COMPARING SENSE OF COMMUNITY SCORES BETWEEN ONLINE INFORMATION TECHNOLOGY STUDENTS BASED DOMESTICALLY AND THOSE BASED INTERNATIONALLY

by

Spencer DeGraw

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

Liberty University

2024

COMPARING SENSE OF COMMUNITY SCORES BETWEEN ONLINE INFORMATION TECHNOLOGY STUDENTS BASED DOMESTICALLY IN THE UNITED STATES AND THOSE BASED INTERNATIONALLY

by Spencer DeGraw

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

Liberty University, Lynchburg, VA

2024

APPROVED BY:

Sara Capwell Geary, Ph.D., Committee Chair

Rebecca M. Lunde, Ed.D., Committee Member

ABSTRACT

The purpose of this quantitative, causal-comparative study is to investigate a student's sense of community within a globally-available, online, asynchronous, Information Technology (IT) course and explore whether there is a difference in the sense of community scores if the student is currently residing in the United States or is currently residing outside of the United States. A sample size of N = 297 students was drawn from a convenience sample of online students who had self-enrolled in IT classes as part of an IT degree program. The Rovai's Classroom Community Scale was used to calculate the sense of classroom community for two independent groups. Initially, a Multivariate analysis of variance (MANOVA) was used for analysis; however, a Mann-Whitney U test was ultimately applied because of failed assumptions. The final results found that the shapes of the three dependent variables were significantly different across the two measured groups, therefore mean rank scores were measured rather than the medians. It was found that the null hypothesis should be rejected for both the Connectedness variable and the Total_CCS_Score variable, while the null hypothesis should be retained for the Learning variable. The research shows that the experience for online IT students is significantly different for students based in the United States and those based outside of the United States. Future studies should consider exploring how to provide or ensure access to the necessary technology and also instructional design elements that might make experiences more alike among the two groups.

Keywords: Social integration, sense of community, information technology, online, international.

Dedication

I am so grateful for the loving support of my wife, Julie, and the regular encouragement she gave me throughout this journey. I also wish to acknowledge my 4 incredible sons: Nick, Josh, Zack, and Jake. I love you all!

Acknowledgments

I was so inspired by the cheerful and encouraging words of Dr. Barthlow. Without her even knowing, she provided a wonderful ray of sunshine, kindness, and encouragement. I also want to acknowledge the help from Dr. Geary and Dr. Lunde who provided important guidance and helpful instruction.

I must also acknowledge the kind and gentle “nudges” from a loving Heavenly Father who kept reminding me that this trip would be worth the journey and that He would guide me through it. I am humbled and grateful for His love and constant influence in my life.

Table of Contents

ABSTRACT....3
Dedication....4
Acknowledgments....5
Table of Contents....6
List of Tables....10
List of Figures....11
List of Abbreviations....12
CHAPTER ONE: INTRODUCTION....13
Overview....13
Background....13
Historical Overview....14
Society-at-Large....15
Theoretical Background....16
Problem Statement....17
Purpose Statement....18
Significance of the Study....19
Research Question....19
Definitions....20
CHAPTER TWO: LITERATURE REVIEW....21
Overview....21
Theoretical Framework....21
Anomic Suicide....22

Altruistic Suicide 23

Egoistic Suicide 23

Fatalistic Suicide 23

Related Literature 26

Encouraging a Sense of Community 27

Demographic Impacts 28

The Teacher's Impact on Sense of Community 33

Student Perception of Community 35

Retention Rates 37

Challenges of Teaching STEM Courses 38

Challenges of Teaching Online 40

Challenges of Teaching STEM Courses Online 41

Experiential Learning 42

Computer-based Scaffolding 44

Summary 50

CHAPTER THREE: METHODS 52

Overview 52

Design 52

Research Question 53

Hypothesis 53

Participants and Setting 54

Population 54

Participants 54

Setting 58

Instrumentation 60

Procedures..62

Data Analysis 63

CHAPTER FOUR: FINDINGS 66

Overview..66

Research Questions 66

Null Hypotheses..67

Descriptive Statistics...67

Results..68

Assumptions for Mann-Whitney U Test 75

CHAPTER FIVE: CONCLUSIONS 81

Overview..81

Discussion 81

Implications..84

Limitations 85

Recommendations for Future Research 86

REFERENCES 88

APPENDIX A – CLASSROOM COMMUNITY SCALE (CCS) 115

APPENDIX B – INSTRUCTIONS FOR THE CCS QUESTIONNAIRE...........................116

APPENDIX C – IRB APPROVAL 118

APPENDIX D – INFORMED CONSENT / INVITATION TO PARTICIPATE 120

APPENDIX E – IRB EXCEPTION 123

APPENDIX F – HOW TO ACCESS THE DATA RESULTS 124

List of Tables

Table 1........ 55

Table 2........ 56

Table 3........ 57

Table 4........ 58

Table 5........ 59

Table 6........ 68

Table 7........ 69

Table 8........ 69

Table 9........ 71

Table 10........ 74

Table 11........ 75

Table 12........ 80

Table 13........ 80

Table 14........ 80

List of Figures

Figure 1 70

Figure 2 72

Figure 4 73

Figure 3 73

Figure 5 77

Figure 6 78

Figure 7 79

List of Abbreviations

Information Technology (IT)

Science, Technology, Engineering, and Math (STEM)

Virtual Machine (VM)

CHAPTER ONE: INTRODUCTION

Overview

The purpose of this quantitative, causal-comparative study is to investigate a student's sense of community within an online IT course and explore whether there is a difference if the student is based in the United States or whether the student is based internationally. Chapter One provides background information about some key challenges of online courses in higher education, a brief historical overview, a discussion about broader societal impacts, and a brief overview of the theoretical framework that guides this study. The problem statement examines the challenges many colleges and universities face with declining student retention in online courses and programs. The study's purpose and significance are discussed and followed by the research question. The chapter concludes with a brief list of key terms and definitions.

Background

A recent study on student retention highlighted a common question many distance learning students ask: *Should I stay, or should I go?* (Radovan, 2019). Just because students can take online courses does not always mean they will continue taking them. With the introduction of the global Internet, the ability to deliver quality online courses has increased (Kolbaek, 2018). Universities and businesses are rapidly expanding their capabilities and reaching beyond their current campuses (Peterson, 2017). However, instructional designers have found that strategies for designing courses for an online modality are not always an easy conversion from the traditional, on-campus, face-to-face course design and require additional insights and design considerations to be effective (Weinhandl et al., 2020).

As online courses have evolved, studies have begun to look at key variables that might impact the effectiveness of these courses. For example, while the popularity of online courses continues to grow, there also seems to be an increase in the number of students who prematurely drop out of school before finishing their degree (Muljana & Luo, 2019). Studies have acknowledged the relationship between a student's sense of belonging to retention rates (G. M. Davis et al., 2019). A sense of belonging or community within the class has also been applied to online courses and has shown a measurable impact on whether students continue their studies (Peacock & Cowan, 2019).

Historical Overview

Colleges and universities have long struggled with the reality of many students beginning an educational program but failing to complete it. Studies as far back as 1926 (Johnson) have explored ways of predicting whether new college students would be successful in their educational goals. Much of the early research focused on more traditional educational paths in the four-year college or university settings; however, later data began to show that a more common entry point into higher education was at the two-year community college level and studies began to look at these lower-level environments to try and predict persistence among first-year two-year college students (Halpin, 1990). Before the 1970s, a majority of the research surrounding student retention focused on characteristics of the individual students. These early studies would look at individual traits, such as gender, race, or socioeconomic factors, to explore whether these traits might impact student attrition, but nobody seemed to consider the interaction between the individuals and the institutions themselves (Burke, 2019). These earlier studies also seemed to lack a theoretical foundation that could help measure the causes of students dropping out of college, and it is during this time that sociologist Vincent Tinto began to establish the groundwork of just such a theoretical foundation (Braxton, 1999). Tinto specifically highlighted that all previous studies about persistence in college or universities failed to delineate the characteristics of a college dropout. He also argued that there were no useful theoretical models that sought to explain the processes that would drive a student to leave institutions of higher education. At this point, he developed his theory of student integration, which addressed his findings (Tinto, 1975).

Society-at-Large

The global inequity of access to different educational opportunities have been discussed in studies (Davey et al., 2021). Often, this has been simply because some lived too far away from educational institutions or because individuals could not afford an education. Other times it was because students might have disabilities that limited their options. McMahon and Walker (2019) highlighted an IBM executive who had acknowledged that, while technology often makes things easier for most people, it actually makes things possible for people with disabilities. The societal impact that online or remote education can provide is becoming more evident as more people can access advanced learning. With the invention of modern digital technology, the speed and scale with which educational opportunities are identified continues to grow. Researchers are exploring ways internet-based learning impacts education and society in different industries (Peng & Yan, 2017).

With the continued growth of online education, other problems have begun to appear. As education moves away from being an elite privilege to becoming a more broadly available product, student retention is becoming more of a concern. While many more students can now access higher education, that also means that more students may begin but never finish their education (Kember et al., 2021). Student retention is becoming more of a concern for educational institutions, and several studies are researching the various factors that might contribute to a lower retention rate (Muljana & Luo, 2019). For many years the higher dropout rate among online programs was assumed to be primarily because of the social or economic conditions in which the students lived. However, more recently, the educational institutions themselves are being looked at, as there seems to be some impact that they can have on retaining students (Radovan, 2019).

Theoretical Background

This study is grounded in the theory of student integration, which can trace its roots back to the work of Vincent Tinto (1975) who had reviewed decades of research that had focused on understanding student departure, or persistence, at the college and university levels. Tinto concluded that much of the earlier research was lacking context and that a primary reason these studies had failed to effectively explain why students dropped out of college could be traced back to two major shortcomings: 1) inadequate attention given to defining the different root causes of why students might drop out, and 2) a lack of theoretical models that sought to explain, not just describe, the variables or processes that might cause a student to leave school prematurely. Tinto's study concluded that students would enter their college experience with one set of goals or expectations, but that, as a result of their social interactions with the college services and cultural environments, the student's goals or expectations might change. His research on social integration within a broader community has similarities to other research studies that explored the psychological underpinnings of how geographic neighborhoods organically evolved into different social structures, behaviors, and attitudes. These parallel studies have led to the idea of a sense of community (McMillan & Chavis, 1986). A sense of community has proven to play a significant role in many areas, and it has been shown to have an impact on persistence with first-year STEM (science, technology, engineering, math) students

(M. D. Johnson et al., 2020), as well as graduate-level STEM programs (Stachl & Baranger, 2020).

Problem Statement

Studies have shown a significant growth rate in the number of students taking online courses (Muller et al., 2019). However, these same studies often highlight that with this significant growth in online delivery, many colleges and universities are seeing a significant increase in the number of students who are dropping out or not completing their education (Muljana & Luo, 2019). Other studies have explored different root causes for why some students may be more likely or less likely to stay in STEM programs (Rainey et al., 2018).

A sense of community may play a role in the retention rates of online students (Nubani & Lee, 2022). A strong sense of community implies more than simply interacting with others; a student with a strong sense of community would be more likely to proactively reach out to others, fully expecting that the interaction will help the student learn (Rovai, 2002a). Using the sense of community as the dependent variable has been applied in several studies. Some have explored its relationship to things like student GPA, family, and home environment, and prior online learning experience (Nubani & Lee, 2022), while others have looked at racial or ethnic identity, and gender or sexual orientation (Beeson et al., 2019). As researchers continue to refine what variables might impact a sense of community in online course design, a gap has been identified that suggests future research should use other sample groups, such as undergraduate students or students from other countries (Kavrayici, 2021). One problem is that the literature has not fully addressed a sense of community as explicitly applied to IT undergraduate students, particularly to measure if there are any differences between the sense of community scores for online students based in the US and those based internationally.

Purpose Statement

The purpose of this quantitative, causal-comparative study is to investigate a student's sense of community within an online IT course and explore whether there is a difference if the student is based in the United States or whether the student is based internationally while taking the course. The independent variable in this study is categorical (Gall et al., 2007) and is based on the geographical location of each student while taking the course. Each student is assigned to one of the following two groups: 1) domestic students, those currently residing within the United States, and 2) internationally-based students (Gall et al., 2007). Three continuous dependent variables are measured using the Classroom Community Score (Rovai, 2002a). To calculate an overall score for sense of classroom community, this instrument identifies, calculates, and combines two distinct measurements: 1) Connectedness - feelings of cohesion, trust, and interdependence among members; and 2) Learning – perceived effectiveness of interactive learning within a classroom setting.

The population includes students enrolled in online IT courses at a small Christian college in the western United States. Students are introduced to the college and its online IT programs through an internationally recognized, global, non-profit organization that seeks students from underserved areas worldwide who desire a Christian-based college education. Each participant completed a foundational college preparation program that validates whether the student can speak, read, and write in English and is financially and emotionally prepared to endure the rigors of an undergraduate education. Once they have completed this preparatory certificate program, they can enroll in online courses through the college. Participating students come from over 188 countries around the globe and have a median age of 30 (BYU Pathway Worldwide, n.d.).

Significance of the Study

There is no shortage of studies related to the comparison of online vs. on-campus face-to-face modalities. However, there continues to be a need to explore specific differences among online offerings, especially when teaching IT courses online. Because of the need for access to fully functioning technology environments (i.e., public or private clouds, simulation, or virtualization technology), researchers have continued to explore how best to teach specific technical skills to online audiences (Luse et al., 2021). Interest in studying different elements around remote learning is expanding as many researchers are beginning to examine the many contributing factors that might impact whether a student can continue studying remotely and how instructional designers might build better online courses (Muljana & Luo, 2019).

Some U.S.-based colleges and universities are beginning to explore how to deliver their programs and degrees to an increasing international audience (Peterson, 2017). As the colleges explore this topic, they need to start making distinctions beyond simply whether a class is offered online or on-campus. The colleges need to identify what other unique challenges may exist between U.S.-based online students and online students who live, for example, in Fiji, Manila, Moldova, or Lagos, and who are all taking the same IT class together. The colleges will need to consider what additional barriers or challenges these newer, more broadly diverse students might face. These types of studies may significantly impact the ability of more and more learners around the globe to get an adequate education in IT.

Research Question

RQ1: Is there a difference in the connectedness, learning, and overall sense of classroom community scores between online, undergraduate IT students who are based domestically (within the United States) and those who are based internationally?

Definitions

The following definitions are provided to assist in reading this study:

1. *Cloud Technology* – This technology enables a ubiquitous, convenient, and on-demand online environment which provides a shared pool of computing resources that can quickly be provisioned or released without heavy administrative interaction (Mew, 2016).
2. *Experiential Learning* – Experiential learning is a type of learning model that emphasizes the importance of practical, real-world experiences in the education process (Dewey, 1938).
3. *Sense of Community* – This is a term used to describe "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to being together." (McMillan & Chavis, 1986, p. 9).
4. *Simulation* – A simulated environment allows time-based events to be saved, represented, analyzed, and understood (Dodgson et al., 2006).
5. *Virtualization* – A virtualized environment allows users to make a single physical device (i.e., server, OS, application) function as multiple devices, enabling companies to scale and grow more quickly and cheaply (V. Ng, 2010).

CHAPTER TWO: LITERATURE REVIEW

Overview

The purpose of this quantitative, causal-comparative study is to investigate a student's sense of community within an online IT course and explore whether there is a difference if the student is based in the United States or whether the student is based internationally. This chapter begins by describing the theoretical concepts that ground this study. It is followed by a review of the literature that has been done to explore how a sense of community among college students taking online courses from all over the world might be impacted by different variables, including demographics, different technologies, student/teacher interaction, student perceptions, and retention rates. Further, the literature review provides a conversation of some of the technical challenges of teaching IT-specific courses online and whether different learning styles or technologies might impact a sense of community. The chapter ends with a brief summary.

Theoretical Framework

This study is grounded in Vincent Tinto's integration theory (Tinto, 1975). Tinto had reviewed decades of research that focused on understanding student departure, or dropout rates, at the college and university levels. Among the many early studies, three significant justifications for studying student attrition seemed to stand out. The first reason for studying student attrition was based on the idea that an American college was more of a training center than it was an intellectual center. If students were failing to graduate from an educational institution, the focus generally did not shine on the students themselves and what they had been failing to do that would keep them from graduating, but rather the focus more often was on what the college must be doing wrong. If the college had a high number of students failing to graduate, the assumption was that the college must be doing something wrong, therefore any college or university would want to keep close track of the attrition rates of their students. A second reason for studying student attrition had to do with the size and complexity of modern higher educational institutions and the massive fixed costs associated with running these organizations (i.e. paid faculty and staff, buildings, among others) The pressure among those administrators tasked with running these large organizations necessarily had them concerned about efficiency. And a third reason for colleges and universities to study attrition rates of students was closely tied to the income requirements of reason number two. If students stop coming to college, then the revenues from their tuition and fees were reduced and the overall income for the institution was affected. Reasons number two and three were closely related, and as the institutions grew, their costs also increased, but if students were dropping out without finishing, then revenues were impacted, and if the number of enrollments drops too low, the reputation of the school could be impacted, which would serve to compound the lower enrollment problems (Summerskill, 1962).

A majority of the early psychological and sociological student retention theories that have been developed can trace their origins back to a book published in 1897 by a French sociologist named Emile Durkheim. Durkheim developed a theoretical typology of suicide that recognized four key social factors that might motivate someone to commit suicide (Crossman, 2020). These four factors include the following:

Anomic Suicide

The anomic suicide factor usually results from traumatic events, such as major social, political, or economic fluctuations that might cause an individual to feel disconnected from the broader society. These types of major events can significantly impact an individual’s normal routine and may cause someone to feel so confused or disconnected from the broader society that they consider suicide.

Altruistic Suicide

Altruistic suicide generally results from people becoming so wrapped up in a cause or perceived social impact that they are willing to die for that cause. One example of this type of suicidal motivation can be found in the infamous Japanese Kamikaze pilots of World War II.

Egoistic Suicide

Egoistic suicide is generally developed over time as people drift away from ordinary activities that would normally integrate someone into the broader society. Examples of this would be when a spouse passes away and the surviving partner finds themselves lonely. This type of result could also happen after someone retires from a rewarding career and finds themselves alone, bored, or isolated. This type of suicide is common among the elderly.

Fatalistic Suicide

Fatalistic suicide generally results after an individual is forced to live under oppressive conditions without the ability to make their own choices or decisions. This is commonly seen in prisons or among prisoners of war (Crossman, 2020).

A core conclusion of Durkheim's book was that suicide was not solely dependent on an individual's temperament, but that social causes can have a direct impact on whether someone might consider suicide. Durkheim suggested that the more socially integrated or the more socially connected a person felt, the less likely that person would consider committing suicide (Crossman, 2020; Godor, 2017). This exploration into different external (social) causes of suicide can be directly applied to educational research and the type of social interactions that would encourage a student to persist through a four-year educational program or those that might discourage persistence, leading to higher drop-out rates (Godor, 2017).

Tinto (1975) noticed that among the mountains of research that had been done on student persistence at the college and university levels, there did not seem to be any theoretical formulations that had been previously identified that could specifically account for why students left college before they were done. He began to work on a study of his own in an attempt to develop a theoretical foundation to more effectively understand student attrition (Braxton, 1999). Tinto eventually published his report in an attempt to identify a predictive theory that could provide a more solid foundation and support deeper research into student retention. (Halpin, 1990). Tinto (1975) defined a theoretical model that could explain the processes of interactions between individual students and the institutions themselves that might lead to students choosing to leave, while also distinguishing between the different reasons for students leaving. The model describes how a student enters a social organization (the institution of higher education) with different backgrounds and experiences and with differing goals and motivations, then begins to interact with the college environment through two primary systems: the academic system, and the social system. As time passes and the student continues to interact with these two primary systems, their original motivations and goals might change as a result of their social integration. For some, it may further reinforce their commitment to persist, while for others this social integration may lead to departure (Halpin, 1990). Tinto (1975) discussed a common mistake found among much of the earlier research that failed to distinguish between dropout data resulting from a student failing their coursework and the very different data resulting from voluntary withdrawal for other causes.

Several studies have built upon Tinto’s work through the years. Some highlighted that Tinto’s theories and practices seemed too broad and explored ways that the institutions themselves might help the students to adapt and acclimate to the college experience (Collings et al., 2014; Hlinka, 2017). One study suggested that peer mentoring programs are no longer considered apprentice or tutoring offerings, but rather are more likely to be used as a retention tool for undergraduate education (Collings et al., 2014). Another study examined whether Tinto's theory needed to be refreshed to a more modern context, specifically taking into consideration the impacts of social media as an additional tool to help in the social integration of students, not only in-person and on campus, but also within an online modality (Wesseling, 2016). As Tinto's theory evolved, researchers began to consider demographic data as they explored the backgrounds of different students in an attempt to better understand if demographics might have an impact on how well students socially integrated into the college or university (Racchini, 2005). Other student retention models and theories have continued to evolve. Some have studied the interaction between students and faculty, while others have looked at what motivates students to become involved in different parts of their college community, whether that is social clubs, professional clubs, or other extra-curricular activities sponsored by the institution (Aljohani, 2016).

This focus on social integration within a broader community has similarities to other research studies that have explored the psychological underpinnings of how geographic neighborhoods organically evolved into different social structures, behaviors, and attitudes. One term commonly used when studying the psychological impact of social interactions among people is sense *of community* (McMillan & Chavis, 1986). A sense of community has proven to play a significant role in many areas, and it has been shown to have an impact on persistence, or attrition rates, among first-year STEM (science, technology, engineering, math) students (M. D. Johnson et al., 2020), as well as graduate-level STEM programs (Stachl & Baranger, 2020). This study uses sense of community as an application of Tinto's social integration model and looks more closely at how instructional designers might consider building online courses with a focus on community to impact student attrition and persistence.

Related Literature

Considering the many variables that might impact, or be impacted by, a sense of community, it is reasonable to consider the impact that course design and technologies used in an online modality might have on sense of community. The scope of this study is specifically examining students taking online IT courses from anywhere in the world. Therefore, it is essential also to understand the broader context in which these students are taking an IT course and in what ways a sense of community might be impacted through the regular efforts and interactions of online, asynchronous students from all over the world. Studies have often looked at different ways that technology might impact social isolation or sense of community (Baker et al., 2018; Oladele et al., 2023; Rennar-Potacco et al., 2019), but the technology required to teach IT courses goes beyond simply presenting content, such as videos, reports, or instructional readings. In addition to facilitating interaction between students, the technology that is used to provide learning experiences or hands-on experiential practice should also be considered. There are infrastructure elements that may need to be considered that will allow any student to run the same type of technology remotely that he could run if he were physically sitting in a campus lab environment (Burgos & Corbi, 2018; Huang, 2019; Mitra & Gupta, 2020). The technology involved in online learning needs to be discussed from different perspectives. For example, one study's perspective was how technology is currently being utilized to combat social isolation, finding three things that were common among the different participants studied: 1) social networking using the cell phone was the most common method of interaction; 2) social outcomes were not clearly defined; 3) methodologies used to evaluate interventions were often limited

(Baker et al., 2018). Other studies have highlighted that different tools and delivery technologies can impact how well students interact with each other and thus help impact the sense of community (Aloni & Harrington, 2018; Clark et al., 2021; Gay & Betts, 2020; Stachl & Baranger, 2020).

Encouraging a Sense of Community

Multiple factors can play into whether a student feels a sense of community. Some studies have shown that social and psychological characteristics of participants can impact whether a student feels a sense of community within a classroom environment (Anli, 2019; Apriceno et al., 2020; Baker et al., 2018; Kavrayici, 2021; Washington & Mondisa, 2021). These studies highlight the importance of social interaction between the teacher and the students, as well as between the students themselves. Students who experience a high sense of classroom community do not report feeling isolated, demonstrating higher academic achievement in learning environments (Anli, 2019). Classrooms are environments where students and instructors work together to learn, and classroom management includes actions or activities taken by the teacher to create a culture or environment in which students can learn. The classroom environment is generally defined or established by the instructor (Kavrayici, 2021). Studies have identified that the way an instructor leads the course through regular interaction and guidance can have a direct impact on whether the students feel a sense of community (Berry, 2019; Kavrayici, 2021). Strategies to build community within a classroom might include the instructor proactively reaching out to students in the class early and often, limiting the amount of time used to lecture, increasing the amount of discussion between students and instructor, or taking time during class to share personal experiences or professional guidance (Acevedo et al., 2021; Berry, 2019).

Demographic Impacts

Researchers have looked at common demographic differences, including age, racial or ethnic identity, gender identity, GPA, and annual household income, among others. In many cases, one's gender or race consciously impacts their interpersonal relationships. For others, it is more about finding common interests or just having a love for the technology or science involved. This points to students having some level of responsibility for their feeling of community within a classroom setting and not solely an impact of race or culture (Beeson et al., 2019; Hall & Jostad, 2020; Pendergast et al., 2018; Rainey et al., 2018). One particular study identified four broad themes that seemed to have an impact on whether students felt connected with others in their STEM major: 1) interpersonal relationships, 2) science identity, 3) personal interest, and 4) competence (Rainey et al., 2018). As researchers continue to explore the different ways that a sense of community can impact learning, it allows consideration of what elements and variables might be impactful within a classroom or online classroom environment. While many demographic groups show correlational relationships through a sense of community, understanding which groups can be impacted can help instructional designers build better courses (Berry, 2019; Studebaker & Curtis, 2021). The next several sections explore the research in some of the key demographic areas that might be impactful in future course designs.

Race

Many studies have already been completed exploring the relationship between race and a sense of community (Balke et al., 2021; Bello, 2018; Brockman, 2021; Garcia, 2019). One study looked specifically at the impact of grouping students with the same racial or ethnic background into introductory STEM courses, which resulted in the students reporting more satisfaction in the course because they did not feel isolated by their race or ethnicity (Abrica et al., 2022). There is supporting research that shows that different ethnic or racial groups are more inclined to graduate from college, and this difference is even more dramatic when looking at which groups are more inclined to study STEM degrees (Brockman, 2021; Cooper et al., 2019; Jelks & Crain, 2020; M. D. Johnson et al., 2020). Other studies looked at whether there might be a hierarchy of identities when it comes to race and those who study STEM degrees. The approach was whether the individuals in the study would identify primarily as a STEM identity (meaning that the individual considered themselves a STEM student first) or whether their racial identity was their primary identifier. The thinking appears to be that, while we can all identify as a particular race or profession, each student would either consciously or unconsciously determine whether they identified primarily by their race first, or whether they identified by their professional interest first, with race being a secondary identity (Martin-Hansen, 2018; Norman et al., 2021; Singer et al., 2020). One study refers to racial or demographic identities as exclusive identities (belonging to a particular race or ethnic group). Consideration is given of the identity of a particular learning community (for example STEM student) as an inclusive identity (Norman et al., 2021). Multiple studies specifically found that White students were more likely to stay in STEM programs, although the studies did not explore the root causes to determine whether it was because of their genetic makeup, or whether it was more because of a broader cultural identity of different racial groups being part of a STEM community (Cooper et al., 2019; Rainey et al., 2018). Studies have been completed to look at the cultural and racial impact of students who identify as STEM students specifically within the Latino community (Bello, 2018; Garcia, 2019)

Gender

There have been several studies looking at why women seem less likely to choose STEM as a career (Master & Meltzoff, 2020; Pedraza & Chen, 2022; Rainey et al., 2018). Different types of belonging have been identified, including *social* belonging, which looks at how comfortable students might be if their demographic is not as well represented in learning environments. There is also *academic* belonging, which considers that students might feel uncomfortable if they sense they do not have the skill set that others in their classes might have (Master & Meltzoff, 2020). This information adds to the growing importance of a sense of community within different groups to increase motivation or encouragement to study STEM degrees. Some studies have even looked at gender and race and have explored whether a sense of belonging might be different for Latina women or Black women and whether either case might impact whether these women continue to study STEM degrees (Bello, 2018; Cook-Sather & Seay, 2021).

Age

Age is another demographic variable that has been studied with a sense of belonging (Au et al., 2020; Beeson et al., 2019; Kilinc & Altinpulluk, 2021; Portacolone et al., 2020; Tang et al., 2021). Some studies have focused on finding ways to encourage seniors to remain active through beloved activities, such as singing in a local community choir, or whether depression or negative emotions were impacted by developing more of a sense of community (Portacolone et al., 2020). Other studies looked more at the impact that technologies might have on a sense of belonging or feeling like part of the community, which sometimes is different for older students than younger students (Baker et al., 2018; Beeson et al., 2019). It is relevant to clarify that among the findings, the most common technology being used involved social media sites and touch-screen technologies (Baker et al., 2018; Kilinc & Altinpulluk, 2021). In an on-campus environment, it has been found that, as age increases, students are less likely to report a positive sense of community (Barry et al., 2021). Overall, it appears that when considering age and its impact on a sense of community within an educational environment, three recommendations have been identified to help older, non-traditional students feel more plugged in and part of the broader community: 1) provide opportunities for the older students to interact with other non-traditional adult students; 2) encourage them to develop relationships with faculty and staff, and 3) design departmental, or college-wide structural supports for these adult students (Olson et al., 2020).

Nationality

Because this study is measuring the sense of community in online courses that can reach an international audience, it is important to explore what research has already been done concerning the sense of community across international boundaries. While there is a growing number of studies that explore the sense of community within international groups studying at U.S. colleges and universities, the articles found, during the research for this study, primarily looked at international students who had traveled to the U.S. and were physically on campus to pursue their studies; some of these studies identified higher anxiety and stress levels because of language barriers or cultural distinctions. (Chen & Zhou, 2019; Garcia, 2019; Rodriguez & Blaney, 2021; Zhang et al., 2022). One study specifically looked at Chinese students who were physically studying in the U.K. and identified similar challenges related to culture and language. Still, they discovered that sometimes the technologies that the students are familiar with might differ between countries of origin, which can create challenges or roadblocks (Smith & Watson, 2022). Another study found that international students who were studying in the United States could build a sense of belonging by supporting the sports teams of the school they were attending. This would naturally involve attending, cheering the success, and even mourning the failure, of the different school teams (K. Kim et al., 2022). Looking specifically at international students who were seeking doctoral degrees within the U.S., another study identified the challenges of seeking financial support as another significant hurdle that needed to be addressed for international students that domestic students do not always experience (Zhang et al., 2022). All of these unique challenges that are so often faced by international students could impact their sense of belonging within the larger classroom or campus environments and need to be considered as designing courses is looked at for an online international market.

Language

Language is often highlighted as a barrier to building a sense of community within a large class because international students may often be more familiar with the different terminology, contexts, and anecdotal examples from their home country and in their language, and the words, contexts, and example scenarios may not be relatable or understood correctly by each student (Cena et al., 2021; Rivas et al., 2019; Rodriguez & Blaney, 2021). Additionally, international students felt a higher sense of stress and homesickness, which added to their sense of isolation (Cena et al., 2021; Rodriguez & Blaney, 2021). Some international students specifically struggled with finding a sense of belonging among their fellow American students. They reported that they found more success in building social relationships with other international students, even if they were not from the same countries. The most common reasons were cultural and language differences, and to many international students, Americans often seem more independent and self-reliant than what many of them were used to (Rivas et al., 2019). Fostering a sense of belonging is critical for helping international students succeed in higher education (Loveland, 2018) but many have acknowledged that with time, and through access to school or departmental support systems, relationships and a sense of belonging could be nurtured (Loveland, 2018; Rivas et al., 2019). Findings continue to highlight the need for schools to seek ways to better understand the needs of their international students and tailor services to better support and encourage them (Cena et al., 2021; Rivas et al., 2019).

Many schools are getting better at providing these targeted services for their international students. Some studies are finding that while so many of these students struggle as they initially acclimate to their college experiences, they are finding help and assistance at the departmental or even classroom level. This provides additional anecdotal insights into the value of specific course design, as some classes can utilize the unique cultural or traditional differences of the diverse students within the class and use them as a way of getting to know each other or learning about each other, which will naturally lead to a stronger sense of belonging and community (Rivas et al., 2019; Rodriguez & Blaney, 2021). Alternatively, some larger internationally-diverse courses might provide opportunities for those students with common backgrounds or languages to work together on projects and assignments, which might also allow them to build friendships and a closer social support network (Schietroma, 2019). Another common thread that helps build a sense of belonging and community within course design is to help international students to practice their English writing and communication skills through the use of online discussion boards, Learning Management Systems (LMS), and social media offerings, where the students would need to write or speak in English with their classmates who are working on the same projects and assignments (Almelhi, 2021; F. Li & Liu, 2018).

The Teacher's Impact on Sense of Community

Various studies have explored the importance of instructor interaction with students in building a sense of community for the students (Chang & Bangsri, 2020; Fiock et al., 2021; A. L. Miller et al., 2019; Turk et al., 2021). Other studies have looked at ways in which course designers can build opportunities for instructors to interact with their online students, thus encouraging students to become more engaged with others and build a sense of community through their interactions (Davidsen et al., 2019; Fiock, 2020; Knekta & McCartney, 2021; Mollenkopf & Gaskill, 2020). Some studies show a clear relationship between a sense of community and persistence within STEM courses (Friess & Lam, 2018; K. C. Li & Wong, 2019; Olson et al., 2020). For example, some studies have found that students who felt they had a strong sense of support from their instructor were more likely to persist through their program and reach graduation (Crowe, 2021; Whitehead & Ives, 2021). Another study highlighted the impact a female instructor might have on women students simply by providing an example to the students of a successful woman in IT (Luo et al., 2022). Sriram et al. (2020) identified three different types of interactions in which students might engage with faculty, staff, and peers: 1) academic interactions, 2) social interactions, and 3) deeper life interactions (defined as those interactions that occur more around meaning, values, and purpose.) They then looked at relationships between the type of interaction and the participants, identifying five variables that could predictably account for 50% of a student's psychological sense of community. These variables are 1) academic interactions with peers, 2) social interactions with peers, 3) deeper life interactions with peers, 4) deeper life interactions with faculty/staff, and 5) social interactions with faculty/staff that involve a commitment of time. Other studies have explored the impact that an instructor's expectations can have on the self-confidence and achievement of their students, finding that as teachers raised the expectations of their students, validated their efforts, provided consistent and helpful feedback, and generally conveyed the sense that they were confident the students could meet the course expectations, student success can become a self-fulfilling prophecy (Gentrup et al., 2020; LaCosse et al., 2021; Papageorge et al., 2020).

The instructor can also serve as a mentor for the student. Mentoring can be defined as a process in which one or more experienced individuals provide knowledge or psychosocial support to less experienced individuals. Several studies have looked at the impact that instructors can have on students through personalized mentoring (Luo et al., 2022; Sriram et al., 2020). While teachers can sometimes fill the mentoring role for their students, some courses are designed to encourage outside professionals to become involved with students. This can be driven through course design and outreach assignments or the personal or professional network of the instructors, but the results of these efforts have been shown to promote an enhanced sense of community among the students as they build relationships with others through the classroom experiences (Sriram et al., 2020; Washington & Mondisa, 2021). STEM majors have historically shown a higher attrition rate than non-STEM majors, and studies have explored the impact that mentoring can have in building confidence and a sense of belonging for STEM students (Apriceno et al., 2020). Students do bear some responsibility for their ability to build a sense of community within their classrooms, and studies have identified psychological characteristics within individual students that could impact whether or not they feel an emotional closeness with their classmates or instructors (Anli, 2019). This adds to the research, as it helps to put parameters around the discussions concerning who might be in the best position to directly impact the sense of community within a classroom setting: the designer, the instructor, or the students themselves.

Student Perception of Community

As might be expected, not all students will rate a sense of community the same way, and several studies have explored student attitudes and perspectives relating to the sense of community (Chatterjee & Correia, 2020; Lin & Gao, 2020; Trespalacios & Lowenthal, 2019).

There is a correlation between the attitude that students have towards collaborative learning and a sense of community when it comes to online or distance learning environments. These attitudes can be directly affected by the type of technology used or the ease with which the technology can be accessed (Chatterjee & Correia, 2020). There also appear to be distinctions between the perceptions of undergraduates and those of graduate students when it comes to their attitudes toward collaborative learning projects and assignments (Chatterjee & Correia, 2020; Trespalacios & Uribe-Florez, 2020). One particular study discovered that the courses within their STEM program that earned the highest scores from student feedback surveys regarding a sense of community were those courses that used a plethora of small group interactive team projects (Trespalacios & Lowenthal, 2019). Interestingly, within the same study, the second most popular reason students felt a sense of community within their courses was a result of the instructor's efforts, personality, or other personal traits. However, the researchers point out that the results for this particular variable included three different teachers who all taught the same course, which would imply that possibly the way the course was designed had more of an impact on the sense of community than the actual instructors themselves. Other studies also encouraged a deeper dive into course design but warned that a sense of community does not just naturally occur; there is still a need for teacher interaction, planning, and guidance to help facilitate community among the students (Chatterjee & Correia, 2020; Trespalacios & Uribe-Florez, 2020).

The global Covid-19 pandemic impacted education in a major way. One interesting result of this disruption provides some unique opportunities for this particular study, as there was ample opportunity for researchers to more fully explore the possible differences in remote learning from classroom learning, and several studies were conducted during this timeframe to explore student perceptions on how remote learning impacted their learning experiences (Cancino & Towle, 2022; Iluzada & Talbert, 2022; Means et al., 2021; J. Zhou & Zhang, 2021). Before this time, many colleges and universities had resisted implementing remote learning models for various reasons (Goncalves & Capucha, 2020; Lin & Gao, 2020; Lowenthal et al., 2021). One particular study took the research one step further and compared students' perceptions of a sense of community by comparing synchronous remote classes against asynchronous remote classes (Lin & Gao, 2020). The findings included identifying the key advantages and disadvantages of synchronous learning, contrasting them with the key advantages and disadvantages of asynchronous learning. Among the findings from this study, it was determined that college students have a stronger sense of community through online interaction, discussions, and sharing ideas using the asynchronous model over the synchronous format.

Retention Rates

Higher education used to be considered an opportunity primarily afforded to a smaller, more elite group. This group generally included students who had already performed well during their high school years and had come straight from high school to college. Thus, most students were in their late teens or early 20s. Most did not have any responsibility to take care of their own families, and they generally came from families with above-average incomes and whose parents also had already completed college degrees (Kember et al., 2021). With the growth of the global internet, more and more students can access higher education, and, while this would seem to be an incredible success, the research is finding that some negative unintended consequences are also being discovered. While enrollments in online college-level programs are growing, the number of students who are not finishing college degrees is also growing at a significant rate (Radovan, 2019; Stone & Springer, 2019; Trespalacios & Lowenthal, 2019). Studies have shown that certain program factors and characteristics can have an impact on student experiences and therefore can impact retention rates (Australian Government Tertiary Education Quality and Standards Agency, 2020; M. D. Johnson et al., 2020; McKim et al., 2018). Some have specifically looked at things, such as social presence and the use of interactive technologies to increase retention rates (O'Hara & Sparrow, 2019; Oregon et al., 2018; Stone & Springer, 2019). Student factors, such as emotional needs and social interaction, have also been found to have an impact on retention numbers (M. D. Johnson et al., 2020; K. C. Li & Wong, 2019; Trespalacios & Lowenthal, 2019). Supporting services offered by the college or university can also play a significant role in increasing retention rates (Gregori et al., 2018; K. C. Li & Wong, 2019; Muljana & Luo, 2019; Netanda et al., 2019). These services might include things like online tutoring services, regular interaction with the instructor, and technical support. Instructors play a significant role in encouraging students to stay in online courses. Researchers have looked at how students struggle with a sense of isolation and how outside interventions can encourage students to stay enrolled in STEM classes (Brezynski et al., 2019; Gay & Betts, 2020). Other studies found financial barriers a key variable in whether students stayed enrolled. Many schools considered scholarship programs, or other financial services, to encourage students to stay enrolled (Chapman et al., 2019; Netanda et al., 2019; Wright et al., 2021).

Challenges of Teaching STEM Courses

When teaching IT courses, it is not enough to just have instructors that know how to teach about a topic or technology, nor is it sufficient to have the latest technical labs or environments to provide the learning experience. If the teacher does not know how to use the environment, they may not be as effective in teaching the course. There is a significant number of research studies that explore what is called teacher self-efficacy which addresses these concerns. Bandura (1977) described self-efficacy as the confidence an individual has in their ability to complete a task. As we consider the broader influence of a sense of community within IT classes, it is important to understand the role a teacher plays in creating the right environment to encourage a sense of belonging. If a student has questions or problems in class, a sense of community would imply the teacher would be comfortable providing aid and support to the student. Therefore, it is necessary to consider the impact that a teacher's self-efficacy has on teaching STEM classes. It is not enough for the teacher to understand the technology they are teaching; they also need to understand and be able to use the technical environment that will be needed to deliver the lessons or provide the experience to the students. The literature highlights that teaching STEM courses requires unique efforts to ensure teachers are confident in teaching the content of their courses (Aydin, 2020; Burch & Mohammed, 2019; Churches & Lawrance, 2021; Crawford et al., 2021).

As teachers become more comfortable in teaching STEM courses by developing their self-efficacy, they should be more able to encourage and build a sense of community and self-efficacy among their students. Studies have also explored the impact on a student's self-efficacy and learning within STEM courses. These studies have looked at how focusing on a sense of community and belonging can increase a student's self-efficacy, which results in higher retention rates within STEM programs (Chiang et al., 2022; De Loof et al., 2022; Hanna et al., 2021; Slovacek et al., 2019; Washington & Mondisa, 2021; S. N. Zhou et al., 2021). Student self-efficacy appears to be a significant consideration in whether or not students continue studying in STEM programs, and the studies have identified many key elements that could positively impact the confidence of the students, thereby encouraging them to continue in their studies toward a degree in STEM (M. D. Johnson et al., 2020; McKim et al., 2018). Studies have also explored what may discourage students from studying STEM as a career (Bickle et al., 2019; Brewer et al., 2021). These studies looked at variables, such as too many math requirements, a student's fear of failure, or being considered *not cool* by others. Students also identified the quality of the program as not meeting expectations.

Challenges of Teaching Online

Teaching classes online also requires some unique strategies and planning. Instructional designers can directly impact a student's sense of community through course design in an online modality (N. L. Davis et al., 2020; Peacock & Cowan, 2019; Peacock et al., 2020; Studebaker & Curtis, 2021). As designers identify different elements that might have an impact on a students' sense of community, there are some unique tools and methods that can be considered for online learning environments. Online courses should have scaffolding and other elements to encourage learning (Collins et al., 2019; Foley & Marr, 2019; T. Miller et al., 2020). The social influences of ensuring a connection with the instructor and providing other support interventions also should be included in online course design (Aloni & Harrington, 2018; Glazier & Harris, 2021). Common technologies that are used to facilitate this are discussion boards, video-conferencing technologies, and instant messaging apps within LMS systems (Aloni & Harrington, 2018; Perrotta, 2020; Rennar-Potacco et al., 2019; Swickard, 2021). Instructional designers also need to consciously design interactive elements into their online courses that encourage students to communicate with each other and provide assistance to one another. Mentoring models are helpful in online learning environments and help to build a sense of community (Fraenza & Rye, 2021; Washington & Mondisa, 2021).

Challenges of Teaching STEM Courses Online

Teaching STEM classes has always been challenging, but things can get even more complex when we consider what is needed to teach STEM classes using a remote, asynchronous modality. Teachers not only have to understand the technology they are teaching about, but they also need to know how to use the technology that will deliver the learning experience to the students (Crawford et al., 2021; Gardner et al., 2019; Kelley et al., 2020). For example, in a face-to-face modality, teaching a student how to install an operating system on a computer requires the student to have access to a computer and the installation files of the operating system. Historically, the schools could provide computers and would often let students install the operating system over and over onto the same physical hardware. Over time, that has not been a scalable solution since the equipment is expensive and can break. Eventually, the concept of virtualization was created which allowed students to install *virtual* machines (VMs) inside of an application running on their host machine (Huang, 2019; Mitra & Gupta, 2020; Ramakrishnan et al., 2020). Studies have found that access to computers is one variable that makes it challenging for students to take STEM classes (Cackley, 2021; Tierney et al., 2018). When we consider remote learning from all over the world, we need to consider those parts of the globe where students are not able to purchase a new computer easily or cheaply. Most of these international students that do have access to computers are likely to be using an older computer that does not have enough memory or processing power to run VMs locally on their machine. This is where schools and teachers need to provide the global infrastructure to support these students. Cloud technology has provided this type of capability, which allows students to install and configure VMs remotely (Chukusol & Piriyasurawong, 2022; Friadi et al., 2022; Hu et al., 2020). With this cloud infrastructure, schools are beginning to provide a more equitable environment where all remote students can have similar learning experiences.

Experiential Learning

While this study is grounded in the theory of integration, the population for the study includes students who are enrolled in IT courses built in an experiential style. Experiential learning is an area that has been widely studied, and multiple studies strongly encourage practical, hands-on projects and other real-world tasks as part of any curriculum, which generally encourages a stronger sense of community (M. D. Johnson et al., 2020; A. Y. Kolb & Kolb, 2017; Massari et al., 2018). By way of background, D. A. Kolb and Fry (1974) explained that the basic foundation of experiential learning is deceptively simple, and that learning happens through an integrated process that begins with real-world experiences, followed by the collection and analysis of relevant data related to the observed experiences. The results of this analysis can provide feedback to the student, who can then modify their actions or reactions and choose new experiences based on that feedback. IT classes often require students to learn by doing. They might require students to install and configure a server or design and build a network with multiple devices. This will also provide opportunities for students to struggle with misconfigurations and systems that require troubleshooting to get them working correctly.

Experiential learning highlights a student-centered focus on course design and teaching, where students are responsible for completing the projects or tasks during the learning processes (Goncalves & Capucha, 2020; Matriano, 2020; Villarroel et al., 2020). Learning happens as students have a hands-on, concrete experience and are then able to reflect on what they observed. This reflection helps them to conceptualize different lessons from their experience which might include changes or adjustments that need to be made or things they liked or did not like, which then motivates the student to pursue additional experimentation. The experience and reflection generate the incentive to analyze and continue their experience. This also creates the potential for students to develop a sense of community as they work interactively with other students on projects and lab assignments (B. K. Johnson, 2020; Koivisto et al., 2017).

Other variations of experiential learning have evolved through the years. Two similarly related, yet uniquely distinct variations are problem-based learning and project-based learning (Aldabbus, 2018; Bertel et al., 2021; Naji et al., 2020). Project-based learning involves a question or problem that the teacher presents to the class and uses this scenario to motivate and encourage students to work together to complete the project. The teacher serves as the facilitator of learning as the students are given their scenarios. This model encourages problem-solving, exploration, research, interaction with others, and creativity (Matriano, 2020; Mentzer et al., 2020; Saleh et al., 2019). As students work together, they are encouraged to use whatever resources are available to them, and there is rarely only one solution to solve a problem. The scenario provided by the instructor usually creates the opportunity for the students to identify how they will complete the project. Inherent in the experience is interaction within the group of students, as well as encouraging problem-solving and creative thinking, all of which help the students learn and develop a sense of community. Projects can usually be easily identified by the instructor and adapted to the needs of the class. Alternatively, problem-based learning is very similar to project-based learning. Many researchers will use the two terms interchangeably because there are so many similarities. Both highlight self-direction and collaboration among the students and provide opportunities to teach many desired hard skills, such as communication and problem-solving (Kolbaek, 2018; Naji et al., 2020). However, problem-based learning is more about the acquisition of new knowledge, whereas project-based learning is more about how knowledge is applied (Mills & Treagust, 2003).

Computer-based Scaffolding

Computer-based scaffolding is a key component of experiential learning because it can provide the student-centered instructional environment needed to promote learning and creative problem-solving (Belland, 2017; N. J. Kim et al., 2018; Moallem & Igoe, 2018; Saleh et al., 2019). When we consider how to best teach STEM classes, applying experiential learning elements to provide scaffolding for the students does appear to have an impact (Alves et al., 2018; Beier et al., 2019; N. J. Kim et al., 2018). To provide the type of experiential scaffolding needed for IT students to truly get a hands-on, real-world experience in their classes, it is common for course designers to use different technology environments (Chitongo & Suthers, 2019; Luse et al., 2021; Mitra & Gupta, 2020; D. T. K. Ng & Chu, 2021). There are many different technologies available for this purpose, but the literature has identified several types of technology that have shown a positive impact on a learner's ability to build new knowledge. Some of these different technologies are discussed in the following sections. Through the use of these technologies, instructional designers can use experiential learning techniques to enhance the learning experiences of online students. The following sections look at many different types of technologies that can be used in online course designs to help have a more experiential learning opportunity while taking IT courses.

Virtualization Technology

The first technology is known as *virtualization*, which is specialized software that allows a student to build virtual machines within their local computer system software environment that run and act as if they were real physical machines, but they are in actuality running an isolated and completely segregated operating system running in the memory of the local computer (Gaspar, 2007). The key uniqueness of virtualization is that it is a real and complete environment (running in memory within the host computer), which allows the student to build and configure whatever they choose and allows experiential learning as students can build any virtual environment they would like (Huang, 2019; Luse et al., 2021; Mitra & Gupta, 2020; Southgate, 2020; Syamsuddin, 2019). Virtualization allows for the sharing of computer resources and, when properly configured, virtualization technology will allow a user to install multiple virtual machines (VMs), all running on one physical computer. VMs are flexible and versatile and are generally safer and less expensive to use in educational lab environments than dedicated physical hardware, thus minimizing the risk of inexperienced students damaging expensive high-end physical machines. If a student misconfigures a VM or corrupts the environment of a VM, it is quick and easy to simply delete and rebuild a new VM (Huang, 2019; Mitra & Gupta, 2020). If the physical hosting machine has enough resources, then there is also no additional cost to create a new VM, students can create as many VMs as needed on the existing hardware without requiring any new purchases, thus providing significant financial savings.

Simulation Technology

The second technology that has been identified as helpful in providing experiential, hands-on learning is known as *simulation technology* (B. K. Johnson, 2020; Koivisto et al., 2017; D. T. K. Ng & Chu, 2021; Rashid et al., 2019). Simulation is an environment that is programmed to act like a real OS, but it is not a truly functioning environment. The best example of this type of environment would be a flight-simulation environment which allows someone to experience what it might be like to fly an airplane without the cost of having to purchase, maintain, and support an actual airplane. Simulated environments also provide the learner with a very safe environment in which to learn. Failing to correctly land an airplane in a simulated environment would not have the same fatal result as failing to land an actual airplane for the first time using a full-sized actual airplane; thus, there are financial, as well as safety and security elements, that are also advantageous through the use of simulated environments (D. T. K. Ng & Chu, 2021).

Cloud-Based Environments

Another technology identified as effective in experiential learning is a cloud-based environment, which is ideal for remote or distance learning. This environment is a form of virtualization but is generally hosted centrally, which allows learners to connect to the learning environment from anywhere in the world (Attaran et al., 2017; Kumar & Sharma, 2017; Mitra & Gupta, 2020). Cloud-based learning can provide an effective student-centered learning environment and, because it is centrally hosted, multiple students can access the same environment, which enables the use of social tools and encourages the learners to collaborate and interact with one another and build a more robust sense of community as they share the experiential learning environment (Chukusol & Piriyasurawong, 2022; Friadi et al., 2022; Gross & Ho, 2021; Kumar & Sharma, 2017). A cloud environment expands upon the idea of running VMs on a single machine where a user can run multiple VMs on a single device. By placing a machine in a centrally accessible environment or data center that can be accessed from anywhere, the VMs that are created on that machine are available to all others. It is this centralization of virtualized systems that makes a cloud environment so powerful for remote asynchronous learning. People can access the same VMs from anywhere in the world, and they can access these VMs at the same time, which creates the possibility of interaction between other students even if they are physically separated from each other. The physical limitations of only being able to use one server are also removed with virtualization technology, as multiple machines can be added to the virtualized environment thus creating a single virtualized *cloud*, or cluster of computers, that may be made up of one or more physical computers grouped together. The cloud, or cluster of computers, can grow and expand beyond the physical constraints of one box. This creates an environment where a cloud could theoretically grow infinitely large because when the resources of the current set of underlying machines hit the physical limits, a new physical machine can be added to the cluster of machines that make up the expansive virtualized environment (Bartlett, 2019).

Discussion Boards

Arguably, one of the most common tools that course designers use to encourage students to interact in an online asynchronous course is the use of discussion boards or discussion forums. Most modern learning management systems provide some form of discussion board feature within the learning system. They are often considered an effective tool for helping students develop or enhance their ability to think clearly and write effectively by requiring students to regularly submit entries (Almelhi, 2021; F. Li & Liu, 2018; Perrotta, 2020). They have also been found to encourage reflection and the sharing of ideas between students, which can reduce anxiety and strengthen a sense of belonging among the students (Aloni & Harrington, 2018; Gay & Betts, 2020; Scott & Schofield, 2022). Three main elements that facilitate meaningful learning through discussion forums have been identified: 1) cognitive presence, 2) teacher presence, and 3) social presence. It has been argued that the social presence might be the most difficult to re-create through discussion boards simply because it generally lacks the spontaneity and fast-paced back and forth that is often found within the classroom setting (Bolduc-Simpson & Simpson, 2020). While there is a prevalence of research that studies the impact of discussion boards in online courses, not all studies are positive regarding the use of discussion boards (Machajewski et al., 2019; Mays & Ross, 2022; Woods, 2022). One study explored whether students were more likely to feel a social presence with classmates through the use of online discussion boards or by using a multi-modal technology that allowed users to create short videos and audio clips in addition to discussion boards (Chen & Bogachenko, 2022).

Video Technology

Others have found that while discussion forums can create a valuable learning community, live interaction between students or between students and the instructor might be more impactful (Mays & Ross, 2022; Milovic & Dingus, 2021). This might involve using video technologies to record student comments, reactions, emotions, and other visual nuances to help build a sense of connection between participants or to record instructors speaking about topics. One study found that while there was value in allowing students to record and share videos, the value of connecting with the instructor proved more impactful (Mays & Ross, 2022). Using a recorded video can build a sense of psychological safety by showing vulnerability between participants and allowing students to speak directly to each other as compared to the written word which can hide emotion and tone. The use of video technology was found to provide this psychological impact whether it was used in a real-time context, or was recorded or delivered in an interactive video format (Adams, 2021; Afify, 2020; Chicoine et al., 2022; Price et al., 2021). These emotional and psychological nuances and distinctions add additional complexities and considerations for course designers, as they would need to consider how long videos should be and whether real-time or interactive videos are effective in every context or whether they add more confusion and dissonance for students in their efforts to create and share them (Afify, 2020; Oregon et al., 2018).

Gamification

Another strategy that is sometimes employed to encourage a sense of community or a sense of involvement within a classroom environment is the use of gamification. Many gaming strategies can provide positive reinforcement and opportunities to build a sense of community among students (Mays & Ross, 2022; Vanderstraeten et al., 2022). Applying game design elements to different environments and scenarios to encourage the participation of students is sometimes referred to as *gamification*. The idea is that students will be more engaged in learning about something if the actions and activities within a learning module include the use of game elements, but this does not mean that instructional designers are expected to build new games from scratch. Instead, the gamification process will often use points or badges as a means to entice and encourage student participation. Other benefits are also often highlighted as resulting from the use of gamification strategies. These include better cohesion between students within a classroom or online section, a reduction of interpersonal conflicts, a measured improvement of social skills, an increased ability to solve problems, as well as many others (Arias-Chavez et al., 2022; Bicen et al., 2022).

While there is a significant amount of research that suggests a positive increase in learning and feelings of connectedness among students, there is also research that suggests gamification is not necessarily effective in other ways. While it has clearly been shown to positively impact student engagement and motivation, it has also been shown to create other unintended consequences, such as impacting confidence or creating doubts or conflict (Iorgulescu, 2022). It has also been shown to be transient and to have short-term effectiveness. While using gamification elements can encourage involvement, these elements should be used sparingly and should not create a sense of *forced fun*. Participants need to have the freedom to consent to whether they want to participate or not. It does not always generate the desired motivational results (Cespon & Lage, 2022; Clark et al., 2021; O'Connor & Cardona, 2019). In addition to using gamification for general learning contexts, other studies have narrowed down the scope of gamification into more specific areas of learning. One key area of study that is relevant to this discussion is the impact of using gamification strategies within Information Technology courses (Farkas et al., 2022; Limantara et al., 2022; Thongmak, 2018). One study looked at the effectiveness of game design and its impact on teaching college-level STEM classes. It looked at several key indicators including 1) the impact of game design on levels of cognitive learning, 2) student engagement, 3) a sense of community, 4) professional skills, and 5) retention. While there were some positive results discovered regarding the impact on cognitive learning and student engagement, the study did not find statistically significant increases in a sense of community or retention. They also found that many of the students felt that the games developed were childish and lacked rigor (Clark et al., 2021). Another college-level study looking at the impact within STEM classes found some positive effects in classroom engagement but underwhelming results in other areas. Teachers also reported that for many students, the games became more of a distraction to the classroom environments. (O'Connor & Cardona, 2019).

Summary

Sense of community has been a significant area of study for many decades. Social scientists began exploring what made geographical neighbors feel bonded to one another and learned many things about how smaller social groups could develop their sense of awareness and social bond. As the internet evolved and these same social scientists began to understand that communities could exist in the virtual world through the internet in the same psychological and emotional way that they existed in close physical proximity, studies began to expand into the virtual space. With the focus of this study primarily looking at a sense of community through a geo-political lens to explore differences that students from all over the world might have when taking the same undergraduate IT courses remotely, there is a need to ensure the population of the study has some consistency and has the same outcomes and expectations regardless of where they physically reside. Effective IT courses are designed to provide a learning environment where the learners can practice configuring and managing different technologies in a real-world experiential context. The advancement of technology is now beginning to provide a more realistic practice environment without the associated costs and risks of using actual computers and hardware. Virtualization, simulation, and centralized cloud environments provide the context and parameters within which IT students should be able to have a similar experience in learning, regardless of where they physically reside. If the experiential environment is equally available to all, the presumption is that a sense of community can be nurtured equitably across the globe, giving all students the same opportunity to interact, learn from one another, and practice using technology in a safe and real-world environment. This study attempts to measure a sense of community within IT courses offered to students around the world to add to the growing research about what might help increase retention rates of those newer students who previously might never have had the opportunity for a college education in IT.

CHAPTER THREE: METHODS

Overview

The purpose of this quantitative, causal-comparative study is to investigate a student's sense of community within an online IT course and explore whether there is a difference in scores between those students who are currently residing within the United States and those students who are currently residing outside of the United States. Chapter three presents the design of the study, the research question, and identifies the hypothesis that was used. Chapter three also identifies the participants and explains how data was collected, as well as what instrumentation was used and what procedures were applied during the study. Finally, the data is analyzed, and the results are documented to provide additional data to the broader body of research.

Design

In this quantitative study, a non-experimental, causal-comparative research design was used. A causal-comparative design was appropriate because it aligns with the definition given by Gall et al. (2007), which says causal-comparative research designs search for cause-and-effect relationships between different groups. The key element of a causal-comparative design is the use of categorical groups that are organized around an identified independent variable that is present for all members of the group. Researchers can then measure the dependent variable for each participant and compare whether there are differences in the dependent variable based on the different groups. The categorical independent variable is considered the presumed cause of a phenomenon and the dependent variable is considered the effect of the phenomenon. Causal-comparative studies can use one or many independent variables, and they can also use one or many dependent variables. Asio (2021) similarly explained that causal-comparative non-experimental designs measure the relationship between an independent variable represented as a category and a dependent variable represented by a quantitative variable. The independent variable in this study is categorical and is based on geographical residency and whether a student is a member of one of the following two groups: domestic students, or international students. Domestic students are undergraduate, IT students taking an online IT course while physically residing within the United States; and international students are those undergraduate, IT students taking an online IT course while physically residing outside the United States. Three dependent variables are measured by using an instrument called the CCS, or Classroom Community Scale (Rovai, 2002a). This instrument calculates the following 3 variables: 1) The total Sense of Community score through the use of a 20-item questionnaire that is separated into two sub-domains; 2) Connectedness – feelings of cohesion, trust, and interdependence among members; and 3) Learning – perceived effectiveness of interactive learning within a classroom setting . A sense of community describes the feeling of belonging and the perception that members of a community matter to each other, meeting the needs of each group member through their commitment to being together (McMillan & Chavis, 1986).

Research Question

RQ1: Is there a difference in the connectedness, learning, and overall sense of classroom community scores between online, undergraduate IT students who are based domestically (within the United States) and those who are based internationally?

Hypothesis

$H_0$1: There is no significant difference in the sense of connectedness, learning, and overall sense of classroom community scores between online, undergraduate, IT students who are based domestically (within the United States) and those who are based internationally, as measured by the Classroom Community Scale (Rovai, 2002a).

Participants and Setting

The following sections provide a brief overview of the population and sampling techniques used, as well as the sample size and overall setting of the study.

Population

The population in this study includes students who live all over the world, have self-enrolled in an online IT course, and have previously completed an online college preparation training program through an international Christian organization whose mission is to provide undergraduate educational opportunities for Christian adherents throughout the world. This organization provides the online college preparation and certification program to ensure students can speak English and are prepared to handle the rigors of college education before they ever enroll in a college course. This international organization has partnered with a small, private, accredited Christian college in the United States that provides all course content and issues associate and bachelor-level undergraduate degrees for those students who complete the degree requirements. The latest statistics for the year 2022 showed that the overall student population for these online-only undergraduate programs comes from over 180 countries and all 50 United States. Females make up 56% of the population, while males make up 44%. The median age for all participants is 30 (BYU Pathway Worldwide, n.d.).

Participants

The participants for the study were drawn from a convenience sample of online students who have self-enrolled in IT classes at the college as part of an undergraduate certificate or degree program in Information Technology. For purposes of the study, the data collected from the students was organized into two naturally occurring groups: 1) domestic students who are those living within the United States, and 2) international students who are those living outside of the United States at the time they participated in the course. These two categorical groups made up the key independent variable for the study. The total sample size for the study was N = 297. This exceeds the required minimum sample size for a MANOVA of 126 when assuming a medium effect size with a .05 alpha level of significance and a statistical power at the .7 level (Gall et al., 2007, p. 145).

The overall sample consisted of 246 males (83%) and 51 females (17%). For the independent variable (Residency) there was a total of 107 domestic students (36%) and a total of 190 international students (64%). The age of each participant was grouped into the following five ranges: 1) Less than 25; 2) Between 25 and 29; 3) Between 30 and 39; Between 40 and 49: 5) 50 and older (see Table 1). Participants were asked how many years of IT experience they had before enrolling in the class and the results were organized into four groupings: 1) <1 year; 2) between 1 and 5 years; 3) between 6 and 10 years, 4) between 11 and 20 years, and 5) over 20 years (see Table 2). Additional key metrics that were important to this study included whether students had daily access to a computer, as well as daily access to the Internet. Responses showed that 281 participants (95%) did have daily access to a computer, while 16 (5%) did not. The study also discovered that 264 participants (89%) had daily access to the Internet, while 33 (11%) did not.

Table 1

Age Range of Participants

Age Group	Number of Participants	Percentage of Participants
Less than 25 years old	60	20%

Between 25 and 29 years old	88	30%
Between 30 and 39 years old	77	26%
Between 40 and 49 years old	48	16%
50+ years old	24	8%

Table 2

Previous Years of IT Experience

Previous IT Experience	Number of Participants	Percentage of Participants
Less than a year	145	49%
Between 1 and 5 Years	91	31%
Between 6 and 10 Years	38	13%
Between 11 and 20 Years	13	4%
20 or More Years	10	3%

Broken down by categorical groups, the Domestic Group consisted of 81 males (75%) and 27 females (25%), while the International Group consisted of 165 males (87%) and 24 females (13%). The age breakdown for each Residency Group (see Table 3) shows that there are more domestic students in the upper two age categories (between 40 and 50+ years old), while the younger age categories show more representation from the international group. It is also telling that across both groups, 56% of all students who were taking online IT courses are between 25 and 40.

Table 3

Age Range of Participants Per Group

Age Group	Number of Participants (Domestic / International)	Percentage of Participants (Domestic / International)
Less than 25 years old	17 / 43	16% / 23%
Between 25 and 29 years old	30 / 57	28% / 30%
Between 30 and 39 years old	24 / 54	22% / 28%
Between 40 and 49 years old	22 / 26	20% / 14%
50+ years old	15 / 9	14% / 5%

Table 4 shows the years of previous IT experience broken down by the two independent groups. One interesting detail is that a higher percentage of internationally-based students had between 1 to 5 years of previous IT experience before signing up for classes (32%), whereas a smaller percentage of U.S.-based students had that much previous IT experience before signing up for classes (28%). Finally, looking at the two data points concerning daily access to technology, the breakdown by group showed that 105 domestic students (97%) had daily access to a computer, and the same number had daily access to the internet, while 3 of the domestic students (3%) did not have daily access to a computer nor the internet. Among those in the international group, 176 students (93%) had daily access to a computer, while 13 (7%) did not, and 159 international students (84%) did have daily access to the internet while 30 (16%) did not have daily access.

Table 4

Previous Years of IT Experience Per Group

Previous IT Experience	Number of Participants (Domestic / International)	Percentage of Participants (Domestic / International)
Less than a year	55 / 90	52% / 48%
Between 1 and 5 Years	31 / 60	28% / 32%
Between 6 and 10 Years	8 / 30	7% / 16%
Between 11 and 20 Years	8 / 5	7% / 2%
20 or More Years	6 / 4	6% / 2%

Setting

The treatments used in this study consisted of 14 different sections of IT courses. The various course sections covered different technology topics and were varied in the number of students within each section (see Table 5). While each course had a maximum capacity of 100 students, during the time of the study the lowest number of students in a single course was 20 and the largest number of students in a single course was 80. The study included students who voluntarily enrolled in at least one of the several IT courses offered by the college. Each course had been designed by a small team of instructional designers who work for the college. Each team was made up of one professional instructional designer and one subject-matter expert (SME) who had a solid background in the technology being taught within the course. Often, the SME for the course design is also an adjunct instructor for the course. The courses were delivered in an online, asynchronous modality and were facilitated by part-time adjunct instructors who were either currently working in separate full-time jobs as IT professionals or had retired from an IT career. The instructors were allowed to make small adjustments to the content of the course, such as changing due dates or providing additional support material or more detailed instructional pages, but they were not authorized to remove assignments or make significant changes to the content. All adjuncts received training on how to facilitate their online course and were regularly measured on several metrics that included how often and how quickly feedback was given to students, how quickly grades were posted, and several other metrics that were closely monitored by the college.

Table 5

Course Topics and Number of Sections Included in the Study

Cloud Computing Essentials – 2 sections
Cloud Server Administration – 3 sections
Database Design and Analysis – 2 sections
Introduction to Windows Client – 3 sections
Linux Fundamentals – 1 section
Networking Fundamentals – 1 section
PC Hardware – 2 sections

All students were expected to have access to a computer with which they could complete assigned tasks. It is understood that many students may not have had access to the type of computer best suited for this type of course. To alleviate the dependency on an expensive computer, the college provided a cloud-based infrastructure that was designed to minimize the need for a student to have an expensive computer to complete the class and allow those students without a powerful computer to use the cloud hosting services, thus the primary requirement to take one of these online IT courses is daily access to a computer with a browser (even if it does not meet the recommended technical specification requirements) and daily access to a consistent internet connection. Students were assigned reading assignments and video content to review each week and were expected to complete several different hands-on experiential labs and projects that were designed for each course. Since these were IT courses, the technical infrastructure is a key part of the learning experience. Some assignments used a simulated environment to which students had direct access through a common login portal. Other projects used a virtualization (cloud) environment that was accessible in one of two ways: first, if a student had an adequate computer, the virtualization software could be downloaded and installed locally on their local machine; alternatively, if a student did not have an adequate computer, they were instructed to use the college-provided cloud hosting services, which allowed a remote student to build their environment on a centrally-located cloud server hosted on campus. Tutoring and technical assistance were offered to all students through different student-run support teams at the college. The study attempted to measure whether students who were connecting from international locations had the same type of learning experience and whether they felt the same sense of community as those students enrolled domestically.

Instrumentation

This study used a survey developed by Rovai (2002a) to measure the sense of community within a classroom setting (See Appendix A for specific details of the instrument used). The instrument is titled the Classroom Community Scale (CCS) and was designed to measure the sense of community in a distance learning modality using the following three key scores: 1) overall sense of classroom community; 2) sense of connectedness; and 3) sense of learning.

Early studies in the sense of community were primarily focused on perceptions of community felt within groups of individuals who were in close physical proximity, such as a neighborhood or a school campus. The studies explored the general idea that any geographically connected group could develop feelings of belonging, or that members of the group mattered to one another and would take care of each other because of their commitment to remain together (McAdam, 1982; McMillan & Chavis, 1986). Later, researchers began exploring the idea that a sense of community could also be felt in an online environment. They looked at the type of communication tools that were being used with computers, sometimes referred to as computer-mediated communication (CMC), and determined that social relationships existed online in a similar way that they did in person (Baym, 1998). Rovai (2002a) eventually developed the CCS to measure the sense of community within a learning environment to learn how to build better remote learning methods. His goal was to help increase retention rates and promote satisfaction among online students. The CCS has been effectively used in several studies to help researchers better understand how students learn remotely (Akatsuka, 2020; Balboni et al., 2018; Lin & Gao, 2020).

The CCS is a 20-item questionnaire with a five-point Likert scale after each question where the students select one of the following responses: strongly agree, agree, neutral, disagree, or strongly disagree. The questions are organized into two subscales: 1) connectedness and 2) learning. To calculate the score, both subscales are totaled and divided by 10 to determine the mean. Then each subscale is weighted at 50% (each is multiplied by 5) to find the actual score. Both subscales are combined to calculate the total CCS score (Rovai, 2002a). To understand what the CCS measures, McMillan and Chavis (1986, p. 9) explained that the overall sense of community was "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together." Rovai (2002a) explained that the connectedness subscale represents how students feel about others within their class, including feelings of cohesion, trust, and interdependence. He also explained that the learning subscale represents how students feel about their interaction with one another and how much classmates share their values and beliefs, helping each other reach their educational goals and expectations. He stated his validity analysis was based on his study of the existing literature surrounding educational settings. For his reliability analysis, he used both Cronbach's coefficient alpha (Cronbach, 1951), as well as the equal-length split-half coefficient (Cronbach, 1946). Cronbach's coefficient alpha measured at .93 for the full classroom scale and is .92 for the connectedness subscale and .87 for the learning subscale (Rovai, 2002a). The equal-length split-half coefficient was measured at .91 (excellent) for the full classroom community scale and measured at .92 (excellent) for the connectedness subscale and .80 (good) for the learning subscale. The original developer had given open-access permission to use this instrument within the published article itself. He wrote the following: "Researchers may use this instrument for studies they conduct provided they give proper attribution by citing this article" (Rovai, 2002a, p.202).

Procedures

According to the developer of the online survey, the original CCS was administered via an online survey (Rovai, 2002a) with several follow-up emails during the final 3 weeks of the semester and for a week following the end of the semester. This study followed a similar approach, as students were invited to participate through direct emails, as well as through announcements and links within the LMS system. Appendix B shows the instructions provided to participating students and explains that the survey is voluntary and that it should not take more than 2 to 5 minutes to complete. IRB approval was received from both the Liberty University IRB team, as well as the IRB team designated by the private college whose students participated in the study. Refer to Appendix C for documentation of these IRB approvals which include IRB processes for both institutions. Refer to Appendix D to see the *Invitation to Participate / Informed Consent* documentation. An IRB exception was authorized for the study to move forward without the tighter requirements of the Office for Human Research Protections (OHRP) and the Food and Drug Administration (FDA) regulations (refer to Appendix E). Student participants were self-enrolled in the IT courses and were not randomly assigned. The percentage of domestic students does not equally match the number of internationally based students, which may need to be considered in the final analysis.

According to Gall et al. (2007), data collection for causal-comparative research can use virtually any type of instrument from standardized tests to questionnaires to interviews so the use of the CCS aligns with standard research practices. The CCS survey questionnaire was administered using a third-party survey tool, and the participants accessed the survey through a direct hyperlink that was provided through emails and announcements included within the LMS system. By using a third-party survey tool, the data collected remains anonymous and cannot be directly associated with any specific student or class section. All data collected will be retained in an Excel document and saved to a specially created private cloud drive managed by the researcher for three years after the completion of the study.

Data Analysis

The analysis used for this study was initially a multivariate analysis of variance (MANOVA), which is commonly used to compare the means of two or more independent variables against two or more dependent variables. This measurement is useful when the dependent variables are correlated with one another (Gall et al., 2007). This procedure is appropriate since the categorical variable in this study uses two identifiable groups (domestic students and international students) and three continuous dependent variables (connectedness, learning, total_CCS_score). The α (alpha) level of .05 and medium effect size was used in this study.

Data screening included a visual inspection of the data to check for missing data points and inaccuracies. Also, because the original hypothesis did not anticipate which mean scores would be higher, a two-tailed test of significance was conducted. Since a MANOVA analysis was initially used in this study, the following assumptions were initially tested: 1) independence of observations – no participant can be in both the domestic group (currently residing inside the United States) and the international group (currently residing outside of the United States) at the same time; 2) assumption of linear relationship – this was measured by visually inspecting a scatterplot matrix for each group; 3) assumption of no multicollinearity – this was measured by using a Pearson correlation coefficient calculation of the two independent variables; 4) assumption of no univariate or multivariate outliers - A Box and Whisker plot was run for each dependent variable to identify any outliers; 5) assumption of multivariate normality – A Shapiro-Wilk test for normality was applied; 6) assumption of homogeneity of variance-covariance matrices – a Box's *M* was not possible with this data set, therefore Levene's test was applied because of unequal sample sizes. 7) assumption of equal variance – A Levene's test was applied to validate this assumption.

After the data was collected and the MANOVA assumptions were applied to the data, some of the assumptions were not met, therefore a non-parametric Mann-Whitney U test was applied to each of the three dependent variables (Connectedness, Learning, and Overall_Sense_of Classroom Community) to see if there were significant differences between each of the dependent variables and the two independent groups (U.S.-based students and internationally-based students). To validate this second test, the following assumptions were applied: 1) one dependent variable is being measured at the ordinal level for each hypothesis; 2) one independent variable is being measured for each hypothesis that consists of two categorical, independent groups; 3) participants in the study cannot be members of both groups (Domestic or International); and 4) the distribution of scores for both groups being measured must be measured to determine if they have the same shape or different shapes to ensure proper interpretation and analysis of the data (Laerd Statistics, 2015).

CHAPTER FOUR: FINDINGS

Overview

Chapter Four answers the following research question and tests the hypothesis that has guided the study. An explanation of the data that was collected from the research questionnaire was accessed and provides an overview of the descriptive and inferential statistics associated with the data. The explanation then provides a review of the assumptions associated with a MANOVA, explaining the initial results. The initial findings showed that some of the necessary assumptions for a MANOVA were not sufficiently met. Out of an abundance of caution, it was determined that a non-parametric Mann-Whitney U test should also be applied to ensure more confidence in the findings. Three new research questions and three new hypotheses were identified and are applied below to reflect the change to a Mann-Whitney *U* test.

Research Questions

RQ1: Is there a difference in the connectedness scores between online, undergraduate IT students who are based domestically (within the United States) and those who are based internationally?

RQ2: Is there a difference in the learning scores between online, undergraduate IT students who are based domestically (within the United States) and those who are based internationally?

RQ3: Is there a difference in the overall sense of classroom community scores between online, undergraduate IT students who are based domestically (within the United States) and those who are based internationally?

Null Hypotheses

$H_0$1: The distribution of Connectedness is the same for those online, undergraduate, IT students who are based domestically (within the United States) and those who are based internationally, as measured by the Classroom Community Scale.

$H_0$2: The distribution of Learning is the same for those online, undergraduate, IT students who are based domestically (within the United States) and those who are based internationally, as measured by the Classroom Community Scale.

$H_0$3: The distribution of Total_CCS_Score is the same for those online, undergraduate, IT students who are based domestically (within the United States) and those who are based internationally, as measured by the Classroom Community Scale.

Descriptive Statistics

A total of 731 students were invited to participate in the study, and a total of 329 responses were submitted. Of the 329 responses, 32 were removed because of incomplete or unusable responses on the survey. The data was initially collected into a singular table that was then manipulated and prepared to provide the data formatting necessary for the calculations. After removing all unusable or incomplete data, the collected data was later organized into two tables to separate the Connected scores (all odd-numbered questions) from the Learning scores (all even-numbered questions). Then the total scores and mean scores for each subscale were calculated and weighted (50% for each subscale), after which the total CCS score was tabulated by summing the two subscales. The total sample size of N = 297 students was determined and confirmed. The Connectedness subscale had a mean score of 12.7542 with a standard deviation of 2.80085, and the Learning subscale had a mean score of 14.1650 with a standard deviation of 2.58760. The overall mean score for the CCS survey was 26.9192 with a standard deviation of

4.86960. A more detailed breakdown of the descriptive statistics is provided in Table 6 which shows the details broken out by sub-domain (Connectedness and Learning), as well as the overall total (Total_CCS_Score).

Table 6

Descriptive Statistics

	N	Mean	Standard Deviation	Minimum	Maximum
Connectedness	297	12.7542	2.80085	5.50	19.00
Learning	297	14.1650	2.58760	7.00	20.00
Total_CCS_Score	297	26.9192	4.86960	13.00	38.00
Residency	297	1.6397	.48089	1.00	2.00

Results

A MANOVA was initially conducted on the data and included appropriate data screening, which involved examining scatterplots and other results for the data set. It was important to keep the sequence of questions in the survey instrument in the original order. The odd-numbered questions are all associated with the connectedness subscale and the even-numbered questions are all associated with the learning subscale (Rovai, 2002a). Half of the items in the questionnaire are negatively worded, therefore scores are adjusted to ensure that the most favorable answers always receive the highest score of 4 and the least favorable answers receive a score of 0. For questions 1, 2, 3, 6, 7, 11, 13, 15, 16, and 19, each answer uses the following scale: strongly agree = 4, agree=3, neutral=2, disagree=1, strongly disagree=0. For questions 4, 5, 8, 9, 10, 12, 14, 17, 18, and 20, each answer uses the following scale: strongly agree=0, agree=1, neutral=2, disagree=3, strongly disagree=4. Scores are calculated by adding the weights of all 20 items. Total possible raw scores range from a maximum of 40 to a minimum of 0. Raw scores for the two subscales each have a maximum of 20 and a minimum of 0. The higher the score the more favorable the results, or the higher the sense of community (Rovai, 2002a). Tables 7 and 8 show the mean scores for each of the questions in the two sub-domains. The highest mean score within the Connectedness sub-domain was found in question number 1, which shows that, on average, the participants feel that other students in the course care about each other. The lowest mean score within the Connectedness sub-domain indicates that participants do not feel that other students depend on them within the course. The results of the Learning sub-domain show the highest mean score was found with question number 2, which shows that students feel encouraged to ask questions. The lowest mean score of this sub-domain was found with question number 12, indicating that the average participant was not sure whether their course resulted in learning (neutral).

Table 7

Questions Associated with the Connectedness Subscale

Removed to comply with copyright

Table 8

Questions Associated with the Learning Subscale

Removed to comply with copyright

The following assumptions were measured to validate the MANOVA test:

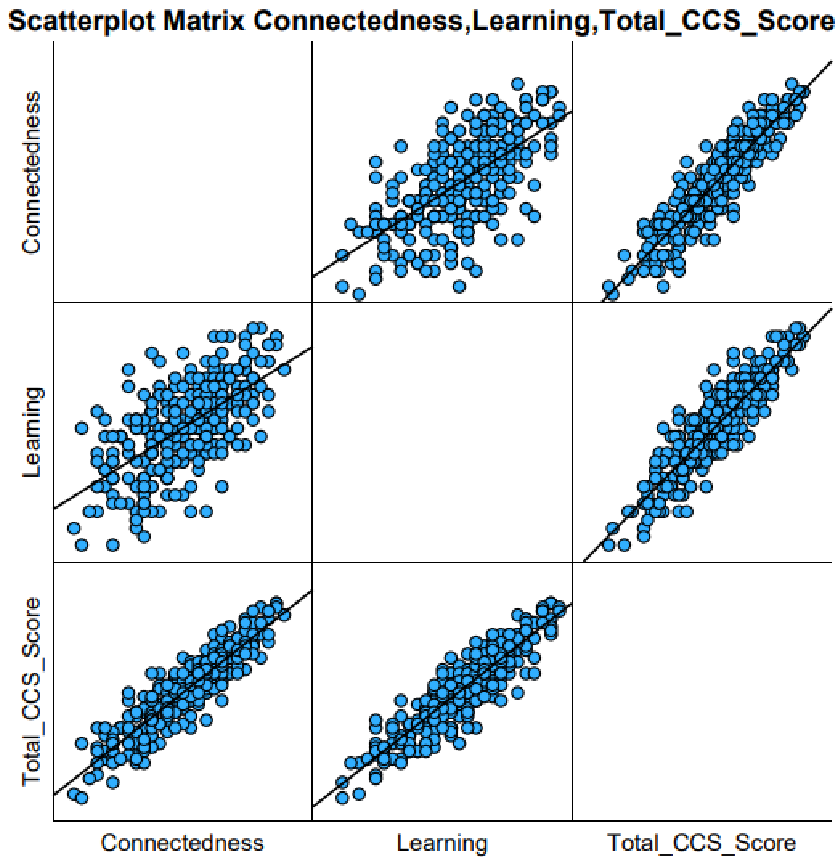
1. Assumption of independence of observations - The survey required each participant to identify whether they were a domestic student or an international student. Since

each student can select only one response for this question, the assumption of independence of observations was validated.

2. Assumption of linear relationship - Visual inspection confirmed the assumption of linear relationship by visually representing the data using a scatterplot matrix for each dependent variable (see Figure 1). Each variable showed a clear positive relationship; therefore, the assumption was met.

Figure 1

Scatterplot Matrix



3. Assumption of no multicollinearity - Applying the Pearson Correlation matrix (Table 9), the data showed the strength of the relationships between the three scores (Connectedness, Learning, and Total CCS Score) are significant with each sub-

domain, showing a very close correlation with the Total CCS Score (.911 and .895). The relationship is slightly less, yet still significant, between the two subdomains (.633). This assumption is met.

Table 9

Pearson Correlation

		Connectedness	Learning	Total_CCS_Score
Connectedness	Pearson Correlation	1	.633**	.911**
	Sig. (2-tailed)		<.001	<.001
	N	297	297	297
Learning	Pearson Correlation	.633**	1	.895**
	Sig. (2-tailed)	<.001		<.001
	N	297	297	297
Total_CCS_Score	Pearson Correlation	.911**	.895**	1
	Sig. (2-tailed)	<.001	<.001	
	N	297	297	297

Note: ** Correlation is significant at the 0.01 level (2-tailed).

4. Assumption of no univariate or multivariate outliers - Visual inspection of Box and Whisker plots initially identified one outlier in the relationship between Residency and Connectedness and one outlier in the relationship between Residency and Total CCS Scores, both of which were removed from the dataset. The relationship between Residency and Learning identified 9 outliers, all of which were removed. Figures 2, 3, and 4 show the plots after removing all outliers. This assumption is confirmed.

Figure 2

Residency and Connectedness

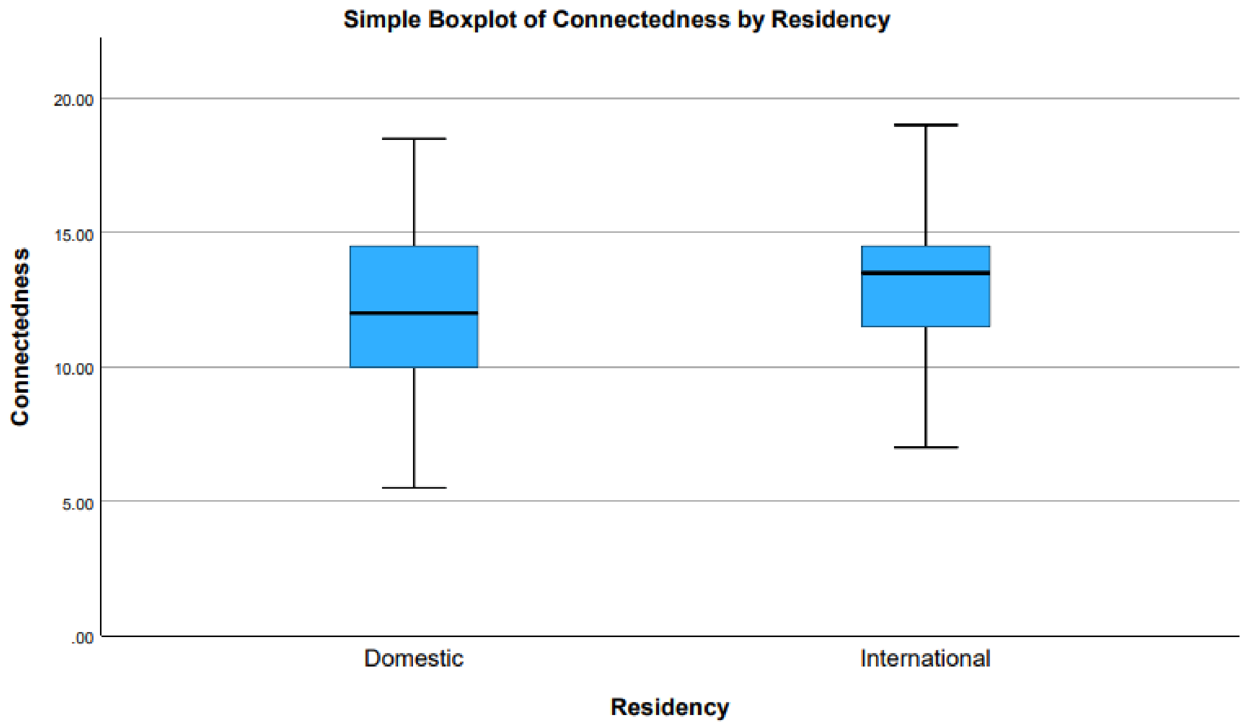


Figure 4

Residency and Learning

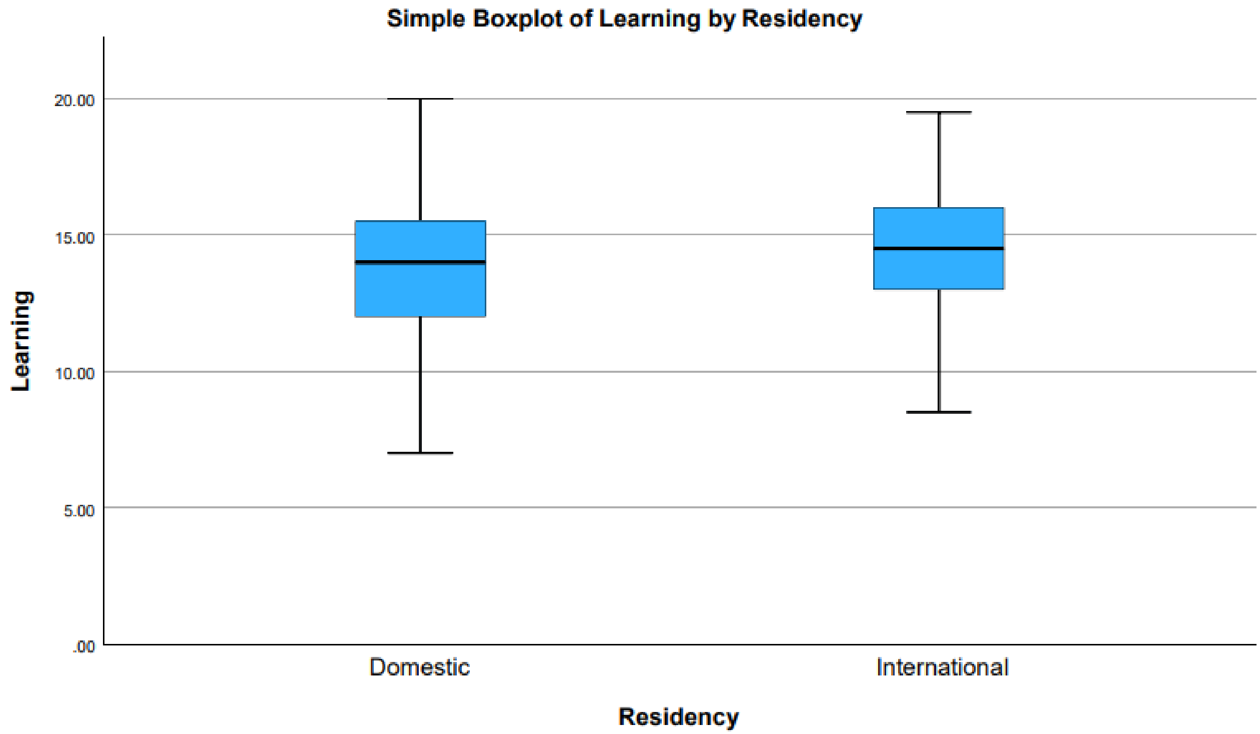
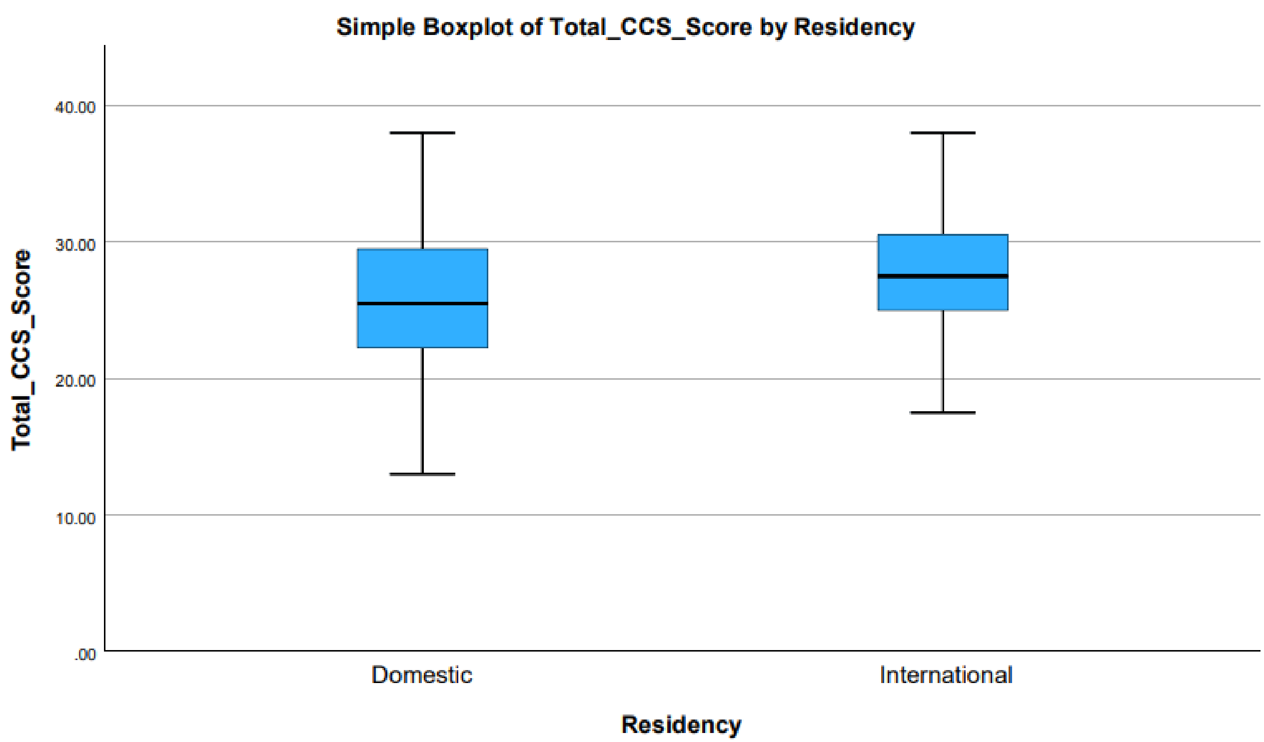


Figure 3

Residency and Total_CCS_Score



5. Assumption of multivariate normality - A Shapiro-Wilk test was applied to verify normality, which showed that Connectedness (.012) and Learning (.015) both had *p*-value scores that were less than 0.05, indicating that there is sufficient evidence that these two variables do not follow a normal distribution. The *p*-value for the Total_CCS_Score (.267) is greater than 0.05, indicating the data does follow a normal distribution (see Table 10). The assumption of normality was not met.

Table 10

Shapiro-Wilk Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Connectedness	.080	297	<.001	.988	297	.012
Learning	.077	297	<.001	.988	297	.015
Total_CCS_Score	.049	297	.080	.994	297	.267

Note: a. Lilliefors Significance Correction

6. Assumption of homogeneity and equal variance - To test for homogeneity, a Box's *M* calculation was not possible with the current dataset because there were less than two nonsingular cell covariance matrices, therefore, a Levene's test was run, which showed the *p*-value for Connectedness at .002, for Learning at .017, and for Total_CCS_Score at <.001 (see Table 11). Since the *p*-value for each variable is less than .05, there is evidence that the variances between the two groups for each variable are significant, therefore the assumption of homogeneity of variances is not met.

Table 11

Levene's Test of Equality of Error Variances (Homogeneity)

		Levene Statistic	df1	df2	Significance Level
Connectedness	Based on Mean	10.239	1	295	.002
	Based on Median	9.764	1	295	.002
	Based on Median and with adjusted df	9.764	1	292.186	.002
	Based on trimmed mean	10.300	1	295	.001
Learning	Based on Mean	5.721	1	295	.017
	Based on Median	5.469	1	295	.020
	Based on Median and with adjusted df	5.469	1	281.556	.020
	Based on trimmed mean	5.726	1	295	.017
Total_CCS_Score	Based on Mean	14.444	1	295	<.001
	Based on Median	13.993	1	295	<.001
	Based on Median and with adjusted df	13.993	1	279.470	<.001
	Based on trimmed mean	14.454	1	295	<.001

Note: Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Assumptions for Mann-Whitney U Test

Because the assumptions of homogeneity and variance were not met with the parametric MANOVA test, and out of an abundance of caution, a non-parametric Mann-Whitney U test was later applied to provide more confidence in the results and analysis of the data. After running the Mann-Whitney U test on the data, a visual inspection of the results discovered that the distributions for all three dependent variables have significantly different shapes, therefore the Mann-Whitney U test was used to compare mean ranks rather than the medians of the dependent variables for the two groups and even though the data fails the equal distribution assumption, the test was still considered valid (Laerd Statistics, 2015). The *p*-values that were returned represent the Asymptotic scores, which means that the *p*-value approaches the real value as the sample size increases (Laerd Statistics, 2015). Because the sample sizes in the study were relatively large, these values were considered acceptable.

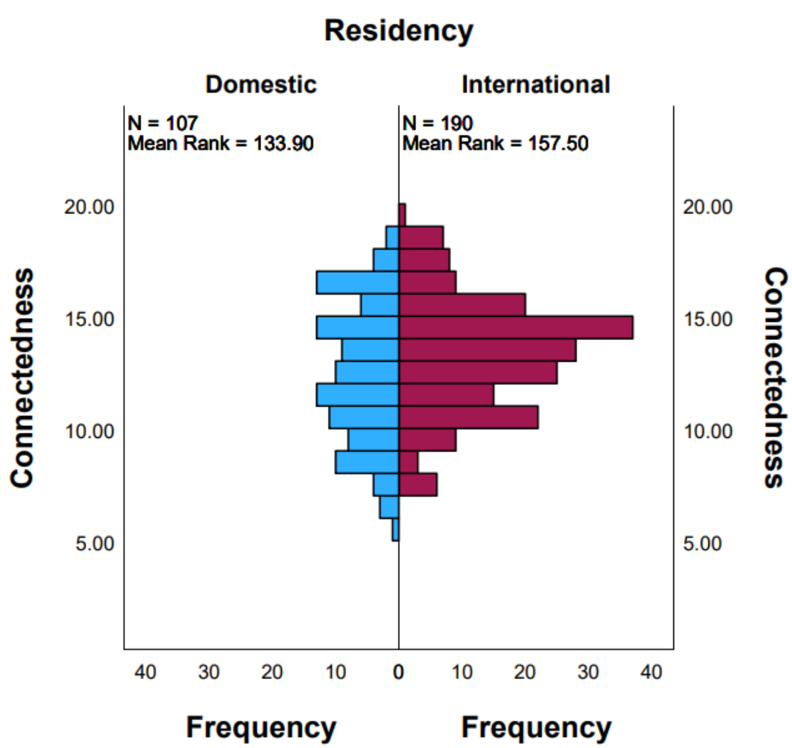
To validate whether the Mann-Whitney U test would effectively compare the data, the following assumptions were tested for all three hypotheses:

1. All dependent variables are measured at the continuous or ordinal level for each of the new hypotheses. Since all three dependent variables (Connectedness, Learning, and Total_CCS_Score) were measured against an independent variable with two groups, this assumption was met for each hypothesis.
2. One independent variable is being measured for each hypothesis that consists of two categorical, independent groups. The independent variable used in the study consisted of two groups, U.S.-based students and internationally-based students; therefore, this assumption was met for each hypothesis.
3. Independence of observations. Participants in the study cannot be members of both groups. The study specifically identifies whether the participating student is based in the United States, or is based internationally; therefore, this assumption was met for each hypothesis.

4. The distribution of scores for both groups must be measured to determine if they have a similar shape for each dependent variable to ensure proper interpretation and analysis of the data (Laerd Statistics, 2015). This assumption was tested individually for each dependent variable, the results were as follows:
    a. The shapes of the Connectedness variable were significantly different between the two groups (see Figure 5); therefore, this assumption was not met for Connectedness.

Figure 5

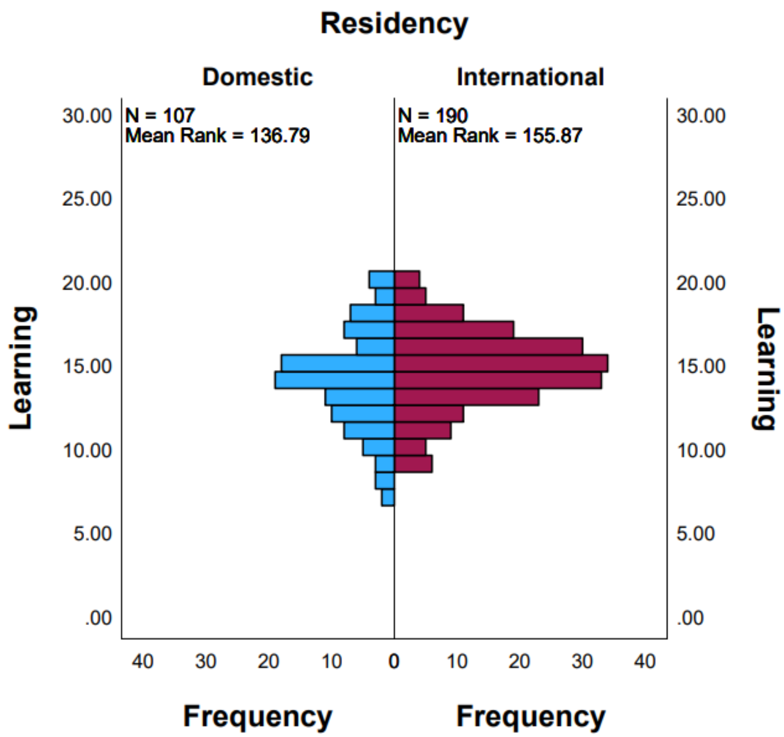
Mann-Whitney U Test - Connectedness comparison between groups



b. The shapes of the Learning variable were significantly different between the two groups (see Figure 6); therefore, this assumption was not met for

Figure 6

Mann-Whitney U Test - Learning comparison between groups



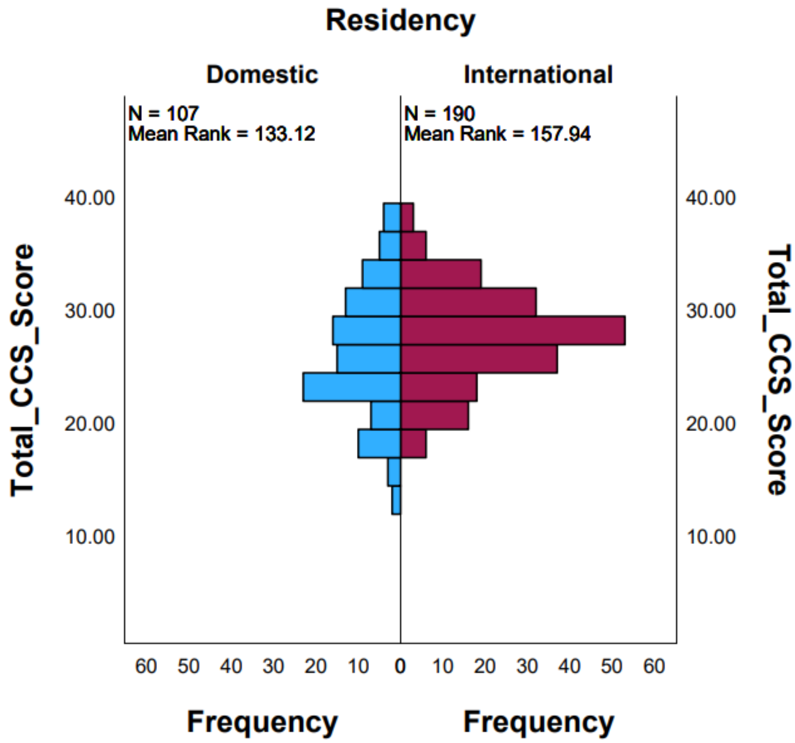
Learning.

c. The shapes of the Total_CCS_Score variable were significantly different between the two groups (see Figure 7); therefore, this assumption was not met for Total_CCS_Score.

The Mann-Whitney U test results for Connectedness showed that the mean rank score was 133.90 for the Domestic group, while the mean rank score for the International group was 157.50 (see Table 12). The U score for the Connectedness variable across Residency was 11780.500 with a *p*-value of .023 and a z-score of 2.277 (see Table 13). Looking at the

Figure 7

Mann-Whitney U Test - Total_CCS_Score comparison between groups



Hypothesis Test Summary report (see Table 14), we see that the null hypothesis should be rejected for the Connectedness variable.

The test results for Learning showed that the mean rank score was 136.79 for the Domestic group and 155.87 for the International group (see Table 12). The *U* score for the Learning variable across Residency was 11471.000 with a *p*-value of .066 and a z-score of 1.842 (see Table 13). Looking at the Hypothesis Test Summary report (see Table 14), we see that the null hypothesis should be retained for the Learning variable.

The test results for the Total_CCS_Score showed that the mean rank score was 133.12 for the Domestic group and 157.94 for the International group (see Table 12). The U score for the Total_CCS_Score across Residency was 11864.000 with a *p*-value of .017 and a z-score of 2.393 (see Table 13). Looking at the Hypothesis Test Summary report (see Table 14), we see that the null hypothesis should be rejected for the Total_CCS_Score.

Table 12

Mann-Whitney U Test - Mean Rank Scores Across Groups (by Variable)

	Domestic Group		International Group	
	Mean Rank Score	N	Mean Rank Score	N
Connectedness	133.90	107	157.50	190
Learning	136.79	107	155.87	190
Total_CCS_Score	133.12	107	157.94	190

Table 13

Mann-Whitney U Test - Test Statistics

	Connectedness	Learning	Total_CCS_Score
Mann-Whitney U Score	11780.500	11471.000	11864.000
Standardized Test Statistic	2.277	1.842	2.393
Asymp. Sig. (2-tailed)	.023	.066	.017

Table 14

Nonparametric Tests - Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Connectedness is the same across categories of Residency.	Independent-Samples Mann-Whitney U Test	.023	Reject the null hypothesis.
2	The distribution of Learning is the same across categories of Residency.	Independent-Samples Mann-Whitney U Test	.066	Retain the null hypothesis.
3	The distribution of Total_CCS_Score is the same across categories of Residency.	Independent-Samples Mann-Whitney U Test	.017	Reject the null hypothesis.

CHAPTER FIVE: CONCLUSIONS

Overview

Chapter five provides a discussion of the final results collected and summarized by this study. The chapter also presents the implications and limitations that were experienced, and finally, provides suggestions for future research.

Discussion

The purpose of this quantitative, causal-comparative study was to investigate a student's sense of community within a globally-available, online, asynchronous, IT course and explore whether the distributions of three different scores (Connectedness, Learning, and Total_CCS_Score) were the same for students currently residing within the United States and those currently residing outside of the United States.

The study of student persistence, or student retention, has been traced back to the work of Vincent Tinto (1975) who had spent decades trying to understand the root causes of student persistence. Many subsequent researchers built upon Tinto's earlier foundation, and several instruments have been identified and refined to better measure sense of community. This study used an instrument developed by Rovai known as the Classroom Community Scale (CCS), which measures an overall sense of community score by combining and tabulating scores generated by two sub-scale measurements: Connectedness and Learning (Rovai, 2002a). Prior research has successfully documented the significant growth in the number of students taking online courses (Muller et al., 2019), as well as the growing number of students who are choosing to drop out before finishing their degree (Muljana & Luo, 2019; Rainey et al., 2018). The purpose of this study was to focus on sense of community scores among online IT students who currently live all over the world to see if there is a difference between the sense of community for those students currently living within the US and those living internationally. Looking through a global lens to explore whether students living anywhere in the world could experience the same sense of participation, educational support, and satisfaction of learning while studying technology-heavy IT courses, especially when there exists significant technical inequity among so many students, will add to the research and provide additional data points for future studies. This information should also add to the research surrounding instructional design elements and strategies that can make teaching online asynchronous IT courses more impactful, interactive, and effective.

Earlier studies on sense of community have identified that social and psychological characteristics of the participants can have an impact on whether they feel a sense of community within the classroom environment (Anli, 2019; Apriceno et al., 2020; Baker et al., 2018; Kavrayici, 2021; Washington & Mondisa, 2021). These results suggest that there may be unique psychological or social dynamics at play in a global scenario that need to be more central in course design and methodology. Earlier studies have explored the importance of social interaction between the teacher and the students, as well as the interactions between the students themselves (Anli, 2019; Berry, 2019; Kavrayici, 2021). As the unique logistics of an internationally organized IT course are considered, the interaction between the instructors and the students requires additional planning and thought, as time zones become a limiting factor and access to technology may differ from country to country. Teachers and course designers will need to consider how to overcome these barriers and may need to consider using video-recording technology, as well as finding ways to schedule direct interaction between students and instructors, if necessary.

Other studies have looked into whether language barriers might impact sense of community scores (Chen & Zhou, 2019; Garcia, 2019; Rodriguez & Blaney, 2021; Zhang et al., 2022) and this would be another logical area to consider moving forward. Most of these earlier studies had a built-in bias to language requirements, as they were mostly looking at international students who were physically studying within the United States, which would imply they would have access to English-speaking tutors who could help translate or explain if they were struggling with the language. In a globally distributed online IT course, where students are still living at home and may not know anybody, or live near anyone, who speaks English, additional considerations might need to be introduced to provide translation services, English proficiency tutoring, including other helps. Additionally, with classes of up to 100 students per section, it is possible to organize them into online collaboration groups based on language or time zone. As technology continues to evolve, translation tools may become better integrated into online LMS systems that could allow each student to access the provided content in their preferred language.

Previous studies have acknowledged that teaching STEM (Science, Technology, Engineering, Math) courses in an online, asynchronous modality does present some unique challenges (Aydin, 2020; Burch & Mohammed, 2019; Churches & Lawrance, 2021; Crawford et al., 2021). This study did add to these earlier findings by including courses that specifically required the use of simulated technology, as well as a virtualized cloud environment to successfully complete the courses. The study also validated previous research that considered the impact that course designers could have on a student’s sense of community (N. L. Davis et al., 2020; Peacock & Cowan, 2019; Peacock et al., 2020; Studebaker & Curtis, 2021). also Included was the support of previous studies that showed the importance of online instructors not only understanding the technology they are teaching in the class, but also understanding how to use the technology to support the class (Crawford et al., 2021; Gardner et al., 2019; Kelley et al., 2020).

A one-way multivariate analysis of variance was initially run to determine whether the online learning experience for Information Technology students was impacted by their geographic location when taking the course. The findings of this study rejected the null hypothesis indicating that there is a significant difference between the way US-based students are experiencing an online IT course and the way that internationally-based students are experiencing the same courses. However, because some of the assumptions required for a MANOVA were not met, a non-parametric Mann-Whitney U test was later applied and showed similar results. The distributions of the Connectedness Scores and the distribution of Total_CCS_Scores were significantly different, implying that the overall learning experience was not the same for domestic students and international students.

Implications

There are two key findings that should be emphasized in this study. First, the reality that 5% of the students in the study did not have daily access to a computer is a significant finding, and it would seem likely that for many who participated in the study and who were living in remote areas of the world, even if they did have daily access to a computer, it likely did not meet the recommended specifications for successfully completing the course. Second, it also seems important to consider that 10% of the students who participated in the study did not have daily access to the Internet. As colleges and universities continue to expand their online course offerings, it would seem necessary to consider how these institutions can better provide the technology access that would be needed for their coursework. For those students who did have access to a computer and the internet, the simulated environments and the use of virtualization technology (locally or through a cloud hosting service) did seem to provide more technical equity among all the students, thus a majority of the students did report a positive sense of community. This particular dilemma, an inequity of access to technology, is slowly becoming a more solvable problem, as the technology available for remote users is continuing to progress and is becoming more pervasive (Chukusol & Piriyasurawong, 2022; Friadi et al., 2022; Hu et al., 2020). It seems difficult to conceive of a way to teach a student about IT technologies without also providing some way for that student to access the technologies they need to successfully complete the course (Cackley, 2021; Tierney et al., 2018). As schools and educational content developers continue to build cloud-based solutions, and simulated or virtualized environments that can be accessed more easily and more consistently over the internet with less dependency on the student needing to purchase their own equipment, it is conceivable that sense of community scores will become more in balance between the US-based IT students and the internationally-based IT students.

Among the key implications of this study is the idea that schools and educational solution providers have an opportunity to explore better and more cost-effective solutions for providing access to computers and internet connectivity to their students around the globe. Whether this manifests through cooperation between schools and service providers, or whether schools look at building out their own technology infrastructures remains to be seen, but the results of this study would indicate that there is a need to explore these types of solutions.

Limitations

There were some key limitations during the study. The first had to do with getting enough students to respond to the online survey. Initially, the study was going to focus on only a small number of online courses to ensure that no student was submitting multiple questionnaires. With each section potentially having up to 100 students, it was assumed that this smaller population would suffice. But with the study being voluntary, and students already receiving plenty of emails from other sources, there was not an overwhelming response initially. After a few weeks, additional IT courses and sections were added that broadened the population of IT students who could participate in the study. Because the study was offered to students in multiple classes, it is possible that a student could have taken the survey more than once if they received the same request in different classes. Since the data collection has been anonymized, there is no way for the researcher to account for this possibility. The third-party technology that was used for the survey does have the ability to identify if a particular browser has previously connected to the survey and notifies the participant that they have already taken the survey and it is no longer available to them, so it is assumed that there would be very few cases of redundant entries, but the possibility does exist if the participant uses a different browser, or if historical data is flushed from the browser's cache between sessions.

Recommendations for Future Research

1. Providing a centralized cloud infrastructure is only the beginning. Future studies should also explore latency (timing) issues and other distance or line-speed differences that will directly impact the user experience for each student around the globe. This might include network traffic data, cloud server usage, and utilization data, as well as information surrounding the amount of time students are actively working together on projects or study groups. This might include comparing service providers.
2. Qualitative research should be considered to better understand user experience based on internet access and speeds.

3. Qualitative research should be considered that explores the effectiveness of student-to-student interactions, or student-to-teacher interactions, within online, asynchronous courses, specifically in relationship to a centralized cloud infrastructure.
4. Studying specific project-based assessments where students could all access the same centrally-available virtualized server(s) and work together on troubleshooting or configuring a system (Goncalves & Capucha, 2020; Matriano, 2020; Villarroel et al., 2020). This type of research could help instructional designers identify ways to make the user experience more impactful by considering technical infrastructure and access to assessment designs.

REFERENCES

Abrica, E. J., Lane, T. B., Zobac, S., & Collins, E. (2022). Sense of belonging and community building within a STEM intervention program: A focus on Latino male undergraduates' experiences. *Journal of Hispanic Higher Education*, *21*(2), 228–242. https://doi.org/10.1177/1538192720974884

Acevedo, N., Nunez-Rivera, S., Casas, Y., Cruz, E., & Rivera, P. (2021). Enacting spiritual activism to develop a sense of belonging: Latina community college students choosing and persisting in STEM. *Journal of Women and Gender in Higher Education*, *14*(1), 59–78.

Adams, K. (2021). Research to resource: Developing a sense of community in online learning environments. *Update: Applications of Research in Music Education*, *39*(2), 5–9.

Afify, M. K. (2020). Effect of interactive video length within e-learning environments on cognitive load, cognitive achievement and retention of learning. *Turkish Online Journal of Distance Education*, *21*(4), 68–89.

Akatsuka, Y. (2020). Promoting critical thinking skills in an online EFL environment. *Journal of Pan-Pacific Association of Applied Linguistics*, *24*(2), 95–113. https://doi.org/10.25256/PAAL.24.2.5

Aldabbus, S. (2018). Project-based learning: Implementation & challenges. *International Journal of Education, Learning, and Development*, *6*(3), 71-79.

Aljohani, O. (2016). A comprehensive review of the major studies and theoretical models of student retention in higher education. *Higher education studies*, *6*(2), 1-18.

Almelhi, A. M. (2021). Effectiveness of the ADDIE model within an E-learning environment in developing creative writing in EFL students. *English Language Teaching*, *14*(2), 20–36.

Aloni, M., & Harrington, C. (2018). Research-based practices for improving the effectiveness of asynchronous online discussion boards. *Scholarship of Teaching and Learning in Psychology*, *4*(4), 271.

Alves, A. C., Leao, C. P., Moreira, F., & Teixeira, S. (2018). Project-based learning and its effects on freshmen social skills in an engineering program. *Human Capital and Competences in Project Management*. IntechOpen. https://doi.org/10.5772/intechopen.72054

Anli, G. (2019). Investigating the relationship between sense of classroom community and interpersonal sensitivity. *International Journal of Progressive Education*, *15*(5), 371–379.

Apriceno, M., Levy, S. R., & London, B. (2020). Mentorship during college transition predicts academic self-efficacy and sense of belonging among STEM students. *Journal of College Student Development 61*(5), 643-648. doi:10.1353/csd.2020.0061

Arias-Chavez, D., Augusto Luy-Montejo, C., Collantes Inga, Z. M., & Cecilia Uribe-Hernández, Y. (2022). Gamification as a resource in education. A bibliometric analysis in times of pandemic. *Journal of Pharmaceutical Negative Results*, *13*, 268–276. https://doi.org/10.47750/pnr.2022.13.S03.043

Asio, J. M. R. (2021). Research designs in the new normal: A brief overview. *Academia Letters*, 2.

Attaran, M., Attaran, S., & Celik, B. G. (2017). Promises and challenges of cloud computing in higher education: A practical guide for implementation. *Journal of Higher Education Theory and Practice, 17*(6), 20-38.

Au, A., Lai, D. W., Yip, H. M., Chan, S., Lai, S., Chaudhury, H., Scharlach, A., & Leeson, G. (2020). Sense of community mediating between age-friendly characteristics and life satisfaction of community-dwelling older adults. *Frontiers in Psychology*, *11*, 86.

Australian Government Tertiary Education Quality and Standards Agency (TEQSA). (2020). Good practice note: Improving retention and completion of students in Australian higher education. In *Australian Government Tertiary Education Quality and Standards Agency*. Australian Government Tertiary Education Quality and Standards Agency.

Aydin, G. (2020). Prerequisites for elementary school teachers before practicing STEM education with students: A case study. *Eurasian Journal of Educational Research*, *88*, 1–39.

Baker, S., Warburton, J., Waycott, J., Batchelor, F., Hoang, T., Dow, B., Ozanne, E., & Vetere, F. (2018). Combatting social isolation and increasing social participation of older adults through the use of technology: A systematic review of existing evidence. *Australasian Journal on Ageing*, *37*(3), 184–193. https://doi.org/10.1111/ajag.12572

Balboni, G., Perrucci, V., Cacciamani, S., & Zumbo, B. D. (2018). Development of a scale of sense of community in university online courses. *Distance Education*, *39*(3), 317–333. https://doi.org/10.1080/01587919.2018.1476843

Balke, V., Grusenmeyer, L., & McDowell, J. (2021). Long-term outcomes of biotechnology student participation in undergraduate research experiences at Delaware Technical Community College. *Scholarship and Practice of Undergraduate Research*, *4*(3), 5–12.

Bandura, A. (1977). Self-Efficacy: Toward a Unifying Theory of Behavioral Change. *Psychological Review*, *84*(2), 191.

Barry, A. E., Jackson, Z. A., & Fullerton, A. B. (2021). An assessment of sense of belonging in higher education among student service members/veterans. *Journal of American College Health*, *69*(3), 335–339. https://doi.org/10.1080/07448481.2019.1676249

Bartlett, J. (2019). Setting up a basic cloud cluster. In: *Building Scalable PHP Web Applications Using the Cloud*. Apress, Berkeley, CA. https://doi.org/10.1007/978-1-4842-5212-3_5

Baym, N. K. (1998). The emergence of online community. *CyberSociety*, *2*(0), 35-68.

Beeson, E., Aideyan, B., O'Shoney, C., Bowes, D. A., Ansell, K. L., & Peterson, H. M. (2019). Predicting sense of community among graduate students in a distance learning environment. *Universal Journal of Educational Research*, *7*(3), 746–753.

Beier, M. E., Kim, M. H., Saterbak, A., Leautaud, V., Bishnoi, S., & Gilberto, J. M. (2019). The effect of authentic project-based learning on attitudes and career aspirations in STEM. *Journal of Research in Science Teaching*, *56*(1), 3–23. https://doi.org/10.1002/tea.21465

Belland, B. R. (2017). *Instructional Scaffolding in STEM Education,* https://doi.org/10.1007/978-3-319-02565-0_6

Bello, B. D. C. (2018). Exploring Latina and Hispanic female students' sense of belonging in STEM majors following a belonging intervention. University of California, Santa Barbara.

Berry, S. (2019). Teaching to connect: Community-building strategies for the virtual classroom. *Online Learning*, *23*(1), 164-183.

Bertel, L. B., Askehave, I., Brohus, H., Geil, O., Kolmos, A., Ovesen, N., & Stoustrup, J. (2021). Digital transformation at Aalborg University: Interdisciplinary problem- and project-based learning in a post-digital age. *Advances in Engineering Education*.

Bicen, H., Demir, B., & Serttas, Z. (2022). The attitudes of teacher candidates towards the gamification process in education. *BRAIN: Broad Research in Artificial Intelligence & Neuroscience*, *13*, 39–50. https://doi.org/10.18662/brain/13.2/330

Bickle, M. C., Rucker, R. D., & Burnsed, K. A. (2019). Online learning: Examination of attributes that promote student satisfaction. *Online Journal of Distance Learning Administration*, *22*(1), 1-8.

Bolduc-Simpson, S., & Simpson, M. (2020). Social places in virtual spaces: Creating a social learning community in online courses. *Distance Learning*, *17*(4), 83–92.

Braxton, J. M. (1999). Theory elaboration and research and development: Toward a fuller understanding of college student retention. *Journal of College Student Retention: Research, Theory & Practice*, *1*(2), 93–97. https://doi.org/10.2190/W42A-1ECN-VGLH-XPA8

Brewer, H. E., González-Espada, W., & Boram, R. D. (2021). Student retention in quantitative STEM majors: Science teachers and college students' perceptions of push and pull factors. *Journal of the Kentucky Academy of Science*, *82*(1), 1–12.

Brezynski, E., Long, E., Allen, M. J., & Wood, D. (2019). The BioCORE scholars program: Improving persistence and academic performance of underrepresented students in biology. *Journal of Best Practices in Health Professions Diversity: Education, Research & Policy*, *12*(1), 108–109.

Brockman, A. J. (2021). "La Crème de la Crème": How racial, gendered, and intersectional social comparisons reveal inequities that affect sense of belonging in STEM. *Sociological Inquiry*, *91*(4), 751–777. https://doi.org/10.1111/soin.12401

Burch, Z. A., & Mohammed, S. (2019). Exploring faculty perceptions about classroom technology integration and acceptance: A literature review. *International Journal of Research in Education and Science (IJRES)*, 5(2), 722-729.

Burgos, D., & Corbi, A. (2018). Transgenic learning for STEAM subjects and virtual containers for OER. *Distance Education*, *39*(1), 4–18.

Burke, A. (2019). Student retention models in higher education: A literature review. *College and University*, *94*(2), 12–21.

BYU Pathway Worldwide. (n.d.). *Facts & stats*. BYU. Pathway Worldwide. Retrieved October 22, 2023, from https://www.byupathway.edu/fact-sheet-2022.pdf

Cackley, A. P. (2021). Financial services industry: Factors affecting careers for women with STEM degrees. Report to the Ranking Member, Subcommittee on Diversity and Inclusion, Committee on Financial Services, House of Representatives. GAO-21-490. *US Government Accountability Office*.

Cancino, M., & Towle, K. (2022). Relationships among higher education EFL student perceptions toward fully online language learning and computer self-efficacy, age, gender, and proficiency level in emergency remote teaching settings. *Higher Learning Research Communications*, *12*, 25–45.

Cena, E., Burns, S., & Wilson, P. (2021). Sense of belonging and the intercultural and academic experiences among international students at a university in Northern Ireland. *Journal of International Students*, *11*(4), 812–831. https://doi.org/10.32674/jis.v11i4.2541

Cespon, M. T., & Lage, J. M. D. (2022). Gamification, online learning and motivation: A quantitative and qualitative analysis in higher education. *Contemporary Educational Technology*, *14*(4), 1–18. https://doi.org/10.30935/cedtech/12297

Chang, Y. C., & Bangsri, A. (2020). Thai students' perceived teacher support on their reading ability: Mediating effects of self-efficacy and sense of school belonging. *International Journal of Educational Methodology*, *6*(2), 435–445.

Chapman, J. L., Hill, A. D., Nagel-Myers, J., & Ramler, I. P. (2019). The liberal arts science scholars program: A multidisciplinary model for supporting science and mathematics students through the first year. *Journal of STEM Education: Innovations and Research*, *20*(1), 17–24.

Chatterjee, R., & Correia, A. P. (2020). Online students' attitudes toward collaborative learning and sense of community. *American Journal of Distance Education*, *34*(1), 53-68.

Chen, J., & Bogachenko, T. (2022). Online community building in distance education: The case of social presence in the Blackboard discussion board versus multimodal VoiceThread Interaction. *Journal of Educational Technology & Society*, *25*(2), 62–75.

Chen, J., & Zhou, G. (2019). Chinese international students' sense of belonging in North American postsecondary institutions: A critical literature review. *Brock Education: A Journal of Educational Research and Practice*, *28*(2), 48–63.

Chiang, F.-K., Zhang, Y., Zhu, D., Shang, X., & Jiang, Z. (2022). The influence of online STEM education camps on students' self-efficacy, computational thinking, and task value. *Journal of Science Education & Technology*, *31*(4), 461–472. https://doi.org/10.1007/s10956-022-09967-y

Chicoine, G., Côté, J., Pepin, J., Boyer, L., Rouleau, G., & Jutras-Aswad, D. (2022). Experiences and perceptions of nurses participating in an interprofessional, videoconference-based educational programme on concurrent mental health and substance use disorders: a qualitative study. *BMC Nursing*, *21*(1), 1–24. https://doi.org/10.1186/s12912-022-00943-w

Chitongo, S., & Suthers, F. (2019). Use of technology in simulation training in midwifery. *British Journal of Midwifery*, *27*(2), 85–89. https://doi.org/10.12968/bjom.2019.27.2.85

Chukusol, C., & Piriyasurawong, P. (2022). Development of flipped classroom using cloud-based learning and board games model to enhance critical thinking skills. *TEM Journal*, *11*(1), 94–103. https://doi.org/10.18421/TEM111-11

Churches, R., & Lawrance, J. (2021). How to assess the potential to teach: New evidence from a STEM teacher assessment centre model in England. Data Insights Report. In *Education Development Trust*.

Clark, R., Spisso, A., Ketchman, K. J., Landis, A. E., Parrish, K., Mohammadiziazi, R., & Bilec, M. M. (2021). Gamifying sustainable engineering courses: Student and instructor perspectives of community, engagement, learning, and retention. *Journal of Civil Engineering Education*, *147*(4).

Collings, R., Swanson, V., & Watkins, R. (2014). The impact of peer mentoring on levels of student wellbeing, integration, and retention: A controlled comparative evaluation of residential students in UK higher education. *Higher Education (00181560)*, *68*(6), 927–942. https://doi.org/10.1007/s10734-014-9752-y

Collins, K., Groff, S., Mathena, C., & Kupczynski, L. (2019). Asynchronous video and the development of instructor social presence and student engagement. *Turkish Online Journal of Distance Education*, *20*(1), 53–70.

Cook-Sather, A., & Seay, K. (2021). “I was involved as an equal member of the community”: How pedagogical partnership can foster a sense of belonging in black, female students. *Cambridge Journal of Education*, *51*(6), 733–750.

Cooper, K. M., Gin, L. E., Akeeh, B., Clark, C. E., Hunter, J. S., Roderick, T. B., Elliott, D. B., Gutierrez, L. A., Mello, R. M., Pfeiffer, L. D., Scott, R. A., Arellano, D., Ramirez, D., Valdez, E. M., Vargas, C., Velarde, K., Zheng, Y., & Brownell, S. E. (2019). Factors that predict life sciences student persistence in undergraduate research experiences. *PloS One*, *14*(8), e0220186. https://doi.org/10.1371/journal.pone.0220186

Crawford, C., Obenland, C., & Nichol, C. (2021). An analysis of the effect of long-term professional development on teacher engineering self-efficacy and its impact on classroom instruction. *Journal of STEM Outreach*, *4*(1).

Cronbach, L. J. (1946). A case study of the split-half reliability coefficient. Journal of Educational Psychology, 37(8), 473–480. https://doi.org/10.1037/h0054328

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *psychometrika*, *16*(3), 297-334.

Crossman, A. (2020, August 27). The study of suicide by Emile Durkheim. Retrieved from https://www.thoughtco.com/study-of-suicide-by-emile-durkheim-3026758

Crowe, J. A. (2021). Creating a departmental climate that increases a student’s sense of belonging, perceived faculty support, and satisfaction with the major. *Innovative Higher Education*, *46*(1), 95–109.

Davey, T., Salazar Luces, J. V., & Davenport, R. (2021). Individual-centred approaches to accessibility in STEM education. *Education Sciences*, 11, 652. https://doi.org/10.3390/educsci11100652

Davidsen, J., Andersen, P. V. K., & Christiansen, E. (2019). Problem-based learning in a box: Lessons learned from an educational design experiment. *Journal of Problem-Based Learning in Higher Education*, *7*(1), 120–132.

Davis, G. M., Hanzsek-Brill, M. B., Petzold, M. C., & Robinson, D. H. (2019). Students' sense of belonging: The development of a predictive retention model. *Journal of the Scholarship of Teaching and Learning*, *19*(1), 117–127.

Davis, N. L., Gough, M., & Taylor, L. L. (2020). How to build an online class. *Journal of Teaching in Travel & Tourism*, *20*(1), 74–84. https://doi.org/10.1080/15313220.2020.1711547

De Loof, H., Boeve-de Pauw, J., & Van Petegem, P. (2022). Engaging students with integrated STEM education: A happy marriage or a failed engagement? *International Journal of Science & Mathematics Education*, *20*(7), 1291–1313. https://doi.org/10.1007/s10763-021-10159-0

Dewey, J. (1938). *Experience and Education*. New York: Simon and Schuster.

Dodgson, M., Gann, D., & Salter, A. (2006). The role of technology in the shift towards open innovation: the case of Procter & Gamble. *R&D Management*, *36*(3), 333–346. https://doi.org/10.1111/j.1467-9310.2006.00429.x

Durkheim, E. (1897). *Le suicide: étude de sociologie*. Alcan.

Farkas, B., Shang, Y., & Alhourani, F. (2022). Teaching business process concepts in an introductory information systems class: A multi-level game-based learning approach. *Journal of Information Systems Education*, *33*(4), 306–323.

Fiock, H. (2020). Designing a community of inquiry in online courses. *International Review of Research in Open and Distributed Learning*, *21*(1), 134–152.

Fiock, H., Maeda, Y., & Richardson, J. C. (2021). Instructor impact on differences in teaching presence scores in online courses. *International Review of Research in Open & Distance Learning*, *22*(3), 55–76. https://doi.org/10.19173/irrodl.v22i3.5456

Foley, K., & Marr, L. (2019). Scaffolding extracurricular online events to support distance learning university students. *Journal of Interactive Media in Education*, *2019*(1).

Fraenza, C., & Rye, T. (2021). Supporting the social integration of online doctoral students through peer mentoring. *Learning Assistance Review*, *26*(1), 133–161.

Friadi, J., Rumengan, E., & Yani, D. P. (2022). Application e-learning based on cloud computing at the faculty of engineering, Batam University. *Eduvest: Journal Of Universal Studies*, *2*(7), 312–318.

Friess, E., & Lam, C. (2018). Cultivating a sense of belonging: Using Twitter to establish a community in an introductory technical communication classroom. *Technical Communication Quarterly*, *27*(4), 343-361.

Gall, M. D., Borg, W. R., & Gall, J. P. (2007). *Educational research: An Introduction* (8th ed.). Pearson Education.

Garcia, C. E. (2019). "They don't even know that we exist": Exploring sense of belonging within sorority and fraternity communities for Latina/o members. *Journal of College Student Development*, *60*(3), 319–336.

Gardner, K., Glassmeyer, D., & Worthy, R. (2019). Impacts of STEM professional development on teachers' knowledge, self-efficacy, and practice. In *Frontiers in Education* (Vol. 4, p. 26). Frontiers Media SA.

Gaspar, A. (2007). Virtualization technologies in the undergraduate IT curriculum. *IT Professional*., 9(4), 10–17.

Gay, G. H. E., & Betts, K. (2020). From discussion forums to e-meetings: Integrating high touch strategies to increase student engagement, academic performance, and retention in large online courses. *Online Learning*, *24*(1), 92–117.

Gentrup, S., Lorenz, G., Kristen, C., & Kogan, I. (2020). Self-fulfilling prophecies in the classroom: Teacher expectations, teacher feedback, and student achievement. *Learning and Instruction*, *66*, 101296.

Glazier, R. A., & Harris, H. S. (2021). Instructor presence and student satisfaction across modalities: Survey data on student preferences in online and on-campus courses. *International Review of Research in Open & Distance Learning*, *22*(3), 77–98. https://doi.org/10.19173/irrodl.v22i3.5546

Godor, B. P. (2017). Academic fatalism: Applying Durkheim's fatalistic suicide typology to student drop-out and the climate of higher education. *Interchange* **48**, 257–269. https://doi.org/10.1007/s10780-016-9292-8

Goncalves, E., & Capucha, L. (2020). Student-centered and ICT-enabled learning models in veterinarian programs: What changed with COVID-19? *Education Sciences*, *10*.

Gregori, P., Martínez, V., & Moyano-Fernández, J. J. (2018). Basic actions to reduce dropout rates in distance learning. *Evaluation and Program Planning*, *66*, 48–52. https://doi.org/10/gcr4b7

Gross, M., & Ho, S. M. (2021). Collective learning for developing cyber defense consciousness: An activity system analysis. *Journal of Information Systems Education*, *32*(1), 65–76.

Hall, J., & Jostad, J. (2020). The role of pay and sense of community in the turnover of outdoor adventure education field staff. *Journal of Outdoor Recreation, Education & Leadership, 12*(3), 333–349.

Halpin, R. L. (1990). An application of the Tinto model to the analysis of freshman persistence in a community college. *Community College Review*, *17*(4), 22–32. https://doi.org/10.1177/009155219001700405

Hanna, J., Carreon, H., Fultz, M., Harvey, E., Howley, C., Norton, M., Richards-Babb, M., Riley, S., Sine, A., & Heatherly, S. A. (2021). Impact of short-duration research experiences on STEM self-efficacy among early-stage, rural, first-generation college students. *Scholarship and Practice of Undergraduate Research*, *4*(4), 42–49.

Hlinka, K. R. (2017). Tailoring retention theories to meet the needs of rural Appalachian community college students. *Community College Review*, *45*(2), 144–164. https://doi.org/10.1177/0091552116686403

Hu, S., Torphy, K. T., Evert, K., & Lane, J. L. (2020). From cloud to classroom: mathematics teachers' planning and enactment of resources accessed within virtual spaces. *Teachers College Record*, *122*(6).

Huang, A. (2019). Teaching, learning, and assessment with virtualization technology. *Journal of Educational Technology Systems*., 47(4), 523–538. https://doi.org/10.1177/0047239518812707

Iluzada, C., & Talbert, T. L. (2022). Learning, course satisfaction, and community in the time of COVID-19: Student perceptions of the switch to emergency remote teaching. *InSight: A Journal of Scholarly Teaching*, *17*, 65–82.

Iorgulescu, S. (2022). An analysis of gamification in education. The need for an ethical code. *Europolity*, *16*(2), 101–126.

Jelks, S. M. R., & Crain, A. M. (2020). Sticking with STEM: Understanding STEM career persistence among STEM bachelor's degree holders. *Journal of Higher Education*, *91*(5), 805–831. https://doi.org/10.1080/00221546.2019.1700477

Johnson, B. K. (2020). Observational experiential Learning: Theoretical support for observer roles in health care simulation. *Journal of Nursing Education, 59*(1), 7-14.

Johnson, J. B. (1926). Predicting success in college at time of entrance. *School and Society*, 23, 82-88.

Johnson, M. D., Sprowles, A. E., Goldenberg, K. R., Margell, S. T., & Castellino, L. (2020). Effect of a place-based learning community on belonging, persistence, and equity gaps for first-year STEM students. *Innovative Higher Education*, *45*(6), 509–531. https://doi.org/10.1007/s10755-020-09519-5

Kavrayici, C. (2021). The relationship between classroom management and sense of classroom community in graduate virtual classrooms. *Turkish Online Journal of Distance Education*, *22*(2), 112–125.

Kelley, T. R., Knowles, J. G., Holland, J. D., & Han, J. (2020). Increasing high school teachers' self-efficacy for integrated STEM instruction through a collaborative community of practice. *International Journal of STEM Education*, *7*(1), 1-13.

Kember, D., Leung, D., & Prosser, M. (2021). Has the open door become a revolving door? The impact on attrition of moving from elite to mass higher education. *Studies in Higher Education*, 46:2, 258-269, https://doi.org/10.1080/03075079.2019.1629411

Kilinc, H., & Altinpulluk, H. (2021). Investigation of the sense of community levels of content generating learners in online learning environments in terms of various variables.

Cukurova University Faculty of Education Journal, *50*(2), 1127–1153. https://doi.org/10.14812/cuefd.745340

Kim, K., Moiseichik, M., Han, J., & Stokowski, S. (2022). Exploring the effect of team identification on international students' adjustment to higher education in the United States. *Journal of Comparative and International Higher Education*, *14*(1), 86–98.

Kim, N. J., Belland, B. R., & Walker, A. E. (2018). Effectiveness of computer-based scaffolding in the context of problem-based Learning for STEM education: Bayesian meta-analysis. *Educational Psychology Review*, *30*(2), 397–429.

Knekta, E., & McCartney, M. (2021). What can departments do to increase students' retention? A case study of students' sense of belonging and involvement in a biology department. *Journal of College Student Retention: Research, Theory & Practice*, *22*(4), 721–742.

Koivisto, J., Niemi, H., Multisilta, J., & Eriksson, E. (2017). Nursing students' experiential learning processes using an online 3D simulation game. *Education and Information Technologies*, *22*(1), 383-398.

Kolb, A. Y., & Kolb, D. A. (2017). Experiential learning theory as a guide for experiential educators in higher education. *Experiential Learning & Teaching in Higher Education (ELTHE): A Journal for Engaged Educators*, *1*(1), 7–44.

Kolb, D. A., & Fry, R. E. (1974). Toward an applied theory of experiential learning. *Issue 732, Part 74 of Working paper*, Sloan School of Management, MIT.

Kolbaek, D. (2018). Problem-Based Learning in the Digital Age. *International Association for Development of the Information Society*.

Kumar, V., & Sharma, D. (2017). Cloud computing as a catalyst in STEM education. *International Journal of Information and Communication Technology Education (IJICTE)*, *13*(2), 38-51.

LaCosse, J., Murphy, M. C., Garcia, J. A., & Zirkel, S. (2021). The role of STEM professors' mindset beliefs on students' anticipated psychological experiences and course interest. *Journal of Educational Psychology*, *113*(5), 949–971.

Laerd Statistics (2015). Mann-Whitney U test using SPSS Statistics. *Statistical tutorials and software guides*. Retrieved from https://statistics.laerd.com/

Li, F., & Liu, Y. (2018). Can using a discussion board enhance writing practice for EAP/ESL students? *Theory & Practice in Language Studies*, *8*(5), 467–474. https://doi.org/10.17507/tpls.0805.02

Li, K. C., & Wong, B. T. M. (2019). Factors related to student persistence in open universities: Changes over the years. *International Review of Research in Open and Distributed Learning*, *20*(4), 132–151.

Limantara, N., Meyliana, A., Gaol, F. L., & Prabowo, H. (2022). Factors influencing the implementation of gamification for learning in information systems education. *International Journal of Emerging Technologies in Learning*, *17*(8), 32–41. https://doi.org/10.3991/ijet.v17i08.29777

Lin, X., & Gao, L. (2020). Students' sense of community and perspectives of taking synchronous and asynchronous online courses. *Asian Journal of Distance Education*, *15*(1), 169-179.

Loveland, E. (2018). Creating a sense of community and belonging for Latinx students. *Journal of College Admission*, *241*, 44–49.

Lowenthal, P. R., West, R. E., Archambault, L., Borup, J., & Belt, E. S. (2021). Faculty perceptions of using synchronous video-based communication technology. *Online Learning*, *25*(4), 74–103.

Luo, L., Stoeger, H., & Subotnik, R. F. (2022). The influences of social agents in completing a STEM degree: An examination of female graduates of selective science high schools. *International Journal of STEM Education*, *9*.

Luse, A., Brown, A., & Rursch, J. (2021). Instruction in 802.11 technology in online virtual labs. *IEEE Transactions on Education*, *64*(1), 12–17.

Machajewski, S., Steffen, A., Romero Fuerte, E., & Rivera, E. (2019). Patterns in faculty learning management system use. *TechTrends: Linking Research & Practice to Improve Learning*, *63*(5), 543–549. https://doi.org/10.1007/s11528-018-0327-0

Martin-Hansen, L. (2018). Examining ways to meaningfully support students in STEM. *International Journal of STEM Education*, *5*(1), 1-6.

Massari, G., Miron, F., Kamantauskiene, V., Alat, Z., Mesquita, C., Tzakosta, M., Verheij, J., & Zirina, T. (2018). A handbook on experiential education: Pedagogical guidelines for teachers and parents. Editura Universitatii

Master, A. H., & Meltzoff, A. N. (2020). Cultural stereotypes and sense of belonging contribute to gender gaps in STEM. *Grantee Submission*, *12*(1), 152–198.

Matriano, E. A. (2020). Ensuring student-centered, constructivist, and project-based experiential learning applying the exploration, research, interaction, and creation (ERIC) learning model. *International Online Journal of Education and Teaching*, *7*(1), 214–227.

Mays, T., & Ross, S. (2022). Sense of community in synchronous and asynchronous online courses: Perceptions and experiences of nontraditional students. *Online Journal of Distance Learning Administration*, *25*(1).

McAdam, D. (1982). *Political process and the development of black insurgency, 1930-1970*. University of Chicago Press.

McKim, A. J., Sorensen, T. J., McKendree, R. B., & Pauley, C. M. (2018). Exploring student retention in postsecondary agriculture, food, and natural resources education programs. *Journal of Research in Technical Careers*, *2*(2), 16–25.

McMahon, D. D., & Walker, Z. (2019). Leveraging emerging technology to design an inclusive future with universal design for learning. *Center for Educational Policy Studies Journal*, *9*(3), 75–93

McMillan, D. W., & Chavis, D. M. (1986). Sense of community: A definition and theory. J. Community Psychol., 14: 6-23. https://doi.org/10.1002/1520-6629(198601)14:1<6::AID-JCOP2290140103>3.0.C.O.;2-I

Means, B., Peters, V., Neisler, J., Wiley, K., & Grifths, R. (2021). Lessons from remote learning during COVID-19. *Digital Promise* https://doi.org/10.51388/20.500.12265/116

Mentzer, K., Frydenberg, M., & Yates, D. J. (2020). Teaching applications and implications of blockchain via project-based learning: A case study. *Information Systems Education Journal*, *18*(6), 57–85.

Mew, L. (2016). Information systems education: The case for the academic cloud. *Information Systems Education Journal*, *14*(5), 71–79.

Miller, A. L., Williams, L. M., & Silberstein, S. M. (2019). Found my place: The importance of faculty relationships for seniors' sense of belonging. *Higher Education Research and Development*, *38*(3), 594–608.

Miller, T., MacLaren, K., & Xu, H. (2020). Online Learning: Practices, perceptions, and technology. *Canadian Journal of Learning and Technology*, *46*(1).

Mills, J., & Treagust, D. (2003). Engineering education: Is problem-based or project-based learning the answer? Australasian Journal Engineering Education. Vol. 3.

Milovic, A., & Dingus, R. (2021). How to not disappear completely: Using video-based discussions to enhance student social presence in an online course. *Marketing Education Review*, *31*(4), 311–321. https://doi.org/10.1080/10528008.2021.1943447

Mitra, S., & Gupta, S. (2020). Mobile Learning under personal cloud with a virtualization framework for outcome-based education. *Education and Information Technologies*, *25*(3), 2129–2156.a

Moallem, M., & Igoe, E. (2018). Problem-based learning and computer-based scaffolds in distance education. *International Association for Development of the Information Society*.

Mollenkopf, D., & Gaskill, M. (2020). Technological transience in a time of unprecedented change: Student support strategies in college courses for those "suddenly online." *Journal of Literacy & Technology*, *21*(2), 130–148.

Muljana, P. S., & Luo, T. (2019). Factors contributing to student retention in online learning and recommended strategies for improvement: A systematic literature review. *Journal of Information Technology Education: Research*, *18*, 19–57.

Muller, K., Gradel, K., Deane, S., Forte, M., McCabe, R., Pickett, A. M., Piorkowski, R., Scalzo, K., Sullivan, R., & National Institute for Learning Outcomes Assessment. (2019).

Assessing student learning in the online modality. Occasional Paper #40. In *National Institute for Learning Outcomes Assessment*.

Naji, K. K., Ebead, U., Al-Ali, A. K., & Du, X. (2020). Comparing models of problem and project-based learning (PBL) courses and student engagement in civil engineering in Qatar. *EURASIA Journal of Mathematics, Science and Technology Education*, *16*(8).

Netanda, R. S., Mamabolo, J., & Themane, M. (2019). Do or die: Student support interventions for the survival of distance education institutions in a competitive higher education system. *Studies in Higher Education*, *44*(2), 397–414. https://doi.org/10.1080/03075079.2017.1378632

Ng, D. T. K., & Chu, S. K. W. (2021). Motivating students to learn STEM via engaging flight simulation activities. *Journal of Science Education and Technology*, 1-22

Ng, V. (2010). Virtualization -- what's in it for me? *NetworkWorld Asia*, *7*(2), 2.

Norman, O., Pinder, P. J., Shelley, M. C., II, Harven, A., & Nkusi, M. (2021). The salience of identity in the academic success of black STEM students and professionals. *Online Submission*, *10*(1–4), 1–16.

Nubani, L., & Lee, E. (2022). Sense of classroom community in interior design studios: In-person Learning versus online learning approaches. *Journal of Interior Design*, *47*(2), 51–70. https://doi.org/10.1111/joid.12217

O'Connor, P., & Cardona, J. (2019). Gamification: A pilot study in a community college setting. *Journal of Education*, *199*(2), 83–88.

O'Hara, R. E., & Sparrow, B. (2019). A summer nudge campaign to motivate community college STEM students to re-enroll. *AERA Open*, *5*(3).

Oladele, J. I., Ayanwale, M. A., & Ndlovu, M. (2023). Technology adoption for STEM education in higher education: Students' experience from selected sub-Saharan African countries. *Pertanika Journal of Science & Technology, 31*(1), 237–256. https://doi.org/10.47836/pjst.31.1.15

Olson, J. S., Elufiede, K., & Murray-Lemon, L. (2020). Unfinished business: Compelling stories of adult student persistence. Adult Higher Education Alliance Annual Conference Proceedings (44th, Orlando, Florida, March 5-6, 2020). *Adult Higher Education Alliance*.

Oregon, E., McCoy, L., & Carmon-Johnson, L. (2018). Case analysis: Exploring the application of using rich media technologies and social presence to decrease attrition in an online graduate program. *Journal of Educators Online*, *15*(2).

Papageorge, N. W., Gershenson, S., & Kang, K. M. (2020). Teacher expectations matter. *Review of Economics and Statistics*, *102*(2), 234-251.

Peacock, S., & Cowan, J. (2019). Promoting sense of belonging in online learning communities of inquiry in accredited courses. *Online Learning*, *23*(2), 67–81.

Peacock, S., Cowan, J., Irvine, L., & Williams, J. (2020). An exploration into the importance of a sense of belonging for online learners. *International Review of Research in Open and Distributed Learning*, *21*(2), 18–35.

Pedraza, L., & Chen, R. (2022). Examining motivator factors of STEM undergraduate persistence through two-factor theory. *Journal of Higher Education, 93*(4), 532–558.

Pendergast, D., Allen, J., McGregor, G., & Ronksley-Pavia, M. (2018). Engaging marginalized, "at-risk" middle-level students: A focus on the importance of a sense of belonging at school. *Education Sciences, 8*.

Peng, Y., & Yan, W. (2017). Effect of internet-based Learning in public health training: An exploratory meta-analysis. *International Association for Development of the Information Society* (p. 20).

Perrotta, K. (2020). Getting HIP: A study on the implementation of asynchronous discussion boards as a high-impact practice in online undergraduate survey history courses. *Journal of Social Studies Research*, *44*(2), 209–217. https://doi.org/10.1016/j.jssr.2020.02.001

Peterson, B. C. (2017). BYU–Idaho Pathway: A gateway to global church education. *Religious Educator: Perspectives on the Restored Gospel*, *18*(3), 43-67.

Portacolone, E., Johnson, J. K., Halpern, J., & Kotwal, A. (2020). Seeking a sense of belonging. *Generations*, *44*(3), 1–8.

Price, E., Lau, A. C., Goldberg, F., Chandra, T., Sean, S. P., Dancy, M., & Robinson, S. (2021). Analyzing a faculty online learning community as a mechanism for supporting faculty implementation of a guided-inquiry curriculum. *International Journal of STEM Education*, *8*(1). https://doi.org/10.1186/s40594-020-00268-7

Racchini, J. (2005). Enhancing student retention. *Athletic Therapy Today*, *10*(3), 48–50.

Radovan, M. (2019). Should I stay, or should I go? Revisiting student retention models in distance education. *Turkish Online Journal of Distance Education*, *20*(3), 29–40.

Rainey, K., Dancy, M., Mickelson, R., Stearns, E., & Moller, S. (2018). Race and gender differences in how sense of belonging influences decisions to major in STEM. *International Journal of STEM Education*, *5*(1), 1-14.

Ramakrishnan, J., Shabbir, M. S., Kassim, N. M., Nguyen, P. T., & Mavaluru, D. (2020). A comprehensive and systematic review of the network virtualization techniques in the IoT.

International Journal of Communication Systems, *33*(7), 1–19. https://doi.org/10.1002/dac.4331

Rashid, N. A., bin Othman, M. Z., bin Johan, R., & Sidek, S. H. (2019). Cisco packet tracer simulation as effective pedagogy in computer networking course. *International Journal of Interactive Mobile Technologies*, *13*(10), 4–18. https://doi.org/10.3991/ijim.v13i10.11283

Rennar-Potacco, D., Orellana, A., Chen, P., & Salazar, A. (2019). Rethinking academic support: Improving the academic outcomes of students in high-risk STEM courses with synchronous videoconferencing. *Journal of College Student Retention: Research, Theory & Practice*, *20*(4), 455–474.

Rivas, J., Hale, K., & Burke, M. G. (2019). Seeking a sense of belonging: Social and cultural integration of international students with American college students. *Journal of International Students*, *9*(2), 687–703.

Rodriguez, S. L., & Blaney, J. M. (2021). "We're the unicorns in STEM": Understanding how academic and social experiences influence sense of belonging for Latina undergraduate students. *Journal of Diversity in Higher Education, 14*(3), 441–455.

Rovai, A. P. (2002a). Development of an instrument to measure classroom community. *Internet & Higher Education*, *5*(3), 197. https://doi.org/10.1016/S1096-7516(02)00102-1

Saleh, S., Muhammad, A., & Syed Abdullah, S. M. (2019). Stem project-based approach in enhancing conceptual understanding and inventive thinking skills among secondary school students. *Journal of Nusantara Studies*, *5*(1), 234–254. https://doi.org/10.24200/jonus.vol5iss1pp234-254

Schietroma, E. (2019). Innovative STEM lessons, CLIL, and ICT in multicultural classes. *Journal of E-Learning & Knowledge Society*, *15*(1), 183–193. https://doi.org/10.20368/1971-8829/1587

Scott, M., & Schofield, S. (2022). Enhancing the student experience through sustainable Communities of Practice. *Asia Pacific Scholar*, *7*(1), 102–105. https://doi.org/10.29060/TAPS.2022-7-1/SC2508

Singer, A., Montgomery, G., & Schmoll, S. (2020). How to foster the formation of STEM identity: Studying diversity in an authentic learning environment. *International Journal of STEM Education*, *7*.

Slovacek, S., Miu, V., Soto, K., & Ye, H. (2019). Supporting STEM in higher education. *International Journal of Education and Practice*, *7*(4), 438–449.

Smith, S., & Watson, S. (2022). Experiences of belonging: A comparative case study between China-domiciled and UK-domiciled students. *Journal of University Teaching and Learning Practice*, *19*(4).

Southgate, E. (2020). Virtual reality in curriculum and pedagogy: Evidence from secondary classrooms. *Digital Games, Simulation, and Learning*.

Sriram, R., Cheatle, J., Weintraub, S. D., Haynes, C., Murray, J. L., & Marquart, C. P. (2020). The influence of academic, social, and deeper life interactions on students' psychological sense of community. *Journal of College Student Development*, *61*(5), 593–608.

Stachl, C. N., & Baranger, A. M. (2020). Sense of belonging within the graduate community of a research-focused STEM department: Quantitative assessment using a visual narrative and item response theory. *PLoS ONE,* 1–27. https://doi.org/10.1371/journal.pone.0233431

Stone, C., & Springer, M. (2019). Interactivity, connectedness, and teacher-presence: Engaging and retaining students online. *Australian Journal of Adult Learning*, *59*(2), 146–169.

Studebaker, B., & Curtis, H. (2021). Building community in an online doctoral program. *Christian Higher Education*, *20*(1–2), 15–27.

Summerskill, J. (1962). Dropouts from college. *The American college: A psychological and social interpretation of the higher learning* (pp. 627–657). John Wiley & Sons, Inc. https://doi.org/10.1037/11181-019

Swickard, F. L. (2021). Creating a sense of community in higher education online learning environments through asynchronous communication using video and social learning platforms (Order No. 28416513). [Doctoral dissertation, Evangel University]. Available from ProQuest Dissertations & Theses Global. (2519815971).

Syamsuddin, I. (2019). VILARITY - Virtual laboratory for information security practices. *TEM Journal*, *8*(3), 1011–1016. https://doi.org/10.18421/TEM83-45

Tang, J. Y. M., Chui, C. H. K., Lou, V. W. Q., Chiu, R. L. H., Kwok, R., Tse, M., Leung, A. Y. M., Chau, P.-H., & Lum, T. Y. S. (2021). The contribution of sense of community to the association between age-friendly built environment and health in a high-density city: A cross-sectional study of middle-aged and older adults in Hong Kong. Journal of Applied Gerontology, 40(12), 1687–1696. https://doi.org/10.1177/0733464821991298

Thongmak, M. (2018). The use of gamification in an introductory MIS course: The views of game participants and game conductors.

Tierney, W. G., Corwin, Z. B., & Ochsner, A. (2018). *Diversifying Digital Learning: Online Literacy and Educational Opportunity*. Johns Hopkins University Press.

Tinto, V. (1975). Dropout from Higher Education: A Theoretical Synthesis of Recent Research. *Review of Educational Research*, *45*(1), 89–125. https://doi.org/10.3102/00346543045001089

Trespalacios, J., & Lowenthal, P. R. (2019). What do they really like? An investigation of students' perceptions of their coursework in a fully online educational technology program. *Australasian Journal of Educational Technology*, *35*(5), 60–78.

Trespalacios, J., & Uribe-Florez, L. J. (2020). Developing online sense of community: Graduate students' experiences and perceptions. *Turkish Online Journal of Distance Education*, *21*(1), 57–72.

Turk, M., Müftüoglu, A. C., & Toraman, S. (2021). Teaching presence in online courses: Similar perceptions but different experiences from multiple instructor perspectives. *Online Learning*, *25*(4), 156–177.

Vanderstraeten, L., Buysschaert, F., De Mulder, V., François, D., Janssens, L., Maes, A., Maes, G., Minnaert, E., & Opdecam, E. (2022). How to welcome first-year students: Best practice of a gamified orientation day. *Proceedings of the European Conference on Games Based Learning*, *1*, 588–596. https://doi.org/10.34190/ecgbl.16.1.672

Villarroel, V., Benavente, M., Chuecas, M. J., & Bruna, D. (2020). Experiential learning in higher education. A student-centered teaching method that improves perceived learning. *Journal of University Teaching and Learning Practice*, *17*(5).

Washington, V., & Mondisa, J. L. (2021). A need for engagement opportunities and personal connections: Understanding the social community outcomes of engineering undergraduates in a mentoring program. *Journal of Engineering Education*, *110*(4), 902–924.

Weinhandl, R., Lavicza, Z., & Houghton, T. (2020). Designing online learning environments for flipped approaches in professional mathematics teacher development. *Journal of Information Technology Education: Research*, *19*, 315–337.

Wesseling, N. (2016). New ways of engagement in higher education. *Journal of Technologies in Society*, *12*(1), 1–11. https://doi.org/10.18848/2381-9251/cgp/v12i01/1-11

Whitehead, A., & Ives, S. (2021). Student perception of close social subgroup influence on STEM degree persistence. *College Student Journal*, *55*(2), 145–162.

Woods, C. E. (2022). Best practices for online embedded librarians supporting graduate business students. *Journal of Business & Finance Librarianship*, *27*(3), 215–226. https://doi.org/10.1080/08963568.2022.2090680

Wright, B., Lee, S., Zaromatidis, K., & Huk, O. (2021). Increasing retention of STEM students with financial need via the NSF S-STEM DESIRE scholarship program. *Journal of STEM Education: Innovations & Research*, *22*(4), 24–38.

Zhang, S., Li, C., & Unger, D. L. (2022). International doctoral students' sense of belonging, mental toughness, and psychological well-being. *Journal of Comparative and International Higher Education*, *14*(2), 138–151.

Zhou, J., & Zhang, Q. (2021). A survey study on U.S. college students' learning experience in COVID-19. *Education Sciences, 11*.

Zhou, S. N., Chen, L. C., Xu, S. R., Lu, C. T., Li, Q., & Li, D. A. (2021). Primary students' performance of STEM domain-specific self-efficacy belief and expectancy-value belief. *Journal of Baltic Science Education*, *20*(4), 677–690.

APPENDIX A – CLASSROOM COMMUNITY SCALE (CCS)

The questionnaire below uses the following Likert-style responses for each question: 1) Strongly agree, 2) Agree, 3) Neutral, 4) Disagree, 5) Strongly disagree.

The following is the 20-item questionnaire that makes up the Classroom Community Scale (CCS) as defined by Rovai (2002a). The instrument is divided into two sub-scales: Connectedness and Learning as noted below:

- ***Removed to comply with copyright.***

APPENDIX B – INSTRUCTIONS FOR THE CCS QUESTIONNAIRE

Below are the instructions provided to the students who select to participate in the study.

"**Directions:**

Below, you will see a series of statements concerning a specific course or program you are presently taking or have recently completed. Read each statement carefully and select the statement that comes closest to indicate how you feel about the course or program. There are no correct or incorrect responses. If you neither agree nor disagree with a statement or are uncertain, simply select the neutral (N) response. Do not spend too much time on any one statement, but give the response that seems to describe how you feel. Please respond to all items."

		Strongly Agree (SA)	Agree (A)	Neutral (N)	Disagree (D)	Strongly Disagree (SD)
1	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
2	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
3	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
4	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
5	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
6	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
7	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
8	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
9	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
10	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
11	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
12	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)

13	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
14	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
15	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
16	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
17	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
18	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
19	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)
20	Removed to comply with copyright.	(SA)	(A)	(N)	(D)	(SD)

APPENDIX C – IRB APPROVAL

IRB approval was required from two separate organizations: Liberty University who conducted the study and the IRB office at BYU Idaho who is the designated IRB manager for the college whose students participated in the study. Below are copies of the approval letters from both organizations:

Date: 10-16-2023

IRB #: IRB-FY23-24-92
Title: Comparing Sense of Community Scores between Online IT Students Based Domestically and Those Based Internationally
Creation Date: 7-20-2023
End Date:
Status: Approved
Principal Investigator: Spencer Degraw
Review Board: Research Ethics Office
Sponsor:

Study History

Submission Type Initial	Review Type Exempt	Decision Exempt

Key Study Contacts

Member Sara Geary	Role Co-Principal Investigator	Contact
Member Spencer Degraw	Role Principal Investigator	Contact
Member Spencer Degraw	Role Primary Contact	Contact

BYU IDAHO | Office of Faculty Development

July 21, 2023

Dear Spencer:

Your study entitled, “Comparing Sense of Community Scores between Online Information Technology Students Based Domestically and Those Based Internationally,” IRB #: S23-12 has been received, reviewed, and approved. It has met the expectation of IRB protocols and is approved for one year from the date of this letter. Please keep a copy of this approval in your records along with any other documentation regarding this project. We request that you update us on any changes to the project for our records. Should a change in your research approach or methodology change, please contact our office for assistance or re-evaluation. Feel free to proceed with your project.

Best Regards,

APPENDIX D – INFORMED CONSENT / INVITATION TO PARTICIPATE

The following letter was provided to all students currently enrolled in online IT courses inviting them to participate in the research study:

Personal Invitation to be part of a Research Study

As a doctoral candidate in the School of Education at Liberty University, I am conducting research to better understand the effectiveness of online IT course designs that are being offered to an international audience.

Participants must be enrolled in an online IT course being offered through Ensign College and will be asked a short, anonymous, online survey. It should take approximately 2 to 5 minutes to complete the questionnaire. Participation will be completely anonymous, and no personal, identifying information will be collected.

Please read the information sheet below for additional information about the research project.

Sincerely,

Spencer DeGraw

To participate, please click below:

- Click here to begin the survey

Title of the Project:

- "Comparing Sense of Community Scores Between Online Information Technology Students Based Domestically and Those Based Internationally"

Principal Investigator:

- Spencer DeGraw (Doctoral Candidate) – School of Education, Liberty University

What is the study about and why is it being done?

The purpose of the study is to investigate a student's Sense of Community within an online IT course and to determine if there is any difference based on where the student is physically residing while participating in an online IT course.

What will happen if you take part in this study?

If you agree to be in this study, you will be asked to do the following:

- Click on the below link which will take you to an online survey. The survey will have 26 questions that include a few demographic questions and will ask your thoughts or feelings about the course you are taking. The questionnaire should take no more than 2 to 5 minutes to complete. The results will be anonymous and will only be used to determine ways to enhance the course design and delivery.

How could you or others benefit from this study?

- Your participation will help us better design online IT courses to ensure that students are able to learn effectively from anywhere in the world.

What risks might you experience from being in this study?

- The expected risks from participating in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

How will personal information be protected?

The records of this study will be kept private. Research records will be stored securely, and only the researcher will have access to the records.

- Participant responses will be anonymous.
- Data will be stored securely in the cloud within a password-locked account. After three years, all electronic records will be deleted.

How will you be compensated for being part of the study?

- Participants will not be compensated for participating in this study.

Is the researcher in a position of authority over participants, or does the researcher have a financial conflict of interest?

The researcher serves as a teacher at the school. To limit potential or perceived conflicts, data collection will be anonymous, so the researcher will not know who participated. This disclosure is made so that you can decide if this relationship will affect your willingness to participate in this study. No action will be taken against an individual based on his or her decision to participate or not participate in this study.

Is study participation voluntary?

Participation in this study is voluntary. Your decision on whether to participate will not affect your current or future relations with Liberty University or Ensign College. If you decide to participate, you are free to not answer any question or withdraw at any time prior to submitting the survey.

What should you do if you decide to withdraw from the study?

If you choose to withdraw from the study, please exit the survey and close your internet browser. Your responses will not be recorded or included in the study.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is Spencer DeGraw. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact him at sdegraw@liberty.edu.

Whom do you contact if you have questions about your rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the IRB. Our physical address is Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA, 24515; our phone number is 434-592-5530, and our email address is irb@liberty.edu.

-

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

Your Consent

Before agreeing to be part of the research, please be sure that you understand what the study is about. You can print a copy of this document for your records. If you have any questions about the study, either now or later, you can contact the researcher using the following email address:

- sdegraw@liberty.edu

By clicking on the survey link below you are agreeing to participate in our study (the survey will take about 2 to 5 minutes):

- **Click here to begin the survey**

APPENDIX E – IRB EXCEPTION

- The IRB approval process determined that this study was informational only and did not fall under the stricter Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and offered the following exception authorization form.

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

October 16, 2023

Spencer Degraw
Sara Geary

Re: IRB Exemption - IRB-FY23-24-92 Comparing Sense of Community Scores between Online IT Students Based Domestically and Those Based Internationally

Dear Spencer Degraw, Sara Geary,

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under the following exemption category, which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:104(d):

Category 2.(i). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

For a PDF of your exemption letter, click on your study number in the My Studies card on your Cayuse dashboard. Next, click the Submissions bar beside the Study Details bar on the Study details page. Finally, click Initial under Submission Type and choose the Letters tab toward the bottom of the Submission Details page. Your information sheet and final versions of your study documents can also be found on the same page under the Attachments tab.

APPENDIX F – HOW TO ACCESS THE DATA RESULTS

- The study data results are currently stored on a private folder in a OneDrive account managed by the researcher. For a copy of the Excel file, please contact Spencer DeGraw at the following email address: sdegraw@liberty.edu