Maxwell, 2012). Along with these predictors, online faculty could encourage students to take formative assessments together. A collaborative assessment has shown to give students an opportunity to strengthen and help each other (Fenrich, Carson, & Overgaard, 2018). Applying constructivist methods, students could have student-centered, collaborative projects to build learning in groups and encourage a sense of community and communication (Covelli, 2017).

Even with positive methods to promote a sense of community, online student interactions could weaken the sense of an online community. Some of these attributes have included students who dominate discussions, support arguments with a lack of data and citations, get into digressions, and exclude fellow students from different cultures (Phirangee, 2016b). Listening to and being thoughtful of others from different backgrounds and cultures has been a key impact when helping students to have a sense of community (Kayumova & Sadykova, 2016). A method to help students develop an understanding of people from different cultures and create a sense of community has been to form diverse groups during the initiation of the class and then through collaborative learning activities throughout the semester (Metro-Roland, 2018).

To complement methods to promote the sense of community, online teachers have encouraged students to use online digital tools to enhance the online learning experience. Digital tools, like WebTools 2.0, have shown to be effective in promoting the sense of community (Basko & McCabe, 2018). Using WebTools 2.0, students could share personal experiences and

could use the tool for effective time management to help create a sense of community (Basko & McCabe, 2018). Students have enjoyed using WebTools 2.0 digital tools, like Google collaboration tools, to create and develop group assignments (Peacock & Grande, 2016). Using video conferencing and video/audio discussions for student interactions have been effective in improving the online sense of community (Haar, 2018). Applying digital tools in an online class tended to enhance student creativity. By finding and applying the right digital tools, students were encouraged to become more creative in completing assignments (Nepo, 2017).

Some online courses have been using social media, like Facebook and Twitter, to create an online social presence and an online sense of community when having extracurricular activities (Berry, 2019b). Kocdar, Karadeniz, and Goksel (2018) found those in Facebook groups had a greater sense of online community than those who were not in Facebook groups in an online college course. The usage of Facebook has provided a benefit to promote a sense of community in a few different areas. A few sense of community benefits found included having group practices for classes (Francescato & Mebane, 2015), creating consensus (Kornbluh, Neal, & Ozer, 2016), having deep and social learning experiences (Mnkandla & Minnaar, 2017), increasing deeper learning and motivation (Hussain, 2018), and accessing instantly multiple sources of learning (Hussain, 2018). Based on a study of university students, most students have used particular social media based on the most used platforms, such as Twitter or Facebook (Bekdemir & Tađrıkulu, 2018), and online faculty should be mindful of the changing popularity of social media platforms. Even with the greater use of social media in the online classes, online faculty and developers should exercise caution. Academic achievement has been shown to be inversely related to social media usage (Bekdemir & Tađrıkulu, 2018).

**Experiential Learning.** Along with providing teacher and student presence, finding effective ways to engage the students with the material has been important for helping students have a sense of community (Phirangee, Epp, & Hewitt, 2016). An effective way to engage students has been to provide opportunities for students to have experiential learning. Dunlap et al. (2016) investigated the combination of experiential learning with presence. Having experiential learning could provide an online course design with purpose and could help develop a community of online learning.

Online classes have applied experiential learning in a variety of ways to help create a sense of community. In a doctoral program taught online, combining discussion forums with projects helped students connect and create a sense of community (Breitenbach, 2019). For pre-service social studies teachers, instructors taught technology learners on appropriate uses by having authentic experiences while learning new technological tools (Önger & Çetin, 2018). Using constructivist theories to develop a sense of community with adult learners helped with student-centered collaborative projects (Covelli, 2017). Teachers and students have shown authentic examples of data science and statistics to encourage innovation and teamwork (Sutherland, Davis, Terton, & Visser, 2018). Even providing virtual real-world situations using immersive learning environments helped to create a sense of online community in a college course (McClannon, Cheney, Bolt, & Terry, 2018).

To enhance experiential learning, online teachers could use several methods to increase the sense of community. Online teachers could assign students roles in group projects to help the students effectively engage with each other in the project (Wicks et al., 2015). When bringing in novice online instructors, new teachers should have real-life training before instructing the courses online (Luo, Murray, & Crompton, 2017). Some of the learning should have field

experience where instructors work with experienced teachers in an online class setting (Williams & Casale, 2015).

**Teacher Presence.** Instructors engaging with students have helped to create a sense of community, which helped promote outcomes, deepen learning, and improve the overall online experience. Students with a greater sense of community believed these students had more access to the teacher and had a greater appreciation for the class (Phirangee, 2016a). To develop teacher presence, teachers could design the course to promote access to all types of students. Using methods such as Universal Design for Learning (UDL) has encouraged student access to knowledge and a sense of community within the course (Al-Azawei, Parslow, & Lundqvist, 2017).

With an effective design as a backdrop, teachers should begin building a sense of community at the start of the semester. Building a rapport with students has been important in creating a sense of community (Ratliff, 2018). Online teachers who apply technology effectively could give a welcoming tone by engaging in personal learning experiences (Berry, 2017). One of the first activities could be an initiation activity to help break down emotional barriers between a teacher and the students (Bixby, 2016). Initiation activities could encourage developing relationships to create a sense of community.

After the initiation process, improving relationships and having group projects and discussions have helped students gain a stronger sense of community (Oliphant & Branch-Mueller, 2016). Phirangee et al. (2016) found teacher-led discussions and collaborations perform better for developing connections and the sense of community than student-led discussions and collaborations. Because of the positive influence on building a community, teachers could take time to encourage individual students, develop extra scaffolding in the early



stages of the course, and assess each student on the ability to perform collaborative group work (Robinson, Kilgore, & Warren, 2017). Gradually teachers could help build a community online by reaching out to all students regularly, limiting the amount of time lecturing, creating interactive videos to engage students, and allowing time for each individual to provide personal and professional updates (Berry, 2019a). When engaging students individually, online teachers could skillfully answer questions to engage the students to promote the sense of community (Jackson, 2019). To effectively answer questions, teachers should facilitate the discussion, listen, and then effectively engage and ask questions (Lloyd, Kolodziej, & Brashears, 2016). Online teachers could make engagement more effective by providing personalized feedback through video, text, or audio (Pollard, Minor, & Swanson, 2014).

To support teacher presence in an online class, teachers could use digital technology to improve the sense of community. More online teachers have been using interactive video tools to develop a sense of community. Delmas (2017) discovered the use of VoiceThread, an interactive video tool, has created a positive sense of community. VoiceThread has helped students have a sense of teacher presence and has humanized the teacher. Along with teacher presence, VoiceThread provides an effective way to promote social and cognitive presence (DeNoyelles, Zydney, & Chen, 2014). The use of VoiceThread could help students build rapport with each other at the start of the semester under the direction of an instructor. After using VoiceThread earlier in the semester to build social presence, an online instructor could create more traditional discussion assignments geared toward addressing the learning outcomes of the course (Gao et al., 2013).

Different studies addressed other digital tools to promote teacher presence. Raspopovic, Cvetanovic, Medan, and Ljubojevic (2017) found online instructors could create a social

presence through the usage of social media such as Twitter, Facebook, LinkedIn, or Google Hangouts, to encourage collaboration and a sense of community. One study from a college in Turkey found using Khan Academy in a flipped classroom setting helped improve student learning and achievement in a calculus class. The Khan Academy website could help teachers evaluate growth and give feedback. Using Khan Academy has helped retain students in class by using the website to motivate student engagement (Zengin, 2017). When teaching an asynchronous course, Ice, Curtis, Phillips, and Wells (2019) found using audio feedback on assignments decreased psychological distance and increased teaching presence. While working with any technology, online instructors should create a caring atmosphere and consistent communication when working with students (Robinson et al., 2017).

### **Sense of Community in Statistics Classes**

Promoting a sense of community could be helpful to undergraduate introductory statistics courses given many students have had negative experiences and attitudes about statistics (Songsore & White, 2018). Garfield (2013) believed using collaborative learning while learning statistics is an effective way to help students have a better experience taking a statistics class. When using collaborative learning, students have been more capable of stating statistical terms, having deeper discussions on statistical interpretations, and having more engaging discussions with other students. Collaborative learning could not only help students with statistical skills but help students work more successfully in teams and develop a capacity to be more effective problem solvers (Björnsdóttir et al., 2015). Learning in a group could help students learn actively, improve motivation, and enjoy discovery learning.

Understanding the effectiveness of collaborative learning has been developing in the field of statistical education. Garfield (1993) originally addressed team learning in small groups

in the face-to-face classroom. From the original research, others have addressed students working together with positive results. Giraud (1997) evaluated the difference between two different types of classes, which focused on building a community compared to those who did not focus on building community. Overall, test scores were better on average when students were building a community using collaborative learning. Even in a larger classroom, Magel (1998) found building community in the large classroom using cooperative learning improved overall test scores. To determine if community learning had any impact on exams in a community college social science statistics class, Kapitanoff and Pandey (2018) found students completing collaborative exams did better than students who worked on the exams individually.

To build from promoting a sense of community in the face-to-face classroom, Everson and Garfield (2008) addressed the strengths of using collaborative learning in the online environment. Using collaborative learning in the online setting helped to promote a greater disposition for students to work on problems, provide deeper discussion, and provide a greater way for online teachers to see any misunderstandings with the statistical concepts. Comparing students in face-to-face classrooms, flipped classrooms, and online classrooms where the first two modalities used collaborative learning, Gundlach, Nelson, Richards, and Levesque-Bristol (2015) found students in collaborative community settings had significantly higher results on average in attitudes and scored higher on average in exams. Björnsdóttir et al. (2015) found no statistical differences in performance between consensus versus nonconsensus collaborative exam groups, but collaborative exams had a positive influence on attitudes toward statistics.

### **Differences between Age Groups**

The first factor to consider in assessing the sense of community was the needs of two different groups of students taking an online class based on age. Online classes typically have

had two different groups of students, which are older-adult students (Millennial students or older) and traditional campus students (Generation Z Students). Generation Z students are students who were born in 1995 or later. Students in the other age group were born before 1995 (Vallone et al., 2016). Meeting the needs of both older and younger students has been important to consider when addressing the needs of both groups of students concurrently. Older students generally have had different social factors influencing possible learning styles compared to Generation Z students (Proflumadue, 2014).

Older-adult students have been usually more self-directed, more independent, apply prior experience, and have required less structure from the teacher (Allen, 2016). These older students have used prior experience (Howell et al., 2016), which have helped these students to be more autonomous and self-directed in learning (Zipp et al., 2017). Applying these adult learning characteristics using student-centered and self-directed methods proved to be beneficial in acquiring skills and learning (DeCelle, 2016). Many older students have been flexible and have wanted to achieve accomplishments alone and have tended to work independently given the schedules these older-adult students have had (Blaschke, 2012). In trying to build knowledge from prior experience, older adults have been typically highly-motivated learners (Howell et al., 2016).

Generation Z students typically have preferred learning in groups and being regularly active and engaged (Ebert, 2016). Younger students have wanted greater care from teachers and fellow students (DeAngelo, 2014). Teachers have had concerns about low retention rates and have found the student and instructor interactions have aided with student retention (Romsa et al., 2017). Because of the need for both teacher and student engagement, Generation Z students have had a greater need for coaching and feedback (Proflumadue, 2014). Student engagement

quite often has included the use of the latest technology for the classroom (Romsa et al., 2017). These younger students have had an increased ability compared to older students to understand visual imagery and have been more adaptable to the latest updates in technology both in and out of the classroom (Loveland, 2017). Even with the ability to adapt quickly to technology, Generation Z students typically have needed a more clear course structure and scaffolding in learning (Yoders, 2014).

When examining attitudes while taking a statistics class, older students generally believed statistics was harder than what younger students believed (Zhang et al., 2012). Even with the perceived difficulty in understanding statistics, older students were less anxious to ask questions about concepts when taking the statistics class online (Zimmerman & Austin, 2018). Older students tended to perform better in mathematical reasoning compared to younger students (Erdem & Soylu, 2017). The difference in mathematical reasoning due to generations seemed to diminish when taking a mathematics class online. Older students performed significantly better in a traditional algebra class, but the difference diminishes when students take the same algebra class online (Amro, Mundy, & Kupczynski, 2015).

### **Differences between Genders**

A second factor to consider when addressing the sense of community was the different genders. Each gender has had researched characteristics when taking an online class as well as taking a math/statistics class. Within online classes, more females than males believed online classes have had a sense of good community and were less results-based. More males than females believed campus courses have had a sense of good community and were less-results based (Yang et al., 2015). Having prior online experience mattered more to males than females,

where males were more comfortable taking an online class after having prior online experience (Dobbs et al., 2017).

Another key issue was how males and females were self-regulated while taking an online class. Females had greater self-regulation and online study habits than males (Chumbley et al., 2018). Even with a greater sense of community and more self-regulation, females were less confident in taking mathematics classes, and more females dropped out than males (Ellis et al., 2016). Part of the issue could be males typically have performed better with mathematical reasoning than females before beginning college (Erdem & Soylu, 2017).

Another part of the drop out concern could be due to gender bias, which favors males (Yang et al., 2015). The gender bias could be a reason why many females have had greater feelings of safety and have had a better sense of community in an online class (Yang et al., 2015). Given females have performed better in class when females have had a greater quality and quantity of interaction, considering the need to build a community online could help bridge the gender gap in mathematics and statistics (Kapitanoff & Pandey, 2018). A difference appeared to exist in attitudes toward statistics between genders. In introductory statistics classes, females had lower attitude scores than males (van Es & Weaver, 2018). When evaluating anxiety across delivery methods and gender, females taking statistics classes online had the highest level of anxiety on average (S. Hedges, 2017). These results gave evidence concerning the need to help improve the ability and confidence in statistics in female students, particularly in an online class (van Es & Weaver, 2018).

### **Opposing or Contradicting Points of View**

The research revealed some contradicting or opposing results when evaluating the sense of community at the general level and the age/gender level. Even if the sense of community was

correlated with perceived learning in one study, the sense of community was not correlated with achievement (Trespacios & Perkins, 2016). With the issue of gender, most research found females had greater negative attitudes concerning statistics and lower confidence in mathematics/statistics, but a greater sense of community when taking math/statistics class online. Some studies found no statistical differences between gender in the sense of community. In a medical class, Lewis, McVay-Dyche, Chen, and Soto (2016) found no statistically significant differences in the sense of community between gender. Wighting (2011) found no statistically significant differences between gender for the sense of community as well as perceived learning for alternative license candidates. Chung (2018) found no statistically significant difference in community engagement between gender in an undergraduate program in Malaysia.

With the issue of attitudes across gender, Aslemand (2018) found no statistically significant differences in attitudes between women and men in a social science introductory statistics course. Even if dissimilarities in learning math exist between gender, Nollenberger, Rodríguez-planas, and Sevilla (2016) found the different levels of understanding math were more a cultural issue rather than a gender issue. When comparing gender differences of Chinese students in the United States, no differences were found in math performance and supports the evidence of culture affecting gender differences (Tsui, Xu, Venator, & Wang, 2016). The older a person was, the person generally was more independent when taking a class, and had less sense of community. A couple of studies contradicted this conclusion. In a social work program, age was not a factor in building a sense of community (Wiest, 2015). Schwieger and Ladwig (2018) found Generation Z students were independent and willing to perform to tasks alone based on a meta-analysis, even if many studies found Generation Z students to be more group-minded.

### **Gaps in the Literature**

Developing a sense of community in an online environment has been shown to help the students become less isolated (Oliphant & Branch-Mueller, 2016) and more engaged in learning the material in class (Phirangee, 2016a). Educators have used teacher presence, experiential learning, and social peer presence to improve the sense of community and student satisfaction in an online course (Dunlap et al., 2016). Assessing the sense of community in an online statistics class was a gap in the literature (Björnsdóttir et al., 2015; Phirangee, 2016b). Evaluating the sense of community while comparing differences across different age groups (DeAngelo, 2014) and genders (Yang et al., 2015) was another gap to address, which could help provide further information toward improving online statistics courses.

### **Literature Review Summary**

The literature review provided a background on the research for the sense of community, particularly in an educational environment, while taking a statistics course. The research was based on the Sense of Community Theory (McMillan & Chavis, 1986) and the Servant Leadership Theory (Greenleaf, 1970). Sense of Community Theory has four different aspects to consider when addressing the sense of community in an educational setting: membership, influence, integration/fulfillment of needs, and a shared emotional connection (McMillan & Chavis, 1986). These sense of community factors have been studied in many different venues, including government agencies, private industry, schools, and internet communities (Chavis et al., 2008). Student satisfaction was correlated with altruism, healing, wisdom, and organization (Sahawneh & Benuto, 2018). These traits matched with characteristics with servant leadership (Focht & Ponton, 2015). Applying these traits of servant leadership has provided a great capacity to improve student satisfaction in an online environment (Sahawneh & Benuto, 2018).



Applying the theory of the sense of community (McMillan & Chavis, 1986) has reaped benefits in many venues, which provide other benefits such as greater volunteerism, feeling included, feeling connected, providing hope, and greater sharing of information (Farahani, 2016; Neal, 2017; Stevens et al., 2018). These benefits and others could be realized when addressing the sense of community in education. Because college retention has been a key issue, helping students have a sense of belonging and being connected could help toward student retention (Travers, 2016). The sense of community could help students with momentum as students move through each class rank before graduation (Davis et al., 2019).

If encouraging the sense of community has been significant for education, developing a sense of community in an online educational environment could be more significant (Phirangee, 2016a). Students could not be as connected to others in an online class, and getting a better understanding of student expectations and encouraging a greater sense of community could help improve student connectedness (Blackmon & Cullen, 2016). When evaluating prior research concerning the development of the online sense of community, three general themes emerged: social presence, cognitive presence through experiential learning, and teaching presence (Dunlap et al., 2016). These types of presence are part of the community of inquiry model and go together to promote a positive online educational experience. For each part of the community of inquiry model, several different methods, tools, and variables were explored, connecting the ability to increase the sense of community in an online environment. Developing a sense of community has been explored in statistics classes, both face-to-face and online classes. Most of the research in building a sense of community dealt with collaborative peer learning (Björnsdóttir et al., 2015; Gundlach et al., 2015).

The literature review addressed two key variables to consider in building a sense of community: the age of student [Generation Z students and millennial students (or older)] and gender. Generation Z students have been typically students who like peer and teacher support and like working in a community (DeAngelo, 2014), where millennial students (or older) have preferred working independently (Allen, 2016). Most evidence revealed male students have had greater confidence and attitudes in mathematics/statistics (Erdem & Soylu, 2017; van Es & Weaver, 2018), but female students have had a greater sense of community in an online environment (Yang et al., 2015). Based on the literature review, a couple of gaps emerged, which are assessing a sense of community for an online statistics class and evaluating the sense of community with an online statistics class within a mixture of different ages and gender in an online class. The study contributes to the knowledge base by assessing the sense of community for an online class and how age and gender influence the sense of community. The literature review in Chapter 2 provided a basis for the methods listed in Chapter 3 for the research. Chapter 3 addresses the methodology, data collection, and analysis used for the quasi-experimental design along with strategies addressing validity, reliability, and objectivity.

### Chapter 3: Methodology

Assessing the sense of community and the possible effects of the sense of community could help determine the quality of the online course (Serdyukov & Sistik-Chandler, 2015). Along with having a quality course with a sense of community, educators at colleges and universities should address how to assess these issues with different types of students in classes involving such factors as age and gender (Dobbs et al., 2017). The purpose of this quantitative quasi-experiment was to determine the possible differences between the levels of age and gender for the sense of community. The study was necessary to assess the sense of community for different types of students working together in the online class. If results from the survey concerning the sense of community were different between the different age groups and gender, then the results would have indicated the course was not serving some groups as effectively as others. Not conducting research could limit the understanding of how well the professors of the mathematics department at a university in Idaho are serving different types of students, an understanding which could help toward improving instruction for a diverse group of students.

#### Research Questions

The study investigated the sense of community in an online statistics class at a university in Idaho across different age/gender groups. From the problem and purpose of the study, three research questions were created. The following research questions guided the study:

**Research Question One:** Does a statistically significant difference exist in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho?

**Research Question Two:** Does a statistically significant difference exist in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho?

**Research Question Three:** Does a statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) exist on the sense of community scores in the online introductory statistics course at a university in Idaho?

### **Hypotheses**

To perform the statistical tests for research questions, each research question required a set of hypotheses. For the study, the hypotheses were derived from the research questions. The three research questions were addressed by the following hypotheses:

$H_{10}$ : A statistically significant difference does not exist in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho.

$H_{1\alpha}$ : A statistically significant difference exists in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho.

$H_{20}$ : A statistically significant difference does not exist in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho.

$H_{2\alpha}$ : A statistically significant difference exists in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho.

H3<sub>0</sub>: A statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) does not exist on the sense of community scores in the online introductory statistics course at a university in Idaho.

H3<sub>α</sub>: A statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) exists on the sense of community scores in the online introductory statistics course at a university in Idaho.

The research was in the form of an applied quasi-experimental study on an online introductory statistics course at a university in Idaho, assessing results from a sense of community survey (Chavis et al., 2008). Students completed the survey at the end of a semester of course work, and data analysis was done the semester afterward. Generation Z students are students who were born in 1995 and later. Those in the other age group students were born before 1995 (Vallone et al., 2016). Data gathering, managing, and analysis tools included Qualtrics, Excel, and the statistical software R. The major sections of Chapter 3 include Research Design and Rationale, Research Procedures, Data Collection, Data Analysis, Reliability and Validity, Ethical Procedures, and Research Summary.

### **Research Design and Rationale**

A quantitative quasi-experimental analysis was performed for an online introductory statistics course. To assess the sense of community, the study used a survey (Chavis et al., 2008) while students learned statistics. Students took the sense of community survey at the end of the semester to assess the sense of community. Possible differences could be found between gender and age with the sense of community. A quantitative method was used over a qualitative method because of the ability to generalize and compare results from different types of populations (Creswell & Creswell, 2018). Because the research was from a quasi-experimental study and not

from an experiment, the study could not determine any causation between gender and age with the sense of community. A quasi-experimental design was better in the study compared to other quantitative designs because the design had factors not randomly assigned to the subjects given the inherent nature of the subjects (like gender and age) but could assess differences across the levels of each factor based on the dependent variable in the survey.

Determining statistically significant differences in the mean sense of community scores between gender and age groups was the purpose of the study, and comparing the means between variables was required (Creswell & Creswell, 2018). Performing the analysis involved a dependent variable and two independent variables where the two independent variables were age and gender. The dependent variable involved the composite score from the sense of community survey where the composite score came from questions assessing the four different sense of community attributes, including reinforcement of needs, membership, influence, and shared emotional connection (Chavis et al., 2008). If there were statistically significant differences in the average sense of community scores between gender and/or age, the differences would show the course was not effectively meeting the sense of community needs equally across the gender and age categories (Sullivan, 2016).

The research design of the quantitative quasi-experimental aligned with the recommendations given by Creswell and Creswell (2018). A quantitative quasi-experimental design had factors not randomly assigned to the subjects given the inherent nature of the subjects but could assess how well the factors predict the dependent variable. Having students from each age/gender combination could help determine possible differences between age groups, possible differences between gender, and possible interactions between age and gender (Sullivan, 2016). An interaction between age and gender exists if the change in means scores between genders in

one age category is unlike the change in mean scores between genders in another age category (Sullivan, 2016).

Time and resource constraints involved the administration of the student survey, which only took place during one semester. One semester was enough given the sample size of 465 students, and reviewing results during multiple semesters should give similar survey results between different groups based on age and gender. The chosen research design was appropriate based on recommendations from Creswell and Creswell (2018) and Sarma and Vardhan (2019) because the design could be used to assess nonrandomized factors contributing to the sense of community variable. The design could help assess how well age, gender, and the interaction of age/gender are effective in predicting the sense of community. With results from the study, the professors of the mathematics department at a university in Idaho could assess possible needed changes to help improve student inclusion to help promote improved student experience and performance in the course.

### **Research Procedures**

To apply the research design, data were collected based on a proposed population definition, sample selection, and instrumentation. Defining the proper population, sample, and instrumentation was key to making a proper inference. These sections include the proposed population, sample selection, and the instrument to assess the sense of community (Creswell & Creswell, 2018; Sarma & Vardhan, 2019; Sullivan, 2016).

### **Population and Sample Selection**

The population was all students taking the online introductory statistics class. During the Winter semester 2020, the sample of 465 students was taken from the online introductory statistics sections (D. Balls, personal communication, February 18, 2020). When the study took

place, the potential sample was of similar size. Using G\*Power (Heinrich Heine Universität Düsseldorf, 2020), a sample size of 231 was required for the study to be valid given the parameters of performing the two-way ANOVA along with the level of significance equal to .05, a power equal to 0.90, the number of groups equal to four, and the effect size equal to 0.25. All the students taking the online course were part of the potential sample in the winter semester 2020, and students who were part of the study in the online course were ages 18 and older. For the sampling design of the research, the data from all the students in the study were used for the analysis. Students potentially were involved in the sample by registering for the online introductory statistics class. Recruitment of online students fulfilled the Health and Human Services Code of Federal Regulations for exempt research in education (USDHHS, 2018).

Students were given notification to take the survey about one week before taking the survey advising the students of an opportunity to help improve the course and for students to receive extra credit. To protect the rights of students, students were given clear informed consent at the start of the survey. The information in the informed consent stated the following: (a) the information of the student was protected; (b) the data were protected by not asking for identifiable information; and (c) the study addressed how the data could benefit assessing the sense of community (Prinsloo & Slade, 2016). As part of the survey, students were asked for gender and age, but the students were not asked for names and other personally identifiable information to ensure the students remained anonymous.

All the data were gathered using a Qualtrics survey instrument. Qualtrics is an online digital tool where: (a) surveys were created, (b) students filled out the survey, and (c) the data from the survey were stored in a retrievable database for analysis. In the learning management system (Canvas), students had access to the survey in Qualtrics. On a Canvas page, students



were notified of an informed consent at the beginning of the survey in Qualtrics and were notified of the opportunity after the informed consent to agree to allow the data of the student from the survey to be a part of the dissertation research. To obtain extra credit points (extra credit for the survey was worth 0.5% of the final grade), the students needed to complete every question in the survey. Getting extra credit showed a benefit to the student rather than a burden of being forced to complete the survey (McInroy, 2017). The introduction and informed consent were presented at the beginning of the survey in Qualtrics and were checked for readability, where the informed consent had simple words and short sentences (Antonacopoulos & Serin, 2016). A student could have chosen to complete the survey but could have marked “no” in the informed consent portion of the survey, and the data were not used in the study even if the student completed the survey for extra credit.

### **Instrumentation**

The study used a dependent variable coming from the Sense of Community Index 2 (SCI-2) (Chavis et al., 2008) (see Appendix A). SCI-2 had a total of 24 questions and four different sense of community subscales: reinforcement of needs, membership, influence, and shared emotional connection. Questions in the survey were closed-ended multiple-choice questions and had a scale from zero (Not at all) to three (Completely). Each of the subscales was based on six survey questions each. For each respondent, the scores were summed across all 24 questions (scores ranging from zero to 72) (Chavis et al., 2008). The summed composite score from the SCI-2 survey was continuous and was the dependent variable for the analysis. Age and gender (1) were asked in the survey, (2) were the independent variables for the analysis, and (3) were allowed to be included as part of the survey (D. Chavis, personal communication, February 14, 2020).

The reliability of the instrument had a coefficient alpha of 0.94. For each subscale, the reliability ranged between 0.79 and 0.86 (Chavis et al., 2008). Analyses from previous studies have shown the survey is a strong predictor of sense of community and the survey instrument is valid (Chavis et al., 2008). SCI-2 was an appropriate instrument to use in the study to assess the sense of community across all students and within each age/gender group for an online class. The SCI-2 instrument has been used in many different countries and cultures in Asia, in North American, in South America, and in the Middle East. The survey has been used in several contexts, including the workplace, schools, internet communities, clubs, and universities (Chavis et al., 2008).

### **Data Collection**

The SCI-2 (Chavis et al., 2008) questions were put into Qualtrics, which contributed toward the dependent variable of the study. A week before students were allowed to complete the survey, students were notified via email from the teachers of the opportunity to complete the survey for extra credit and help the university improve the online statistics course for future students. When the survey was available, students were provided a link to the survey within the learning management system (Canvas). On a Canvas page, students were notified of an informed consent at the beginning of the survey in Qualtrics and were notified of the opportunity after the informed consent to agree to allow the data of the student from the survey to be a part of the dissertation research. Students completed the survey in Qualtrics at the end of the semester.

As part of the survey, students recorded both the age and gender of the student, which were the two independent variables or factors in the analysis. Students did the survey for extra credit points to provide benefit to the students (McInroy, 2017). Even with the requirements for extra credit, some students had the option to request data not be included in the study or to chose

not to complete the survey. This option was presented in readable informed consent (Antonacopoulos & Serin, 2016) in the first part of the survey. Students marked “no” in the informed consent portion of the survey if students did not want the data to be part of the study.

The survey instrument from the SCI-2 survey (Chavis et al., 2008) was connected to the Canvas gradebook. If a student completed the survey, then the points were automatically added to the gradebook in Canvas. Online teachers knew if students completed the survey as indicated in the Canvas gradebook but did not know if students allowed the use of the data or what answers students provided in the survey. None of the teachers of the students completing the survey did the analysis of the data.

### **Permissions and Data Protection**

To be able to use the survey data, permission to use the data required approval by the mathematics department chair at a university in Idaho and the Institutional Review Board (IRB) at a university in Idaho and the American College of Education (ACE), which aligned with the Health and Human Services Code of Federal Regulations educational exempt research (USDHHS, 2018). Personal information of the students was kept confidential during the analysis process, as well as when the results were presented. Because the survey did not ask for any names of the students or any other personal identifiable information, students were kept anonymous (USDHHS, 2018). Data were stored only on a secured Qualtrics server, several backup drives, and a computer, all of which were password-protected (McDowall, 2018). Access to the datasets was given through a username and a password. The data were only distributed by permission from the IRB at a university in Idaho and the department chair in the mathematics department at a university in Idaho.

## **Participant Exit and Data Preparation**

Inclusionary criteria for the study were (a) students who were registered for the online statistics course during the semester the study was conducted; (b) students who did not drop out of the course by the time the students were scheduled to complete the survey; (c) students in the course who were 18 years of age or older; (d) students who allowed the use of the survey data in the survey after reading the informed consent; and (e) students who completed all questions from the survey. The remaining students exited the study once the analysis was complete and were notified in the informed consent where students could request to view the results when the study was completed. When the students filled out the survey, the students had an opportunity to read and agree to an informed consent for data to be used based on requirements using human subjects from the Health and Human Services Code of Federal Regulations (USDHHS, 2018). Students received clear and understandable informed consent at the start of the survey in Qualtrics, stating the research involved with the survey and the rights of the students (Antonacopoulos & Serin, 2016). If the students did not agree to the informed consent, the information the students provided was not part of the study, and the data from the student were flagged to help with data cleaning (Greenwood-Nimmo & Shields, 2017).

Data from the survey file were downloaded and stored in Excel files. Several steps were taken to clean and scrub the data files for analysis. To find and eliminate missing and unusual values, cleaning and scrubbing methods were used as described by Greenwood-Nimmo and Shields (2017) where the dataset was sorted by each column in Excel to find missing and unusual values to determine unworkable records. Scores from each sense of community question were summed to get the dependent variable from the survey in Excel (Winston, 2016). Using the age column within the data, an age group variable was created where students 24 or older were in the

older group, and students under 24 were in the younger group as defined by Vallone et al. (2016). The survey file contained records of students who allowed consent to use the data and have completed information from the survey.

An excel file from the SCI-2 survey (Chavis et al., 2008) was created to perform the analysis. The final file had a total of three columns where the first two columns were the independent variables and the last column was the composite sense of community score. Each column was labeled age.group, gender, SoC (for the sense of community composite score). The final file was a CSV file to be imported to the software package R for analysis (Wickham & Grolemund, 2017). For security purposes, the dataset was password-protected, and the types of passwords used did have a greater level of security where the passwords used a combination of upper case letters, lower case letters, at least one symbol, and at least one number (McDowall, 2018). On several drives for backups, the dataset was saved along with the drive within the main computer being used to perform the analysis.

### **Data Analysis**

To perform the data analysis, particularly the two-way ANOVA procedure (Sarma & Vardhan, 2019) and Tukey's post hoc tests (Sullivan, 2016), the statistical software R was used. The software package was founded by the R Foundation for Statistical Computing (2020). The statistical software package R has become a serious rival in relevance and reliability compared to other software like SAS and SPSS due to the free and open-source system of the software (Wickham & Grolemund, 2017). For the sense of community composite score (the dependent variable), the data were checked to ensure each result fell within the range of possible numbers using methods proposed by Greenwood-Nimmo and Shields (2017) using frequency tables in R. Gender and age variables were checked using demographic tables in R for possible unusual

values. If unusual values existed on the record or a student indicated the student did not want the data to be part of the analysis, the record was removed for analysis using the filter function in R (Wickham & Grolemund, 2017). The following variables were needed when performing the complete analyses: gender, age, and the composite sense of community score from the SCI-2 survey.

To align with the research questions and hypotheses, the two-way ANOVA procedure (Sarma & Vardhan, 2019) and a Tukey's post hoc test (Sullivan, 2016) were performed to analyze the data. The age and gender were the independent variables, and the summed composite scores from the SCI-2 survey was the dependent variable when looking for differences in the sense of community between age and gender. When performing a test of two-way ANOVA procedure along with a Tukey's post hoc tests, three general comparisons were done:

- Comparing the average sense of community composite scores between genders
- Comparing the average sense of community composite scores between age groups
- Comparing the average sense of community composite scores between a combination of genders and age groups.

Two-way ANOVA has six assumptions where the first four involve the type of data being collected and how the data were collected. The dependent variable is continuous, while the independent variables are categorical (Sarma & Vardhan, 2019). Each observation is independent of the others meaning none of the observations are related in any way (Sarma & Vardhan, 2019). For the analysis, the sample size needs to be large. Using G\*Power (Heinrich Heine Universität Düsseldorf, 2020), the estimated sample size was 231 to make the results of two-way ANOVA valid.

The remaining two-way ANOVA assumptions are (1) the residuals from the model are normally distributed, and (2) the variances are similar across age/gender groups. Normality was tested using QQ-plots and Shapiro-Wilks test in R (Sullivan, 2016), and a test of heterogeneity of variances was tested using Levene's test in R (Sullivan, 2016). Tukey's post hoc tests have the same assumptions and assumption checks as a two-way ANOVA test (Sullivan, 2016).

The two-way ANOVA tested the age and gender factors along with the interaction of the two factors. Each of the  $p$ -values was compared to a significance level ( $\alpha$ ) of .05 (Sarma & Vardhan, 2019). For the main factors, age and gender, the null hypothesis was rejected if  $p \leq .05$  and statistically significant evidence showing differences existed between age groups or genders. With the interaction, the null hypothesis was rejected if  $p \leq .05$  and significance evidence showed an interaction existed between the factors age and gender (Sullivan, 2016).

Tukey's post hoc tests (Sullivan, 2016) were only necessary if multiple significances were found in any of the two-way ANOVA analyses. A Bonferroni's correction was used to minimize the familywise Type I error rate (Lee & Lee, 2018), where the level of significance (.05) was divided by the number of comparisons when performing a multiple comparison test. If the study found many statistically significant results, evidence existed showing the sense of community was significantly different across different age groups, gender groups, and/or a combination of age/gender groups. If the study found few or no statistically significant results, evidence showed the sense of community was not significantly different across different age groups, gender groups, and/or a combination of age/gender groups.

The dependent variable for the SCI-2 survey (Chavis et al., 2008) was the summed composite score of all of the survey questions. A two-way ANOVA test was used to test the sense of community composite score for age, gender, and the interaction of the two factors. If

any significances existed in the two-way ANOVA test ( $p \leq .05$ ), a Tukey's post hoc test with a Bonferroni correction was used to compare the different combinations of age/gender.

### **Reliability and Validity**

Effective research requires data to be reliable, valid, and objective. To be able to have dependable data to perform a two-way ANOVA (Sarma & Vardhan, 2019) and Tukey's multiple comparisons (Sullivan, 2016), the reliability, validity, and objectivity needed to be checked. To check on the dependability of the data, possible threats to the data collected in the study, external and internal validity, reliability, and objectivity, as explained in Creswell and Creswell (2018), were evaluated.

### **Threats to External Validity**

The analysis could have had several issues with external validity (Creswell & Creswell, 2018). An issue was almost all of the students taking the statistics course online at a university in Idaho are members of the Church of Jesus Christ of Latter-day Saints. Religious homogeneity of the students in the course made generalizing the results with other institutions of higher education difficult because of the unifying experience of a shared religion (Neal, 2017). A second issue was generalizing based on the online statistics setting in the study. Conducting a similar study for different types of classes, such as English or history classes as well as conducting the study for a face-to-face course, could yield different results. The statistics course in the study was an introductory course. Upper-level courses could produce different results compared to the study. Another possible issue was the study was conducted only during one semester, which could make generalizing across previous and future semesters a challenge. Given the sample size of 465 students, the results could be generalized across the introductory statistics courses at a university in Idaho. Because of these three issues, the generalization of the



study was restricted (Creswell & Creswell, 2018), but the study was still useful for those classes and students with similar characteristics (L. V. Hedges, 2018).

### **Threats to Internal Validity**

Along with external validity threats, the study had several possible threats to internal validity, which affects the usefulness of the quasi-experimental study (Creswell & Creswell, 2018). The first issue addressed students who typically add an online statistics class. Most campus students would rather take face-to-face classes than online classes. Face-to-face sections of the introductory statistic class typically have filled up first before the online sections because most students have preferred face-to-face classes (Tichavsky et al., 2015). At least some students who signed up for the online class could be students who were prone to procrastinate and were possibly afraid to take the statistics course and could not have performed as well in the statistics class. The registration process at a university in Idaho could have created a selection bias where a higher percentage of the better campus students took the campus sections versus the online sections.

Some of the students who initially signed up for an online section could have eventually taken a campus section, which would have helped reduce selection bias but could have impacted the effect of students dropping out of the online sections, which would have affected mortality validity. Being able to recruit a sample of 465 students should be enough data across different ages and genders to have minimized the effect of mortality validity. The lack of randomization could have introduced bias in the study (Creswell & Creswell, 2018; Sullivan, 2016), especially if some groups were more represented in the survey than others. An unequal representation could have happened where more students in one group being compared had a higher response rate than the other groups in the analysis. Notifying students of the survey and the benefits the

students could receive taking part in the research could have helped to motivate students to complete the survey (McInroy, 2017).

### **Threats to Reliability**

The historical reliability from the survey has been high where the survey has been used in multiple contexts (Creswell & Creswell, 2018). One of the possible threats could be where only some of the questions were used in the survey. To ensure the highest possible reliability, students were getting all of the questions from the survey as prescribed by Chavis et al. (2008). Another concern was the energy and mood students could have toward the end of the semester. Given some students could be negatively affected by stress at the end of the semester (Fischer, Nater, & Laferton, 2016), these possible changes could impact how the students answered the questions, which possibly did not reflect how the students felt throughout most of the semester. To minimize the potential impact of stress with some students, students were not required to take the survey but could receive direct benefits due to extra credit and indirect benefits in helping the course improve with the information from the students (Ketefian, 2015).

### **Threats to Objectivity**

When performing research, determining possible biases in the design and methods could help decrease the threats to objectivity (Creswell & Creswell, 2018). The study had a couple of methods to reduce threats to objectivity. Those who were analyzing the results of the data did not teach any of the sections involved in the study. Avoiding online teachers performing research with the data helped minimize the influence of the research and the results of the study. People have been susceptible to bias when analyzing and interpreting the results (Sullivan, 2016). To minimize the impact of the potential bias, at least two statisticians in the mathematics department at a university in Idaho not involved with the study reviewed the results and analysis

independently and gained approval to use the data from the mathematics department chair at a university in Idaho. These two methods in place ensured greater objectivity in the data and analysis of the study.

### **Ethical Procedures**

Ethical issues needed to be anticipated. Anticipating ethical issues helped put procedures in place to provide safeguards against unethical behavior (Creswell & Creswell, 2018). The following ethical issues were addressed: protecting participants and legal requirements, appropriate treatment of data, and ethical issues in the workplace.

#### **Protecting Participants and Legal Requirements**

Students who took an online introductory statistics class for one academic semester were eligible to participate in the study. Because the study was completed by gathering data during a regular education class, lawful protection of human subjects is under section 46.104 of the Health and Human Services Code of Federal Regulations (USDHHS, 2018). A week before students were allowed to complete the survey, students were notified via email from the teachers of the opportunity to complete the survey for extra credit and to help the university improve the online statistics course for future students. The students had an informed consent (see Appendix B) at the beginning of the survey in Qualtrics using section 46.101 of the Health and Human Services Code of Federal Regulations (USDHHS, 2018), which explained (1) the role of the students, (2) the purpose of the research, and (3) the benefits and risks of the survey (Ketefian, 2015). Two benefits stated were the extra credit for the students and helping further research to help improve the online statistics class. Informed consent explained the possible risks of taking the survey, and these risks would be minor and were not greater than any risk encountered in everyday life, but students could still withdraw from the survey at any time without penalty. For

minors trying to complete the survey, several items in the introduction and informed consent included (a) a statement saying minors were not eligible to complete the survey, (b) a statement saying minors could contact the teacher for an equal amount of extra credit instead of completing the survey, and (c) functionality in the survey where students stating an age under 18 at the beginning of the survey were directed to the end of the survey.

SCI-2 survey instrument (Chavis et al., 2008) and consent to use the SCI-2 survey instrument are in Appendices A and C. The research did not require special requirements to protect the students, but the research did require the personal information of the student to be protected because the data had some information, which was personal and could identify students. Permission from the IRB of a university in Idaho (see Appendices D and E), where the research took place, and from the IRB of the American College of Education were obtained before the dataset was collected, analyzed, and the results of the study were reported. To honor the three principles of beneficence, respect for persons, and justice from the Belmont Report (Department of Health, Education, and Welfare, 1979), several items took place in the study. All participants had the opportunity to obtain extra credit and help students in future classes (beneficence). Students (a) received an informed consent to participate, (b) kept anonymity because names and personal identifiable information were not asked in the survey, and (c) were not judged or graded negatively based on survey responses or non-participation as stated in the informed consent (respect of persons). Special populations such as elderly, low-income persons, or pregnant women were not targeted for the study and had an equal opportunity as any other students in the online statistics classes to complete the survey (justice).

### **Appropriate Treatment of Data**

Part of the dataset could identify individuals and threaten the anonymity of the subjects, which means the datasets should be secured based on the Health and Human Services Code of Federal Regulations (USDHHS, 2018). The datasets were located in Excel files, which were password-protected. These types of passwords used had a greater level of security where the passwords used a combination of upper case letters, lower case letters, at least one symbol, and at least one number (McDowall, 2018). Datasets were saved on several drives for backups along with the drive within the main computer being used to perform the analysis. Student names and other personal identifiable information of each student were not asked in the survey. The analysis happened in the statistical software package R, but the editing of the data took place within Excel to create the CSV file used to perform the analyses in R (Wickham & Grolemund, 2017). The CSV file is deleted three years after the analysis was completed. No one was allowed permission to use the computer and the dataset without approval from the IRB and the department chair in the mathematics department at a university in Idaho.

### **Ethical Issues in the Work Place**

The primary concern with data storage was the protection of privacy for human subjects (USDHHS, 2018). Data were stored on a computer, which was located in a university office where several people have access to the computer. After a short period of inactivity, the computer timed out and needed a password to get back in after inactivity. When the computer was not being used, the office door was locked to inhibit unapproved entry to the office. Once work was not being completed with the Excel files, the Excel files closed, which required a password to have reaccess to the files (McDowall, 2018). Restricting access to data helped in

protecting the privacy of human subjects (Mitchell, 2019). Records are retained for three years after the completion of the study as required by law and then destroyed.

### **Research Summary**

The different sections of the research and analysis include Research Design and Rationale, Research Procedures, Data Collection, Data Analysis, Reliability and Validity, and Ethical Procedures. A quantitative quasi-experimental study was the research design with students who took the online introductory statistics class at a university in Idaho. The chosen research design was appropriate based on recommendations from Creswell and Creswell (2018) and Sarma and Vardhan (2019). The research was trying to determine the differences between gender and age with a sense of community composite score. Having students from each age/gender combination helped determine possible differences between age groups, possible differences between gender, and possible interaction between age and gender. Because the research was from a quasi-experimental study and not from an experiment, the study did not determine any causation between gender and age with the sense of community.

A two-way ANOVA procedure (Sarma & Vardhan, 2019) and a Tukey's post hoc test (Sullivan, 2016) were applied to analyze the data. The analysis included assessing the effect of age and gender along with the interaction between age/gender with the dependent variable from the sense of community survey. If a test had statistically significant two-way ANOVA results ( $p \leq .05$ ), significant evidence existed showing differences between age groups, genders, or age/gender groups for the sense of community. If the two-way ANOVA test had any statistically significant results ( $p \leq .05$ ), a Tukey's post hoc test was applied to compare across the different age/gender groups.

Concerns about external validity due to the homogeneity of students in an online statistics class restricted how generalizable the results were (Creswell & Creswell, 2018). Possible concerns about internal validity due to students switching to another class or dropping were minimized due to the probable large sample size (Creswell & Creswell, 2018). Reliability concerns were minimized by using every question in the survey from Chavis et al. (2008). Issues with objectivity in the study were minimized by having other statisticians in the mathematics department at a university in Idaho review the results and the interpretation of the results. Two concerns with research ethics were data protection and data collection and were addressed in the Health and Human Services Code of Federal Regulations (USDHHS, 2018). Students had an introduction and informed consent to the survey at the beginning of the survey in Qualtrics. The datasets: were in password-protected computers, were in password-protected Excel datasets and had only a limited number of researchers with the permission of access. The analysis of the data addressing the sense of community is presented in Chapter 4.

## Chapter 4: Research Findings and Data Analysis Results

Educators at colleges and universities have been creating more online courses due to advances in modern technology. The growth could surpass the campus course offerings soon for all colleges and universities (Nash, 2015). Because of the growth, many professors and administrators at colleges and universities have been concerned with the quality of online courses. A significant concern with online courses has been students do not have a sense of community (Serdyukov & Sistek-Chandler, 2015). The potential impact of factors such as age and gender have complicated efforts to build community in an online setting

The problem explored in the research study was online classes have been serving more students, but the implications on the sense of community across a mixture of different age groups [Millennials (and older) vs. Generation Z] and different genders were unknown. The purpose of this quantitative quasi-experiment was to determine the possible differences between the levels of age and gender for the sense of community. Sections in Chapter 4 include Research Question, Data Collection, Data Analysis and Results, Reliability and Validity, and Chapter Summary.

### Research Questions

The sense of community was investigated in an online statistics class at a university in Idaho across different age/gender groups. From the problem and purpose of the study, three research questions were created. The following research questions guided the study:

**Research Question One:** Does a statistically significant difference exist in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho?



**Research Question Two:** Does a statistically significant difference exist in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho?

**Research Question Three:** Does a statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) exist on the sense of community scores in the online introductory statistics course at a university in Idaho?

### **Data Collection**

On March 19, 2020, students in the introductory online statistics course at a university in Idaho were notified via email of an opportunity to take the Sense of Community survey (SCI-2) (Chavis et al., 2008). The link to the survey was available on March 26, 2020, and was closed on April 8, 2020, in the learning management system (Canvas). By clicking on the link to the survey, students were directed to a Qualtrics survey and completed the SCI-2 survey. Students typically took about five to 10 minutes to complete the survey, and students responded to 24 questions from the SCI-2 survey as well as age and gender questions.

The inclusion/exclusion criteria for being in the study include students (a) who registered for the winter semester 2020 online statistics course at a university in Idaho, (b) who did not drop the class, (c) who were older than 18, (d) who allowed the survey information to be part of the study, and (e) who completed all survey questions. At the start of the winter 2020 semester, 664 registered students in the online statistics class were initially eligible to take part in the survey (D. Balls, personal communication, April 9, 2020), which was about 100 students less than anticipated. When students were able to start the survey toward the end of the semester, 569 students were still enrolled in the class (95 students dropped the course) (D. Balls, personal communication, April 9, 2020). Three students were not eligible to complete the survey because

the students were minors. From those non-minor students who were still enrolled in the course, 499 students filled out the survey.

Of those participants who completed the survey, 18 students did not want the information to be part of the study, and 16 students did not fill in all the information in the survey and were pulled out of the study. With the inclusion/exclusion criteria above, 465 students were part of the study. The estimated sample size needed for the study was 231 using G\*Power (Heinrich Heine Universität Düsseldorf, 2020). The sample size was large enough for a sufficiently powered study.

Table 1 displays by age/gender group and overall: 1) the number of eligible enrolled students at the start of the semester, 2) the number of students who dropped the course, 3) the number of students not permitting access to survey data, 4) the number of students not completing all of the questions, 5) the number of students not completing the survey, and 6) the students who were part of the study. Given the COVID-19 pandemic, a possible greater dropout rate for winter semester 2020 compared to previous semesters was a concern. The dropout rate for the winter semester 2020 was 14.3% compared to the dropout rate of fall semester 2019 of 14.2%. These two dropout rates show the possible response rate change due to COVID-19 was likely minimal. Because the sample obtained was a voluntary response sample, the sample obtained was a non-randomized sample and likely had a bias, which could affect results.

Table 1

*Enrolled Students in Online Statistics Class at a university in Idaho Along with Reasons for Not Being in Sample and the Total Sample Size in the Study by Age Group/Gender*

Gender	Age Group <sup>a</sup>	Eligible Enrolled Students <sup>b</sup>	Students Who Dropped <sup>b</sup>	Students Not Permitting Data Access	Students Not Finishing All Questions	Students Not Completing Survey at All	Total Sample Size
Female	Younger	143	26 (18.2%)	4 (2.8%)	2 (1.4%)	20 (14.0%)	91 (63.6%)
	Older	252	27 (10.7%)	1 (0.4%)	6 (2.4%)	8 (3.2%)	210 (83.3%)
Male	Younger	92	12 (13.0%)	3 (3.3%)	2 (2.2%)	21 (22.8%)	54 (58.7%)
	Older	177	30 (16.9%)	10 (5.6%)	6 (3.4%)	21 (11.9%)	110 (62.1%)
Total		664	95 (14.3%)	18 (2.7%)	16 (2.4%)	70 (10.5%)	465 (70.0%)

*Note.* The percentages in parentheses are the row percentages for the enrolled students within each age/gender category.

<sup>a</sup>Age groups are defined based on Vallone et al. (2016) where the older age group is 24 and older.

<sup>b</sup>Retrieved from D. Balls, personal communication, April 9, 2020.

As shown in Table 1, the overall completion rate was 70.0%, where the older female group had the highest response rate (83.3%) compared to the other three age/gender groups whose response rates were between 58-64%. Because older females had the highest completion rate, the results of the study were likely biased more toward the older female population. Within the survey, 24 questions (on a scale of zero to three points each) were grouped in four

community subscales: membership, influence, integration/fulfillment of needs, and a shared emotional connection (McMillan & Chavis, 1986). Each subscale was assessed using six questions, where each question had four possible responses: Not at All, Somewhat, Mostly, and Completely. Based on the instructions by Chavis et al. (2008), each of the four possible responses was given a set score as listed in Table 2. The scores from the 24 survey questions were summed to make sense of community composite score with a range between zero and 72. Answers from a student were removed if any of the data were missing.

Table 2

*Scoring Format for the SCI-2 Survey*

Response	Points
Not at All	0
Somewhat	1
Mostly	2
Completely	3

Using the definition from Vallone et al. (2016), the age group variable was calculated where the older group was 24 years or older, and the younger group was below 24 years. The final file used for analysis had three columns: age group (old and young), gender (male and female) and sense of community composite score (ranging from zero to 72), where age group and gender were the independent variables and the composite sense of community score was the dependent variable using the scoring format listed in Table 2. Students were removed from the analysis if the student answered no to a question at the beginning of the survey, which explained the purpose of the survey and asked for consent to allow for the responses from the students to be

used for the dissertation research. If a student did not answer any of the sense of community questions or did not respond to the gender or age question, the data from the student were removed. The unusual event of the COVID-19 pandemic occurred during the data collection. From the original data collection plan, the only major deviation was the data collection and analysis occurred at home rather than in a campus office due to the stay-at-home order from the Idaho governor.

To protect the identity and information of the participants, students were not asked to disclose any personal identifiable information. Qualtrics server and downloaded data from the server were password protected. These types of passwords had a greater level of security where the passwords used a combination of upper-case letters, lower-case letters, at least one symbol, and at least one number. Downloaded data were stored in a locked room and saved on several drives for backups. The CSV files were then imported to R to run the two-way ANOVA along with the assumptions for two-way ANOVA and supporting descriptive statistics.

### **Treatment or Intervention Fidelity**

A quasi-experimental design was used in the study because the levels of the independent variables (age and gender) could not be randomized. The data for the study were gathered using the SCI-2 survey instrument. No treatment or intervention fidelity was involved in the study.

### **Data Analysis and Results**

Once the data were collected, cleaned, and imported to R, data analysis was performed to investigate the differences between genders, age groups, and age/gender groups. Descriptive statistics were first calculated to provide a preliminary review of the data based on the research questions. Inferential statistics were done using a two-way ANOVA model, where both the

assumptions of the two-way ANOVA were checked, and the two-way ANOVA was computed using R and interpreted based on the research questions.

### **Descriptive Statistics**

Using R, descriptive statistics were calculated and a preliminary review of the data was completed using graphical and numerical descriptive statistics. For each of the levels of independent variables, age (younger/older) and gender (female/male) and interaction of the two variables (younger females, younger males, older females, and older males), several numerical summaries were calculated with the composite sense of community score as the response variable. Table 3 reveals the means, standard deviations, and sample sizes for each level of gender.

Table 3

*Means, Standard Deviations and Sample Sizes across Gender for the Composite Sense of Community Score*

Gender	Mean	Standard Deviation	N
Female	40.6	15.2	301
Male	39.8	16.7	164

Based on the results from Table 3, females had a slightly higher sample mean composite score than males by an absolute average difference in sample means of 0.8. These results suggest a possible difference in the sense of community on average between genders addressing the first research question. Females in the sample had a slightly lower variability than males based on a lower standard deviation. Table 4 reveals the means, standard deviations, and sample

sizes for each level of age group. Referring to the results in Table 4, older students had a higher sample mean composite score than younger students by an absolute difference in sample means of two. The results suggest a possible difference in the sense of community on average between age groups addressing the second research question. Older students in the sample had a slightly lower variability than younger students based on a lower standard deviation.

Table 4

*Means, Standard Deviations and Sample Sizes across Age Group for the Composite Sense of Community Score*

Age Group	Mean	Standard Deviation	N
Younger (under 24)	39.0	15.8	145
Older (24 or older)	41.0	15.7	320

To investigate the interaction between the two factors, the sample was divided into four groups. Table 5 lists the four different types of groups where the mean, standard deviation, and sample size are listed for each group. The effect on the composite score due to age had little effect on males. With the effect on the composite score due to age, older females in the sample had a larger mean composite score than younger females. An interaction between age and gender could exist because the change in means scores between age groups with females was unlike the change in mean scores with males (Sullivan, 2016) addressing the third research question. Compared to males, females in the sample had a smaller variability in the data based on the standard deviations regardless of age, where older females had the smallest variability.

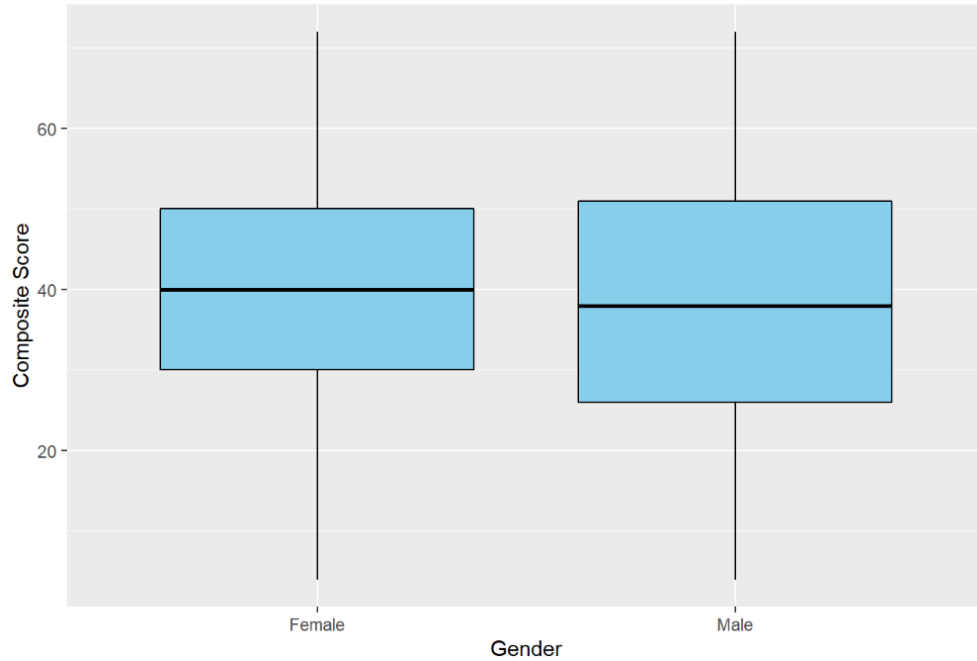
Table 5

*Means, Standard Deviations and Sample Sizes across Age/Gender Group for the Composite Sense of Community Score*

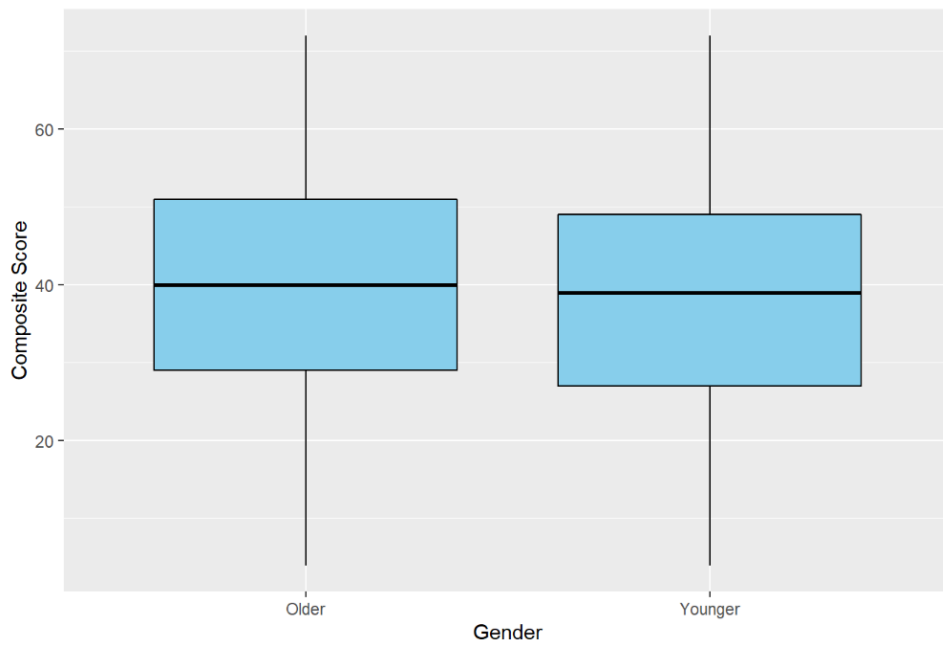
Gender	Age Group	Mean	Standard Deviation	N
Female	Younger (under 24)	38.5	15.7	91
	Older (24 or older)	41.6	14.9	210
Male	Younger (under 24)	39.9	16.0	54
	Older (24 or older)	39.8	17.1	110

To complement the numerical summaries in Tables 3, 4, and 5, box and whisker plots below provide visual comparisons between genders, age groups, and age/gender groups. The box and whisker plots in Figures 4, 5, and 6 provide a visual representation of the five-number summary (minimum, first quartile, median, third quartile, and maximum), give a visual comparing the centers of data and the variability. Box and whisker plots in Figures 4, 5, and 6 show similar results in terms of variability.

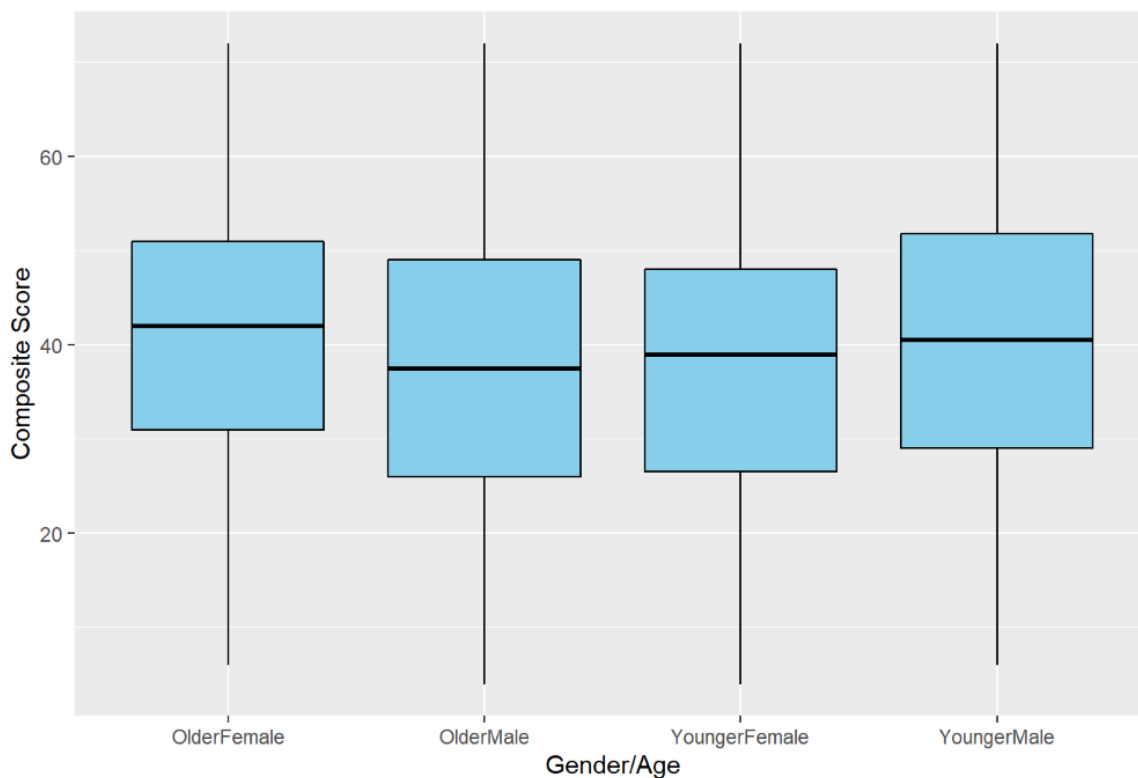




*Figure 4.* Box and whisker plot comparison for the sense of community composite score across gender.



*Figure 5.* Box and whisker plot comparison for the sense of community composite score across age groups.



*Figure 6.* Box and whisker plot comparison for the sense of community composite score across age/gender groups.

When looking at the medians in Figure 4, females in the sample had a higher median score than males, which suggests a greater sense of community for females than males addressing the first research question. Observing the box and whisker plots in Figure 5, older students in the sample had higher median scores than younger students, which suggests a greater sense of community for older students than younger students addressing the second research question. In Figure 6, the gap between the median sense of community scores between older females and younger females was slightly larger than the gap between the median sense of community scores between older males and younger males addressing the third research question concerning the interaction between age and gender with the sense of community score.

Figure 7 reveals how the two factors interact with each other and provides a display of all the scores from each of the students in the study. If the two lines in Figure 7 are non-parallel, the

non-parallel lines would indicate a possible interaction between age group and gender addressing the third research question. An interaction could be present between age and gender when evaluating the composite sense of community score when the two lines are non-parallel to each other.



*Figure 7.* XY plot plotting the means of the four different age/gender groups and the individual observations by age and gender.

Along with the non-parallel lines showing a possible interaction, Figure 7 reveals the types of students who provide extremely low or high scores from the survey. Viewing Figure 7 from the bottom left, a group of younger females gave a low sense of community score, and the lowest scores mostly came from older students. When viewing the highest scores, the majority of scores appear to have come from older students. Older students could have more extreme scores, but the variability of the sense of community score based on the standard deviations in Table 4 was about the same across gender.

## Assumptions

For the two-way ANOVA assumptions, four of the assumptions were based on the type of data collected and how the data were collected. The dependent variable, composite sense of community score, was continuous. Age group (older and younger) and gender (male/female), the two independent variables, were categorical. Each observation was independent of each other, meaning none of the observations were related in any way. For the analysis, the sample size needed to be large. Using G\*Power (Heinrich Heine Universität Düsseldorf, 2020), the estimated sample size of 231 made the results of two-way ANOVA valid. The total number of students in the study was 465, which made the ANOVA test valid based on the correct sample size.

After the data were collected, the two assumptions to be checked were the variances being similar across age/gender groups, and the residuals from the model being normally distributed. To check for variances being equal across all groups, Levine's test was applied to compare the variability between age groups, genders, and age/gender groups. The null hypothesis was the variances are equal across the groups, while the alternative hypothesis was the variances are different across the groups. If  $p \leq .05$  from Levine's test, then the null hypothesis was rejected, and sufficient evidence exists the variances between the groups are statistically not equal.

When using Levine's test across gender, the results were statistically non-significant,  $F(1, 463) = 3.09, p = 0.08$ . The null hypothesis was not rejected ( $p > .05$ ), and sufficient evidence did not exist for unequal variances across gender. Applying Levine's test across age groups, the results were statistically non-significant,  $F(1, 463) = 0.00, p = 0.96$ . For age groups, the null hypothesis was not rejected ( $p > .05$ ), and sufficient evidence did not exist for unequal variances.

Levine's test across age/gender groups showed statistically non-significant results,  $F(3, 461) = 1.41, p = 0.24$ . Across age/gender groups, the null hypothesis was not rejected ( $p > .05$ ), and sufficient evidence did not exist for unequal variances. Based on the multiple Levine's tests, the requirement of equal variance for a two-way ANOVA test was satisfied.

For checking for the normality of residuals, the Shapiro-Wilks test and QQ-plot of the residuals were used. The null hypothesis for the Shapiro-Wilks test was the residuals are normally distributed and the alternative hypothesis was the residuals are not normally distributed. If  $p \leq .05$  from the Shapiro-Wilks test, then the null hypothesis was rejected and sufficient evidence existed where the residuals for the two-way ANOVA model were not normally distributed. When using the Shapiro-Wilks test for testing the normality of the residuals, the results were statistically significant,  $W = 0.99, p = 0.00$ . The null hypothesis was rejected ( $p \leq .05$ ) and sufficient evidence existed for the residuals not being normally distributed.

Figure 8 reveals a QQ plot of the residuals. If the residuals were normal, the points would follow closely to the diagonal line. The extreme points on both ends of the QQ plot show a departure from the diagonal line, but most of the residuals appear to be at or close to the line. Shapiro-Wilks tests are more sensitive for detecting non-normality with large sample sizes.

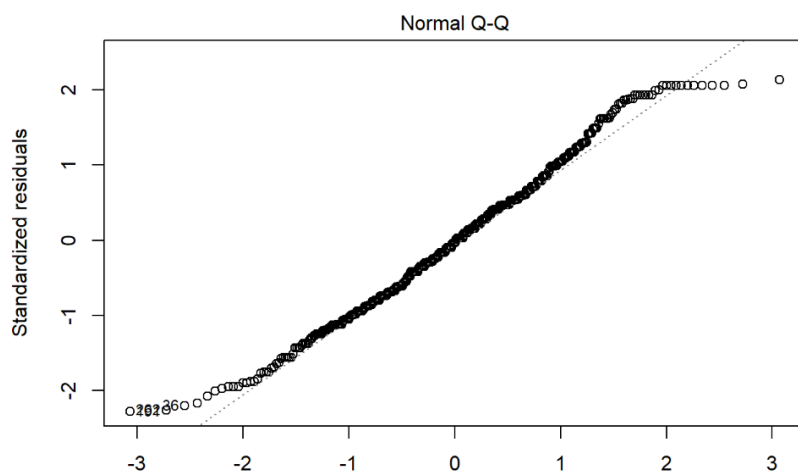


Figure 8. QQ plot of the residuals of the two-way ANOVA model for the analysis.

The methods of ANOVA are robust to small departures from the requirements of normality, which would not affect the results of performing a two-way ANOVA (Sullivan, 2016). These results in the study were a slight departure from the normality assumption, and one could assume the two-way ANOVA was robust for the data used in the study. Shapiro-Wilks test was sensitive to small differences of normality in the study due to the large sample size (Frison, Checchi, Kerac, & Nicholas, 2016), and most of the residuals were close to the diagonal line in the QQ plot shown in Figure 8.

### **Inferential Statistics**

Three research questions were guiding the study. Based on the research questions, performing a two-way ANOVA test helped to address the following:

- Comparing the average of the sense of community composite score between genders
- Comparing the average of the sense of community composite score between age groups
- Comparing the average of the sense of community composite score between a combination of genders and age groups (testing the interaction of age group and gender).

Table 6 reveals the results of the two-way ANOVA testing for the effect of gender, age group, and the interaction between gender and age group.

Table 6

*Two-way ANOVA table for the Composite Sense of Community Score*

Source	SS	df	MS	<i>F</i>	<i>p</i>	Partial $\eta^2$
Grand Mean	588088.00	1	588088.00	2370.73	0.00	
Gender	5.00	1	5.00	0.02	0.89	0.0006
Age Group	207.00	1	207.00	0.83	0.36	0.0032
Gender x Age Group	232.00	1	232.00	0.93	0.33	0.0020
Residual Error	114357.00	461	248.06			
Total	702889.00	465				

When assessing the research question concerning the effect of gender on the sense of community composite score, the null and alternative hypothesis for the test are stated below.

$H_{10}$ : A statistically significant difference does not exist in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho.

$H_{1\alpha}$ : A statistically significant difference exists in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho.

For the null hypothesis ( $H_{10}$ ) based on the effect of gender, the null hypothesis was not rejected because  $p > .05$  as listed in Table 6. Given the null hypothesis was not rejected, no statistically significant effect was observed for gender. The means between females and males were not significantly different statistically.

When assessing the research question concerning the effect of age on the sense of community composite score, the null and alternative hypothesis for the test are stated below.

$H_{2_0}$ : A statistically significant difference does not exist in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho.

$H_{2_a}$ : A statistically significant difference exists in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho.

For the null hypothesis ( $H_{2_0}$ ) based on the effect of age groups, the null hypothesis was not rejected because  $p > .05$  as listed in Table 6. Given the null hypothesis was not rejected, no statistically significant effect was observed for the age group. The means between older and younger groups were not significantly different statistically.

When assessing the research question concerning the interaction effect between age and the sense of community, the null and alternative hypotheses for the test are stated below.

$H_{3_0}$ : A statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) does not exist on the sense of community scores in the online introductory statistics course at a university in Idaho.

$H_{3_a}$ : A statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) exists on the sense of community scores in the online introductory statistics course at a university in Idaho.

For the null hypothesis ( $H_{3_0}$ ) based on the interaction effect between age and gender, the null hypothesis was not rejected because  $p > .05$  as listed in Table 6. Given the null hypothesis was not rejected, no statistically significant interaction effect was observed between gender and age.



The change in mean scores between genders in one age category was not significantly different statistically from the change in mean scores between genders in another age category.

If statistically significant differences existed for either the age group effect, gender effect, or the interaction effect, then Tukey's post hoc tests would have been performed across all the different age/gender groups. The  $p$ -values for all the  $F$  tests were greater than the level of significance of .05 ( $p > .05$ ), and none of the null hypotheses were rejected. Because none of the hypotheses were rejected, Tukey's post hoc tests were not needed as part of the study.

Table 7 summarizes the statistical tests used, and the results found based on the research questions and assumptions to check for ANOVA. Only the Shapiro-Wilks test for testing non-normality of residuals was statistically significant, which meant the residuals were found to be non-normal. Non-normality was a departure from the Two-way ANOVA assumptions. Reviewing the results from the Shapiro-Wilks test and the QQ-plot of results, the results showed a slight departure from the assumption. Two-way ANOVA  $F$ -tests are robust to slight departures of assumptions.

Table 7

*Summary of Results from Assessing the Sense of Community Score with Research or Assumption Questions, Type of Statistical Tests, and Conclusions*

Tests for Research Questions		
Research Question or Assumption	Type of Statistical Test	Conclusions
Issue		
Does a statistically significant difference exist in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho?	Two-way ANOVA	No statistically significant differences existed in the Sense of Community score between males and females.
Does a statistically significant difference exist in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho?	Two-way ANOVA	No statistically significant differences existed in the Sense of Community score between younger and older students.

(Continued)

Table 7.

(Continued).

Tests for Research Questions		
Research Question or Assumption	Type of Statistical Test	Conclusions
Issue		
Does a statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) exist on the sense of community scores in the online introductory statistics course at a university in Idaho?	Two-way ANOVA	No statistically significant interaction existed in the Sense of Community score between gender and age group.
Tests for Checking Assumptions		
Test unequal variances with the sense of community score across gender.	Levene's Test	No statistically significant variability differences existed between genders.
Test unequal variances with the sense of community score across age groups.	Levene's Test	No statistically significant variability differences existed between age groups.

(Continued).

Table 7.

(Continued).

Tests for Checking Assumptions		
Research Question or Assumption Issue	Type of Statistical Test	Conclusions
Test unequal variances with the sense of community score across age/gender groups.	Levene's Test	No statistically significant variability differences existed between age/gender groups.
Test residual in the Two-way ANOVA model not normally distributed.	Shapiro-Wilks Test with QQ-plots	Statistically significant non-normality existed with the Two-way ANOVA model residuals. ANOVA was robust to slight departures from assumptions.

### Reliability and Validity

To have both internal validity and reliability, the hypotheses should align with the survey instrument. The composite score from the sense of community survey was the dependent variable for the hypotheses. Using the dependent variable of the sense of community composite score aligned with the research questions concerning the sense of community. Along with the sense of community, age, and gender were reported in the survey to help provide the independent variables for the study. Because the sense of community survey (SCI-2) has been reported to have high reliability (coefficient alpha of 0.94) (Chavis et al., 2008), none of the sense of community survey questions was changed in the Qualtrics survey instrument.

To address the issue of external validity, students were not asked to provide personal identifiable information. Not requiring personal identifiable information and making a statement about the issue in the informed consent helped reduce the threats to external validity. Along with not asking for personal identifiable information, a sample size of 465 students was obtained to help with external validity. Getting 465 students in the study met the requirements based on the G\*Power used to calculate proper sample sizes for a valid test (Heinrich Heine Universität Düsseldorf, 2020). The large sample size would help in generalizing across introductory statistics courses at a university in Idaho. To help motivate students to complete the survey and minimize unequal representation in the survey across groups, students were notified by email concerning the survey and the benefits provided by completing the survey (McInroy, 2017). Despite the efforts to notify students, a disproportionate number of older females took part in the survey, which could provide a bias in the study toward older females.

### **Chapter Summary**

Data were collected at the end of the winter semester of 2020 from March 26, 2020 to April 8, 2020 where students in online introductory statistics courses were allowed to complete a sense of community survey (SCI-2). Out of 664 eligible students taking the online statistics class in the winter semester of 2020, 465 students completed the survey and were part of the study. The remaining students were not part of the study because of either dropping out, not completing the survey, not answering all the survey questions, or not allowing the survey data to be used for research. After the data were obtained, the data were collected and cleaned to have two independent variables, age and gender, and the dependent variable, composite sense of community score.

After the data were ready for analysis, means and standard deviations were calculated comparing genders, age groups, and age/gender groups. Along with the numerical summaries, box and whisker plots were created comparing levels of gender, age groups, and age/gender groups. An XY plot was created to help evaluate the interaction between age group and gender. Based on the descriptive statistics, some possible differences were detected, such as older females had a slightly higher composite sense of community scores than others and interaction existing between the gender and age group variables.

To complete the analysis and answer the research questions, a two-way ANOVA was performed where  $F$  tests were performed for the gender effect, age group effect, and the interaction effect between age and gender. After checking the assumptions, the results of the two-way ANOVA tests were evaluated. The  $p$ -values from all the  $F$  tests were greater than the level of significance ( $p > .05$ ), and none of the null hypotheses were rejected. Because no null hypotheses were rejected, no statistically significant effect was found for age group, and gender and no statistically significant interaction between age and gender was found. These results from the research questions and assumptions checking were summarized in Table 7.

These results of Chapter 4 are a foundation of the material in Chapter 5. The material in Chapter 5 addresses the findings, interpretations, and conclusions of the study. Along with the interpretation of results based on Chapter 4, recommendations, implications for leadership, and limitations are discussed in Chapter 5.

## Chapter 5: Discussion and Conclusion

The problem explored in the research study was online classes have been serving more students, but the implications on the sense of community across a mixture of different age groups [Millennials (and older) vs. Generation Z] and different genders were unknown. The sense of community was evaluated in an online introductory statistics course at a university in Idaho. Gathering the Sense of Community survey (SCI-2) scores from students taking the online introductory statistics course during one semester at a university in Idaho was the method to address the problem. The focus of the study was to compare the sense of community across genders, ages, and age/gender groups. If statistically significant differences were found across age groups, genders, and age/gender groups, the results would suggest faculty members of the online introductory statistics course at a university in Idaho have not been addressing the need to build community in the online course across different groups effectively.

The significance of the study was to add to the knowledge of effectively facilitating the sense of community in an online class and how the sense of community might affect online student outcomes and issues. Creating a sense of community in an educational setting is important to help with student retention, success, and achievement. Having a sense of community in an online environment is potentially more vital than face-to-face classes because of the greater tendency for students to become isolated in an online class. Addressing the issue across different ages and genders would help educators have a well-rounded approach to facilitating the sense of community in an online environment. The research would help build on knowledge concerning the sense of community effect on students in an online educational setting.

For the study, the primary focus was to address three research questions. These research questions steered the direction of the methodology and analysis. The following research questions guided the study:

**Research Question One:** Does a statistically significant difference exist in the mean sense of community scores between genders (male/female) in the online introductory statistics course at a university in Idaho?

**Research Question Two:** Does a statistically significant difference exist in the mean sense of community scores between age groups (Millennial (and older) students/Generation Z students) in the online introductory statistics course at a university in Idaho?

**Research Question Three:** Does a statistically significant interaction effect of age group (Millennial (and older) students/Generation Z students) and gender (male/female) exist on the sense of community scores in the online introductory statistics course at a university in Idaho?

A quantitative methodology was used for the study to address the research questions concerning the age group effect, the gender effect, and the interaction effect between age and gender on the sense of community scores in an online introductory statistics class at a university in Idaho. Student responses to the SCI-2 survey provided a sense of community score, which was the dependent variable in the study. These students responded to age and gender questions, which were the independent variables. A two-way ANOVA was performed to simultaneously compare the differences between age groups, the differences between genders, and the interaction effect between age groups and genders. The level of significance for the study was .05. If  $p \leq .05$  for testing the gender factor, age group factor, or the interaction factor, then groups of students based on age, gender, or a combination of age and gender do not have the same sense of community in the online introductory statistics course at a university in Idaho.



Using the two-way ANOVA was appropriate with the survey data. The assumptions for the two-way ANOVA were met, or the two-way ANOVA was robust to slight departures of the assumptions. In this situation, being robust to slight departures of the assumptions means two-way ANOVA was still a powerful test even though an assumption test (normality of residuals) did not quite meet the requirements. When using two-way ANOVA, statistically non-significant evidence was found of any differences in the mean for the sense of community score between genders and age groups, and no statistically significant interaction effect was found between age groups and gender where all the  $p$ -values were greater than .05 ( $p > .05$ ). Based on the results, no group according to age and gender was different in having a sense of community within the course compared to the other age and gender groups addressing the first two research questions. Along with the first two results, no statistically significant interaction effect between age group and gender was found, which addresses the third research question. The sections in Chapter 5 include Findings, Interpretations, and Conclusions, Limitations, Recommendations, and Implications for Leadership.

### **Findings, Interpretations, Conclusions**

For the findings, interpretations, and conclusions section, the results of the study were first compared to prior conclusions of other research concerning the sense of community with age groups, gender, and age/gender groups. The comparison of research was followed by connecting the Sense of Community Theory with the implications of the results. Using the Servant Leadership Theory to complement the Sense of Community Theory, further implications were analyzed based on the study results.

## **Comparing Literature of Prior Research**

For research question one, based on the results of the study, no statistically significant differences were found in the sense of community across gender at a university in Idaho. On average, different genders had similar levels of belonging, influence, integration, and connections with others based on the Sense of Community Theory (McMillan & Chavis, 1986). The result compared similarly to what others showed about finding no statistically significant differences in the sense of community across genders. No statistically significant differences in the sense of community were found in an online medical graduate program where students had the opportunity to improve teaching skills to gain new knowledge (Lewis et al., 2016). In an alternative licensure orientation course, no statistically significant differences across gender were found when investigating the sense of community (Wighting, 2011). From a study at an undergraduate program in Malaysia across all majors, the levels of sense of community were not different across the genders (Chung, 2018).

Females did have a higher sense of community score in the study at a university in Idaho, but the score difference was not statistically significant. The non-significant statistical differences of the study had contradictory conclusions to other studies with statistically significant differences when comparing the sense of community across gender. At a midwestern university in the United States across different majors, females had a greater sense of community in an online class versus males (Yang et al., 2015). Within the same study, Yang et al. (2015) found females had a greater sense of security and safety when taking an online class in large part due to a greater sense of community.

In a dual enrollment online course in an introductory to agriculture class, females had greater self-regulation, which helped females become more connected to the online class than

males (Chumbley et al., 2018). Part of the reason females had a greater sense of community was due to females being less threatened because of the lack of a face-to-face meeting with the teacher and peers where females were safer in taking an online class (Chumbley et al., 2018). For an online introductory statistics class at a school of economics in the Eastern United States, building a sense of community helped females gain greater confidence in learning statistics (van Es & Weaver, 2018). Having both quality and quantity with online collaboration exams in an introductory statistics course in a social science program helped females have a greater sense of community (Kapitanoff & Pandey, 2018).

Because non-significant statistical differences between age groups were found in the study at a university in Idaho, then the structure of the course ameliorated differences between younger and older students providing a more uniform sense of community. Different age groups had similar levels of belonging, influence, integration, and connections with others based on the Sense of Community Theory (McMillan & Chavis, 1986), which addressed the second research question of the study. The results in the study were comparable to one study. In a study comparing two different social work programs in the same college, age was not a factor in building a sense of community in either program (Wiest, 2015).

Older students in the study at a university in Idaho had a higher sense of community score on average compared to younger students, but the difference in scores was not statistically significant. The non-significant statistical differences of the study had contradictory conclusions compared to prior studies on how students from different age groups have a significantly different sense of online community needs. Graduate students in a distance learning environment in a cross-sectional study in the United States had statistical differences with the sense of community across age (Beeson et al., 2019).

Older students need less structure (Allen, 2016) and prefer to be self-directed (Zipp et al., 2017). In a study on training with older nurses, nurses did better with connecting to the class when the class was self-directed (DeCelle, 2016). With an adult education program at a faith-based Midwestern university, older students used prior experience in the learning and proactively engaged in learning (Howell et al., 2016). Other studies have determined younger students typically preferred to work in groups and preferred having more scaffolding and course structure (Loveland, 2017), where younger students had a greater need to use modern technology (Yoders, 2014). A nationwide survey of college students found younger students typically needed greater support and mentoring (DeAngelo, 2014).

For research question three, based on the results of the study, no statistically significant interaction between age group and gender were found. Because a non-significant statistical interaction was found in the study at a university in Idaho, then on average, different age/gender groups had similar levels of belonging, influence, integration, and connections with others based on the Sense of Community Theory (McMillan & Chavis, 1986). The non-significant statistical interaction in the study was comparable to a couple of other studies. With medical professionals using teaching to build knowledge in an online program, no statistically significant differences in the sense of community were found across different age/gender groups (Lewis et al., 2016). In an online agricultural course, no statistically significant interaction between age and gender was found when assessing the self-regulation of online learning, which could affect the sense of community in the online classroom (Chumbley et al., 2018).

### **Connecting Framework with Implications**

Each of the elements in the online statistics course at a university in Idaho has helped to promote the ideas of the Sense of Community Theory (McMillan & Chavis, 1986) and apply the

attributes from the Servant Leadership Theory (Greenleaf, 1970). Having a sense of community has been at the center of the online education program at a university in Idaho (A. Young, personal communication, August 3, 2019), while servant leadership has helped students at a university in Idaho become disciple leaders of Jesus Christ in the classroom. Both theories were the theoretical framework of the study and helped to create the weekly structure of the online introductory statistics course at a university in Idaho involving preparation, teaching one another, and pondering/proving course material. Each week, the course was well-structured, where the students met in groups twice to work through group quizzes. Near the end of the semester, students worked in groups to complete a semester project, where students gathered, analyzed, and reported on statistical data.

The primary theoretical framework for the study involving the online statistics course was the Sense of Community Theory, where members of the group are benefitted in a group through belonging, influence, integration, and connections with others (McMillan & Chavis, 1986). Because non-significant statistical differences were found in the study at a university in Idaho, then on average, groups based on age groups, gender, and age/gender group had similar levels of belonging, influence, integration, and connections with others. These non-significant statistical average differences in the sense of community across age groups, genders, and age/gender groups addressed all three research questions. In terms of the sense of community, the course did not favor one group over another. The course was created where students have similar levels of the sense of community, which could imply the course does well in promoting interdependence amongst a diverse group of students. Having interdependence amongst a diverse group was key for building a stronger sense of community (Neal, 2017). Even amongst

students from different backgrounds, students felt similarly about the community within the online introductory statistics course at a university in Idaho.

While finding no statistically significant differences in the sense of community scores across gender and age groups, and no statistically significant interaction between age group and gender, the overall average for the sense of community score was close to the middle of the sense of community score rating range. The aggregate sense of community score average was 40.34. Given a student score ranges from zero to 72, students on average gave the course a medium sense of community rating. Based on the Sense of Community Theory, students have an average sense of belonging, influence, integration, and connections with others (McMillan & Chavis, 1986).

Given the overall average rating was close to the middle of the score range, the course should be changed in several ways to improve the sense of community in the online introductory statistics course across several different groups. Finding ways to help to improve the sense of community in online classes has helped students have greater connections (Blackmon & Cullen, 2016), have a greater sense of belonging within the course (Beeson et al., 2019), and have increased perceived learning of the material (Trespacios & Perkins, 2016). To encourage a greater sense of community, applying the Servant leadership Theory (Greenleaf, 1970) in an online classroom could motivate students to build a strong sense of community. Encouraging servant leadership helps to connect students at a university in Idaho with part of the mission statement of the university, which is to help students become disciple leaders of Jesus Christ. Improving the sense of community across all age groups, genders, and age/gender groups involve improving on the three types of presence in the Community of Inquiry theory: teaching

presence, social presence, and cognitive presence. The ways to increase the three types of presences in the online courses are discussed in the recommendations section.

### **Limitations**

Almost all of the students in the online class at a university in Idaho are members of the Church of Jesus Christ of Latter-day Saints. Religious homogeneity made generalizing and external validity of the study hard because of the uniting effect of a common religious belief (Neal, 2017). Performing a similar analysis for different college courses other than online statistics classes, such as English or chemistry classes, might have provided different outcomes. Analyzing upper-division classes or face-to-face classes might have had different results compared to the study for the online statistics classes at a university in Idaho. Two limitations to the quasi-experimental design of the study were (a) the factors, age and gender, were not randomized, and (b) the analysis could not determine any causation between gender and age with the sense of community (Creswell & Creswell, 2018).

To have both internal validity and reliability, the research questions and hypotheses aligned well with the survey instrument. The composite score from the SCI-2 survey was the dependent variable for the hypotheses. Because the SCI-2 survey has been reported to have high reliability (coefficient alpha of 0.94) (Chavis et al., 2008), none of the sense of community (SCI-2) survey questions was changed in the Qualtrics survey instrument to have similar reliability in the study.

Younger campus students would prefer to attend face-to-face courses than online courses. Face-to-face sections of the introductory statistic class reached capacity before the online sections because younger students prefer face-to-face courses. Some younger students who signed up for an online class could have signed up late and might have been fearful of taking a

statistics course, given the negative reputation a statistics course has had with students. The registration method at a university in Idaho might have generated selection bias where a greater number of the better campus students took the face-to-face introductory statistics classes versus the online introductory statistics classes. Some of the students who originally signed up for an online section of introductory statistics might have eventually taken a campus section, which would have helped reduce selection bias. The scenario could have impacted the effect of students dropping out of the online sections, which would have affected mortality validity. Getting a large sample size of students (465 students) was enough data across different ages and genders to minimize the effect of mortality validity.

Some of the data within the study were not used due to students not allowing survey data to be used, or students did not fully complete the survey, which made the data from the student invalid. Having students not complete the survey or having students not allowing the survey results to be used for analysis reduced the power of the test as well as external validity, but having a large total sample size and large sample sizes for each group provided a large enough power (greater than 0.90) and sufficient external validity for the analysis. Older females had a much higher response rate compared to other age/gender groups, which could have created a bias in the study toward older females. Because of the large sample sizes within every group, the impact of non-response bias was likely minimal. The data were collected only for one semester. Given the different students taking the class and possibly different instructors teaching the class, the results could have varied across different semesters and teachers.

Another limitation was the possibility of having several Type II errors happening in the study. Type II errors happen where the null hypotheses were not rejected when the alternative hypotheses are true (Sullivan, 2016). For the study, the alternative hypotheses would be



different groups based on age groups, gender, and age/gender groups would have a significantly different average sense of community scores statistically. If a type II error occurred in the study, then statistically significant differences in the sense of community scores based on age and gender groups, along with a statistically significant interaction between age and gender, were not detected. Even with these potential concerns of a type II error, getting a type II error in the study had a low probability of happening because the estimated power of the test was above 0.90 due to the large sample size. A power above 0.90 would make the probability of committing a type II error in the study to be less than 0.10 (Sullivan, 2016). Given a low probability of committing a type II error, the chance the results would be incorrect was low (Sullivan, 2016).

### **Recommendations**

Based on the study, no statistically significant differences existed between age groups, genders, and age/gender groups in building the sense of community in the online introductory statistics course at a university in Idaho. Even if no statistically significant differences were found with the sense of community across different groups, the overall sense of community with online introductory statistics courses might improve using methods to improve the sense of community involving the three types of presence in the Community of Inquiry theory (social, cognitive, and teaching). Applying the methods to improve each presence should be considered and tested by teachers and course designers, to determine if the sense of community improvements are happening across different demographic groups, including age and gender.

Course designers and teachers for online introductory statistics courses should create a social presence in the online introductory statistics courses involving an initiation activity, developing social relationships, and then nurturing a greater sense of community. Having a multi-phase program to improve social presence should help students increase enjoyment in the

classroom, and a greater percentage of students would be retained in the course. To start, having an initiation program within the online introductory statistics class helps students understand the expectations of the class and get connected with fellow peers and the teacher at the start of the semester. After the initiation process, the online introductory statistics course should have more group collaborations and discussions to build social relationships within the online class. The course should encourage the teachers to create thoughtful questions on the applications of statistics to generate class discussions using discussion boards or video threads such as VoiceThread. Collaborative assessments within study groups should be considered where students help each other with gaps in understanding while taking the assessment together. Engaging in collaborative learning within a statistics class could help students become connected and improve course attitudes.

Improving the cognitive presence using experiential learning in online courses helps improve the sense of community across different groups. The online introductory statistics course at a university in Idaho does have a semester project where students collect data and put together a report at the end of the semester, which provides a way for students to perform a real-world application activity with a group. Course designers and teachers should consider improving the real-world application activity to promote a sense of community. A discussion forum could be incorporated to help students come up with real-world application ideas using social media. Projects in the online introductory statistics could be more student-centered and student-initiated, which could help improve the sense of community. When groups complete application activities, having peer evaluations from different groups helps improve connections between students. While performing application activities, having assigned roles within the group helps promote purpose and cohesiveness within each of the groups.

Course designers and teachers should consider improving teacher presence in online classes to help improve the sense of community for students. Increasing access to the teacher should help students become more connected within the online classroom. Encouraging online introductory statistics teachers to build a rapport with the students and to use a welcoming tone when communicating might help students to become more included within the online classroom. Even with peer discussions in the online introductory statistics course, having the teacher lead the discussions helps with teacher presence within the class. Teachers practicing the theory of servant leadership with individual students should help students become connected in the online introductory statistics course. When providing feedback to students, teachers should provide personalized feedback either through video, text, or audio. While leading discussions, teachers should skillfully ask questions to help students learn deeply, work together, and connect with both peers and the teacher.

Online teachers should have a greater presence with a proper design in the course. Using the Universal Design for Learning helps each student have greater access to the teacher and course material based on the individual needs and concerns of the students. As part of helping individual students, the online introductory statistics course should have extra scaffolding, and course supports for students who might struggle in the confidence of learning statistics. When increasing teacher presence in the online class, designing an initiation activity should help teachers develop a rapport with the students and discusses practical uses of statistics. Teachers and course designers should consider using digital tools to increase teacher presence and improve the sense of community for the students. To supplement the primary material, online statistics teachers connect material in Khan Academy with course material to give students extra practice and insights in understanding statistics. Using social media such as Facebook or Twitter

helps teachers connect with students in social media where students typically seek social connections.

Several gaps in the literature still exist concerning the sense of community and how the sense of community could be improved in an online course, particularly an online introductory statistics course. SCI-2 survey has four different subscales based on the elements from the theory of the sense of community (McMillan & Chavis, 1986), which are reinforcement of needs, membership, influence, and shared emotional connections. The four elements should be analyzed when comparing each age group, gender group, and age/gender groups.

Other factors or independent variables should be used when comparing the sense of community. Many students prefer taking courses face-to-face due to the perceived connection with the teacher and fellow students. Comparing face-to-face and online sections of the introductory statistics course at a university in Idaho helps to determine a statistical difference in the sense of community between the two modalities. More factors or variables not measured in the study should be analyzed to determine other possible statistical differences in the sense of community. These factors could include race, ethnicity, socio-economic status, majors, type of student (traditional campus student vs. fully online student), first-generation college student vs. multi-generational college student, international vs. domestic students, levels of motivation, the religiosity of students, major, class rank, and levels of financial aid. Most of these factors are at-risk factors for student retention based on prior analyses at a university in Idaho (B. Memmott, personal communication, October 26, 2017).

Several variables might be correlated with students having a sense of community. Students have had negative attitudes about taking a statistics course. Because of these attitudes, determining correlations between student attitudes toward statistics and having a sense of

community is a gap in the literature to address for future studies. Along with attitudes in statistics, correlating course performance using exams in the online introductory statistics course and the sense of community is another gap in the literature. To complement the SCI-2 survey, a survey instrument is available to measure servant leadership in an organization or group such as the Servant Leadership Survey (van Dierendonck & Nuijten, 2011). Investigating the correlation between the sense of community using the SCI-2 survey and servant leadership in an online introductory statistics course should be done. The combination of dependent and independent variables should be tested for statistically significant differences and/or correlations with the sense of community.

### **Implications for Leadership**

Several actionable items stem from the study from both a sense of community standpoint and using data and analysis to improve research at a university in Idaho. The literature reveals benefits in considering the sense of community in an online environment (Phirangee et al., 2016). Focusing on the sense of community helps with student retention. Given the concern for college retention, particularly with freshmen, finding ways to aid students gain a sense of community helps retain a greater percentage of students in classes, particularly online classes (Tinto, 2007). Having a sense of community has been shown to help improve perceived learning in the classroom (Trespacios & Perkins, 2016). Helping students have a sense of community encourages students to create connections (Blackmon & Cullen, 2016) and have a sense of belonging (Beeson et al., 2019) in online courses. Addressing the sense of community in the online introductory statistics course helps students who are traditionally marginalized (Torres-Harding et al., 2015).

Even though no statistical differences were found with the sense of community in the online introductory statistics course at a university in Idaho, the aggregate average sense of community score was close to the middle of the score range. Being able to make improvements and testing those improvements is imperative to improve the quality of the sense of community in the online introductory statistics course. Using the SCI-2 survey, the course could be evaluated and then changed to see if any improvements positively affect the sense of community in the online course. Applying methods to improve any of the three types of presence as described in the Community of Inquiry theory, potentially helps improve the sense of community. The methods used could be compared to what was being done in the course to make incremental improvements with the sense of community. Other aspects could be correlated with the sense of community in the online introductory statistics course to assess the impact of the sense of community. Determining correlations on the sense of community with other factors such as attitudes toward statistics and servant leadership helps in providing insights in determining the effect the sense of community has with other aspects in the course.

When improvements are made in the online introductory statistics course based on prior research and data analysis, the results could be presented in forums at a university in Idaho community. Presenting the results in an online community might help to encourage other faculty to make research-based changes to help improve the sense of community in many courses at a university in Idaho. Given the sense of community has been the heart of online learning at a university in Idaho (A. Young, personal communication, August 3, 2019), other online classes at a university in Idaho could be helped where teachers and course facilitators could apply the information of the study. Assessing the sense of community could help not only the online

introductory statistics course at a university in Idaho but other courses at a university in Idaho as well.

Many educators at a university in Idaho are reluctant to perform research and collect data for college courses. Educators at a university in Idaho could be trained to use prior research to find ways to improve the sense of community. Not only could educators be encouraged to use research, but educators could be trained to collect data assessing the sense of community using the SCI-2 survey tool. Assessing and improving the sense of community in the online course might help with determining ways to encourage both teachers and students to serve others.

### **Chapter Summary**

Statistical differences in the sense of community between gender and age groups were determined as well as the statistical interaction between gender and age groups. The significance of the study was to help add to the knowledge of the effect of the sense of community within the online classroom and if different age/gender groups have a different sense of community in the online environment. Using the SCI-2 survey (Chavis et al., 2008), no statistically significant differences in the sense of community scores across different genders and age groups were found, and no statistically significant interaction between age group and gender was found. The study was based on the sense of community theory (McMillan & Chavis, 1986) and complemented with servant leadership theory (Greenleaf, 1970). Results of the study were compared to other similar research. Even if no statistically significant differences in the sense of community scores were found across age and gender and no statistically significant interaction between age and gender was found, the overall average sense of community score was in the middle of the sense of community score range. Sense of community scores in the online introductory statistics course at a university in Idaho should improve. Using methods to increase

the three types of presence from the Community of Inquiry model (teaching presence, social presence, and cognitive presence) (Dunlap et al., 2016) helps improve the sense of community for students in an online introductory statistics course.

Many practices should be considered to improve the sense of community for students in the online introductory statistics course at a university in Idaho. Improving the sense of community in an online environment helps students to become less isolated and have more connections within the course. Because of the greater connections, students are more likely to be retained and have a better experience in the course (Tinto, 2007). Along with recommendations to improve the course using methods based on the community of inquiry (Dunlap et al., 2016), further recommendations would be to test independent variables other than age and gender, such as modality (campus vs. face-to-face), race, ethnicity, and socio-economic status. The sense of community could be correlated with other variables such as attitudes toward statistics and servant leadership. Several limitations exist to make inference in other settings, including religious homogeneity, students dropping out from the class, some students not completing the survey, and only completing the survey for one semester. Some of these limitations were mitigated due to the large sample size obtained for the study.

Educational leadership is fostered from the study in a few ways. Promoting the sense of community in the online introductory statistics course helps students to become successful and more connected. Seeking ways to improve the sense of community for students could be beneficial to the students and the teachers. Encouraging others at a university in Idaho to perform research and collect data in determining ways to improve the sense of community helps students not only in the online introductory statistics course but other courses across the university.



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## Appendix A: Sense of Community Survey (SCI-2)

## SENSE OF COMMUNITY INDEX II

The following questions about community refer to: \_\_\_\_\_

How important is it to you to feel a sense of community with other community members?

1	2	3	4	5	6
Prefer Not to be Part of This Community	Not Important at All	Not Very Important	Somewhat Important	Important	Very Important

How well do each of the following statements represent how you feel about this community?

	Not at All	Somewhat	Mostly	Completely
1. I get important needs of mine met because I am part of this community.				
2. Community members and I value the same things.				



3. This community has been successful in getting the needs of its members met.				
4. Being a member of this community makes me feel good.				
5. When I have a problem, I can talk about it with members of this community.				
6. People in this community have similar needs, priorities, and goals.				
7. I can trust people in this community.				
8. I can recognize most of the members of this community.				
9. Most community members know me.				
10. This community has symbols and expressions of membership such as clothes, signs, art, architecture, logos, landmarks, and flags that people can recognize.				
11. I put a lot of time and effort into being part of this community.				
12. Being a member of this community is a part of my identity.				
13. Fitting into this community is important to me.				
	Not at All	Somewhat	Mostly	Completely

14. This community can influence other communities.				
15. I care about what other community members think of me.				
16. I have influence over what this community is like.				
17. If there is a problem in this community, members can get it solved.				
18. This community has good leaders.				
19. It is very important to me to be a part of this community.				
20. I am with other community members a lot and enjoy being with them.				
21. I expect to be a part of this community for a long time.				
22. Members of this community have shared important events together, such as holidays, celebrations, or disasters.				
23. I feel hopeful about the future of this community.				
24. Members of this community care about each other.				

What is your gender?

- a) Female
- b) Male

Thank you for your willingness to complete the survey. Your information is valuable to help improve the online statistics course. Your extra credit should be displayed in the Canvas grade book. Again, if you are under 18, please contact your instructor and your instructor will provide you an alternative to earn the same amount of extra credit.

## Appendix B: Words of the Informed Consent from the Survey

Thank you for taking the time and effort to respond to this survey. Please read each question carefully and choose the most appropriate response.

Also, you will be asked if we could use the information from your survey in a study. The survey will not ask for personal identifying information to protect your anonymity and your instructor and researcher will not know how you responded to the survey.

The survey will take about 5-10 minutes. Your responses benefit you with earning 0.5% extra credit toward your overall grade and will benefit other BYU-Idaho students in addressing ways to improve the sense of community in a statistics class. You will only get extra credit if you complete the entire survey.

The emotional and physical risks in taking the survey are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests. However, the participation in this survey is voluntary you could withdraw from the survey at any time without penalty.

The data will be used for a doctoral dissertation at the American College of Education addressing the need to improve the **sense of community** in an online class. If you would like additional information about or the results from the dissertation research, you could contact, Ryan Cromar (cromarr@byu.edu) or Dr. Krista Allison ([krista.allison@ace.edu](mailto:krista.allison@ace.edu)).

The responses will be used to improve the Math 221 (Statistics) course. Will you consent to allow for your responses to be used for the dissertation research?

(You will not be judged or graded for your responses in the survey) - You will still get extra credit if you answer "No" to this question so long as you complete the survey.

- Yes
- No

If you are under 18, you are not eligible to complete the survey. Thank you for your willingness to do the survey. To please contact your instructor and your instructor will provide you an alternative to earn the same amount of extra credit.

What is your current age? \_\_\_\_\_

*Note:* If the age listed above is under 18, the student will be directed to the end of the survey and reminded again to contact their instructor to earn the same amount of extra credit.

## Appendix C: Approval Letter for Sense of Community Survey



438 N. Frederick Ave  
Suite 315  
Gaithersburg, MD 20877  
301.519.0722  
301.519.0724  
[www.communityscience.com](http://www.communityscience.com)

August 19, 2019

To whom it may concern:

This letter is to formally approve Ryan Cromar to use the Sense of Community Index 2 (SCI-2) for his dissertation research entitled "Community and Attitudes for an Online Course: A Quantitative Quasi-Experimental Study".

As a condition of this approval Ryan Cromar has agreed that **no** changes will be made to the Sense of Community Index for use in either print or electronic form, without written permission from Community Science.

Sincerely,

A handwritten signature in black ink that reads "David M. Chavis".

David M. Chavis, Ph.D.  
President/CEO

## Appendix D: IRB Approval from a university in Idaho

June 11, 2019

Dear Ryan,

Your request to use human subjects for the study entitled, *Community and Attitudes for an Online Course: A Quantitative Correlational Study* IRB#: S19-F006, is approved for 12 months from the date of this letter.

Please notify the IRB if you intend to make any significant modifications to the study's design or implementation.

Best of luck with your study.

Respectfully,



Dean, Faculty Development & Mentored Research

Director,  Institutional Review Board

## Appendix E: Modified IRB Approval from a university in Idaho

September 25, 2019

Dear Ryan,

Your request to use human subjects for the study entitled, *Community and Attitudes for an Online Course: A Quantitative Correlational Study* IRB#: S19-F006, has recently been reviewed for modification of scope and extended timeline. The modified project entitled: *Community and Attitudes for an Online Course: A Quantitative Quasi-Experimental Study*, is approved through 12/31/2020.

Please notify the IRB if you intend to make any significant modifications to the study's design or implementation.

Best of luck with your study.

Respectfully,



Dean, Faculty Development & Mentored Research

Director,  Institutional Review Board