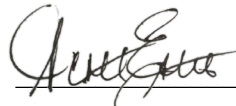DOES BELONGING COUNT IN MATH? AN ACTION RESEARCH STUDY ON

BELONGING AND ACADEMIC PERFORMANCE IN THE COREQUISITE AND

GATEWAY MATH COURSES

A Scholarly Research Project

Submitted in Partial Fulfillment of the Requirements for the Degree

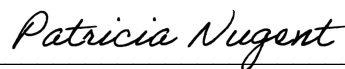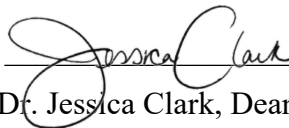Doctor of Education

Approved:

_____

Dr. Scott Estes, Research Mentor

_____

Dr. Erik Dalmasso, Program Director

_____

Dr. Patricia Nugent, Department Chair

_____

Dr. Jessica Clark, Dean

Dawn Leann Peterson

Bradley University

December 2022

ABSTRACT

This action research study was born out of the researcher's anecdotal observations that often the students in her remedial math courses who do not appear to form relationships with their classmates are the same students who fail to complete the course successfully. The purpose of this quantitative action research study was to determine whether there is a relationship between students' sense of belonging in a corequisite mathematics class and academic performance. The study also sought to determine if the teaching and learning strategies positively impacted sense of belonging. Belonging surveys and self-reported grades were used to answer the questions "What is the nature of the relationship between the change in a student's sense of belonging in a corequisite math course and their academic performance in the corequisite and gateway math courses?" and "To what extent will the methods used for fostering a sense of belonging in the treatment group impact students' sense of belonging compared to the control group?" There was no statistically significant relationship between belonging and course grades, yet one group did experience a significant increase in belonging. The researcher concludes that although students' sense of belonging and course grades may not be associated, instructors should foster sense of belonging in the classes they teach.

DEDICATION

For my kids, B and E.

B, thank you for taking the time to ask how writing was going and for the countless delicious dinners you made. E, thank you for making sure we had our girl time--watching our favorite dramas and going plant shopping together provided the breaks I needed. To both of you, even though I may not have said so at the time, I noticed when you took care of chores around the house without being asked. The two of you are my greatest blessings. I couldn't have taken this journey without your unending understanding, patience, support, and encouragement. I love you!

ACKNOWLEDGMENTS

There are many people who helped me complete my action research project, but there are a few to whom I owe a debt of gratitude.

Dr. McCloud, I had never conducted an action research study before. Thank you for your steady guidance and advice as I chose my research topic, planned my study, and carried out that plan. You taught me how to fly.

Dr. Estes, it was unnerving to have someone new step into my study as I began to write the final chapter. It turned out I had no reason to worry. The time you put in and the care you took to comment on my study and answer all of my questions was more than I ever hoped for. Dr. McCloud taught me to fly. You taught me to soar.

To my students, past, present, and future, you are the reason I do what I do. I hope you learn half as much from me as I learn from you.

And last but mostly definitely not least…Jen and Seema, we have walked through the fire and talked each other off the ledge. We have listened, encouraged, vented, laughed, shared, and supported. I am grateful to call you classmates and, even more, I am blessed to call you friends.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

There are eight students in class today. The instructor assigns each student a number and uses an 8-sided die to randomly put students into three groups. The students move into their groups. The only duo gets to work right away, challenging each other to explain their reasoning when they disagree. Noticing a student sitting alone, the instructor goes to the student and quietly asks if she knows who she is supposed to be working with. "Yeah," she huffs, reluctantly joining two classmates who have arranged three desks in a circle. The other group of three is sitting so they all face the front of the classroom. Two are seated side by side, while the third sits behind his group members. None of them makes an effort to turn their desk even the slightest bit. The students sitting side by side attempt to get the third student involved in the discussion, but after ten minutes of unsuccessfully trying to include him, they give up. Thirty minutes later, the class transitions from working in groups to a whole class debriefing of the activity. As the class discussion begins, a ninth student walks through the door with less than 15 minutes of class remaining.

Welcome to a typical day in my corequisite math class. What is a corequisite class? In general, a corequisite class is a course that must be taken in conjunction with another course. The purpose of the corequisite math class is to provide extra support for the remedial mathematics needed to be successful in a liberal arts gateway math course. The syllabus for the corequisite class includes converting between fractions, decimals, and percentages, using order of operations, finding a percent of a number, and solving linear equations, among many others.

As a professor at a community college in the Midwest, this instructor designed the corequisite course and has taught it each fall and spring semester since the first class was held

during the fall of 2017. Every semester there are isolated learners in the class: students who keep

to themselves and do not willingly engage with others. This professor has anecdotally noticed

these same students struggle to do well in the corequisite class and struggle even more in the

gateway course. This instructor has questioned whether their lack of engagement with their peers

has any connection to their course performance. This practitioner began to think about

activities—not all content-related—that would encourage more student interaction and foster a

sense of belonging in the classroom. This researcher further wondered what the outcome would

be if a student's sense of belonging increased. Would their grade in the course be positively

impacted?

This chapter introduces the study's research problem, beginning with background

information about the need for this study within the context of a corequisite mathematics

classroom. Key terms used in the study are defined, followed by a brief review of exigent

literature, deficiencies in published research, and the significance of this action research study.

Next, the research purpose and questions are presented, along with a discussion of the study's

methodology. The chapter closes with an overview of the organizational structure of this

research report.

<div align="center">

Statement of the Research Problem

</div>

Background

Sense of belonging depends on context (Baumeister & Leary, 1995; Freeman et al., 2007;

Goodenow, 1993; Strayhorn, 2019), nor is belonging experienced by individuals in the same way

(Strayhorn, 2019). A student might feel they belong in one setting (a club or student

organization, for example) yet feel isolated in another (say, a classroom or the campus as a

whole). Research suggests that students find it challenging to attend to the task at hand until they

can determine where they stand in a particular social setting (Goodenow, 1993). Strayhorn

(2019) argues that for college students, focusing on academic tasks such as studying, learning,

and retaining information will be hard until they feel a sense of belonging in the classroom.

Now, consider these statistics regarding community colleges and remedial mathematics.

According to a National Center for Education Statistics (NCES) report by Chen (2016), 59% of

all students who first enroll in a public two-year college take remedial mathematics courses. The

majority of students taking remedial math enrolled in two or three remedial courses (Chen,

2016). Only 50% of those taking remedial math courses successfully completed all of the courses

they attempted. Twenty-nine percent completed some, and 20% completed none of their

remedial courses (Chen, 2016). The same report (Chen, 2016) reveals that remediation was more

common in certain demographic groups than others. For instance, 78% percent of Black students

and 75% of Hispanic students took remedial courses compared to 64% of White students.

Seventy-six percent of students in the lowest income group enrolled in remedial courses versus

59% in the highest. Proportionally, more females (71%) took remedial courses than males (65%)

(Chen, 2016).

The Merriam-Webster Dictionary (n.d.) defines remediation as "the act or process of

remedying" and a remedy as "something that corrects or counteracts" (definition 2). Taking these

definitions together in the context of mathematics in a community college, this researcher defines

mathematical remediation as the act or process of correcting or counteracting a lack of

mathematical knowledge and skills needed to be successful in a college-level math course.

Consider things students in remedial math courses have said to this professor over her

career, statements such as, "I've never been good at math," "I suck at math," and "It doesn't

matter what I do because I'm never going to get this." Based on these comments, it is safe to

assume many college students needing math remediation do not have an abundant history of

mathematical accomplishments or achievements. Their experiences have likely been full of

frustration, confusion, and falling short of expectations.

Research Problem

Pause a moment to consider national statistics that appear in the NCES report (Chen,

2016) regarding success and completion rates in remedial mathematics courses. Combine them

with the disproportionate number of Black, Hispanic, low-income, and female students taking

remedial math classes. Mix in a student's personal mindset that they are not and never will be

good at mathematics. It does not take long to discern why students in a corequisite math course

might be uncomfortable, hesitant, or unwilling to let their guard down and engage with their

classmates. While keeping to oneself is understandable, focusing on academic tasks is difficult if

there is no sense of belonging (Strayhorn, 2019). For this mathematics professor and researcher,

a curious nature led to wondering if students in a corequisite class could be more successful if

they felt a sense of belonging within the corequisite classroom.

<div align="center">

Definition of Key Terms

</div>

In this study, this researcher defined *mathematical remediation* as the act or process of

correcting or counteracting a lack of mathematical knowledge and skills needed to be successful

in a college-level math course. The phrase *developmental mathematics* was used interchangeably

with remedial mathematics by the researcher.

Gateway math course refers to a student's first credit-bearing, college-level math course.

For students needing remediation, a *corequisite math course* is a developmental mathematics

course that is required to be taken simultaneously with a student's gateway mathematics course.

In this study, *sense of belonging* pertains to students' perception of mattering, of being accepted and respected, of believing they are a valued member of a classroom community, and of sensing their ideas and opinions are taken seriously by the classroom instructor and their peers.

Brief Review of Literature

Prevalence of Mathematics Remediation and Corequisite Support

According to the National Center for Education Statistics, approximately 59% of all students who first enroll in a public, two-year college take remedial mathematics courses (Chen, 2016), with the majority enrolling in more than one remedial course. Unfortunately, less than half of students who take remedial math courses successfully complete all the courses they attempt (Chen, 2016; Chen et al., 2020).

Within the past ten years, corequisite remediation has become one of the most prevalent strategies for increasing student success. Nearly half of the states have made corequisite remediation part of their developmental education policy (Education Commission of the States, 2021). Studies focused on corequisite support show students are more likely to succeed in corequisite courses than in traditional developmental mathematics classes (Boatman, 2021; Kashyap & Mathew, 2017; Logue et al., 2019; Ran & Lin, 2022).

Definitions of Sense of Belonging

In his hierarchy of needs, Maslow (1943) identified sense of belonging to be of such importance that the only needs preceding it are physiological needs such as food, water, air, warmth, and rest, and the need to feel safe and secure. Others assert belonging is a basic human need (Baumeister & Leary, 1995; Goodenow, 1993; Lahdenperä & Nieminen, 2020; Maslow, 1943; Strayhorn, 2019; Tinto, 2017) and "a fundamental motivation, sufficient to drive behaviors

and perceptions" (Strayhorn, 2019, p. 28). Students' sense of belonging refers to feeling

accepted, valued, and included (Goodenow, 1993; Hurtado & Carter, 1997; Strayhorn, 2019),

while Tovar & Simon (2010) define sense of belonging as a sense of identification in relation to

a specific group. For college students, Strayhorn (I ; Strayhorn, 2019). For example, studies

indicate sense of belonging is positively associated with interactions with peers and faculty (Han

et al., 2017; Hausmann et al., 2007; Hoffman et al., 2002) as well as with the social supports

available when entering a university (Hausmann et al., 2007; D. R. Johnson et al., 2007).

Sense of belonging is based on students' perceptions of the interactions that take place

within the environment they find themselves (Strayhorn, 2019). While students need to feel they

belong at the institutional level, they also need to belong in the classroom. Zumbrunn et al.

(2014) found instructor academic and social support to be predictors of belonging. Furthermore,

researchers concluded the most effective ways to foster sense of belonging are by encouraging

student participation and providing students the opportunity to interact with each other (Freeman

et al., 2007; Hoffman et al., 2002; Kraus & Sears, 2008; Solomon, 2007; Strayhorn, 2019).

Belongingness is a need when attending college classes in person, but it is also a need in

online courses. Since online courses are mainly asynchronous, there is potential for students to

experience disconnectedness and isolation from both their instructor and their peers (Akyol et al.,

2009; Dawson, 2006; Rovai, 2002). Interaction and dialogue within the online classroom are

essential to developing a sense of community and connectedness (Delahunty et al., 2013; Hill et

al., 2009; Ryman et al., 2009).

Effects of Sense of Belonging

Researchers have measured the effects of students' sense of belonging at the institutional

level (Buskirk-Cohen & Plants, 2019; Han et al., 2017; Hausmann et al., 2007; D. R. Johnson et

al., 2007; Tinto, 2017) and in the classroom (Freeman et al., 2007; Zumbrunn et al., 2014).

Evidence shows a strong sense of belonging leads to academic success when measured by GPA, retention, and persistence (Buskirk-Cohen & Plants, 2019; Freeman et al., 2007; Han et al., 2017; Hausmann et al., 2007; D. R. Johnson et al., 2007; Tinto, 2017; Zumbrunn et al., 2014). Other studies show students' sense of belonging within the university community impacts academic motivation (Freeman et al., 2007; Tinto, 2017) and is a significant indicator of a student's intent to persist (Hausmann et al., 2007; Tinto, 2017).

Deficiencies in the Literature

When seeking literature related to sense of belonging in the collegiate setting, the search terms "sense of belonging or sense of community," "college or university or community college," "in person or classroom," "online or e-learning," and "classroom performance or course performance or course grade," were used along with seemingly countless variations thereof. The search was conducted using three databases: Education Resources Information Center (ERIC), EBSCO Information Services, and Google Scholar. Many studies examined the impact of a sense of belonging at the institutional or classroom level on overall academic performance, motivation, persistence, and retention. However, studies addressing how a sense of belonging in a particular classroom affects academic performance in that class were unable to be found by this researcher. The lack of existing literature on this topic is evidence of a void in the research.

<div align="center">

Significance of the Study

</div>

Abundant research has been published on the importance of sense of belonging and its subsequent impact on overall academic performance, persistence, and retention. What is lacking, however, are studies that measure the extent to which sense of belonging in a specific course

affects academic performance in that course. This action research study directly addresses the aforementioned gap in the existing scholarly research about sense of belonging and course-level success.

Corequisite support for mathematics is a relatively new idea. More institutions of higher learning are transitioning to corequisite models of instruction (Education Commission of the States, 2021). Consequently, research on corequisite math courses is just beginning to emerge. This newness makes the population of interest in this study one that is somewhat unique. By conducting research in a corequisite course, this researcher contributed to a field of research that she believes is growing in importance.

Purpose of the Study and Research Questions

The purpose of this action research study was to determine whether there is a relationship between students' sense of belonging in a corequisite mathematics class and their academic performance in the corequisite and gateway math courses. Secondarily, the study sought to determine if the teaching and learning strategies chosen to promote sense of belonging positively impacted sense of belonging. This researcher collected two consecutive semesters of data from students enrolled in the corequisite course to answer these questions:

1. What is the nature of the relationship between the change in a student's sense of belonging in a corequisite math course and their academic performance in
   a. the corequisite course?
   b. the gateway math course?
2. To what extent will the methods used for fostering a sense of belonging in the treatment group impact students' sense of belonging compared to the control group?

Methodology

Due to uncertainty in course modality during the pandemic, the researcher was prepared to conduct her research in the in-person, online synchronous, and online asynchronous settings. The researcher had no control over course modality. These factors made preparation and adaptability very important.

Although students' random assignment to a specific corequisite section was not feasible, this study had a treatment group and a control group. This professor and researcher instructed the treatment group, and a colleague taught the control group. The control group was taught using a combination of lecture and group work, the methods traditionally used by the researcher's colleague. On the other hand, the treatment group was taught using various strategies designed to engage the students and increase sense of belonging. The implemented teaching and learning strategies included a few that appear in peer-reviewed studies, with many from non-peer-reviewed sources.

Students' sense of belonging was assessed during week four and again during week 15 of the semester. Sense of belonging was measured using one of two surveys developed to assess students' sense of belonging. Goodenow (1993) created the Psychological Sense of School Membership (PSSM) scale for middle school students. The PSSM uses a Likert-type scale. It has been adapted by many researchers and used in colleges and universities (Buskirk-Cohen & Plants, 2019; Freeman et al., 2007; Zumbrunn et al., 2014). The PSSM is appropriate for students in a physical classroom and was therefore chosen as the survey instrument to employ in the in-person setting. The Classroom Community Scale, developed by Rovai (2002), was the survey tool chosen for online courses.

The first research question was, "What is the nature of the relationship between the change in a student's sense of belonging in a corequisite math course and their academic

performance in the corequisite course and the gateway math course?" Students self-reported their grades in each math course when completing the belongingness survey. To allow for comparisons between each participant's week four and week 15 survey responses while maintaining anonymity, participants chose an identifier known only to them. The researcher used the paired data to calculate each student's change in sense of belonging and their change in course grade. These data points were plotted for each corequisite section. A Pearson correlation coefficient was calculated to determine if there was an association between a change in sense of belonging and a change in course grade for both the corequisite and gateway math courses.

The second research question was, "To what extent will the methods used for fostering a sense of belonging in the treatment group impact students' sense of belonging compared to the control group? " To answer this question, the mean belonging score and the standard deviation were calculated for each section. Then, using a pre-experimental one-group pretest-posttest design (Mertler, 2020), a paired two-sample *t*-test for means was carried out to determine if there was a significant change in sense of belonging over the semester for each corequisite section. Similarly, a quasi-experimental pretest-posttest control group design (Mertler, 2020) required a one-way ANOVA to test whether the change in sense of belonging between the control and treatment groups was statistically significant.

The chosen methodologies were feasible regarding cost, time, and modality uncertainty due to Covid-19. The only expense was printing paper copies of the survey instruments for those corequisite sections held in person. Although online surveys could have been utilized when teaching in person, this researcher believed that students were more likely to fill out a hard copy of a survey during class time than complete an online survey outside of class time. The first iteration of this study took place during the Fall 2021 semester, with the second iteration in

Spring 2022. There was no guarantee the modality would remain the same from one semester to the next. The researcher proactively spoke with her department chairperson to ensure she would teach at least one section of the corequisite course paired with the gateway math course during both semesters of data collection.

Organization of the Research Report

This chapter introduced the reader to an action research study about the relationship between students' sense of belonging in a corequisite math course and academic performance in the corequisite and gateway math courses. Chapter 2 will review literature related to developmental mathematics and sense of belonging. The study's research methodology is detailed in chapter 3, and chapter 4 contains an analysis of data, the study findings, and a discussion of the significance of the results. Chapter 5 features concluding remarks about the action research study, including implications for practice and recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

Introduction

Statistics show that for students needing mathematics remediation in college, the probability of succeeding is low (Chen, 2016; Chen et al., 2020). As a math professor at a community college, this researcher has noticed that the students in a corequisite math class who do not appear to connect with others in the room are often the same students who are unsuccessful in the class. This study's purpose was to determine whether students' sense of belonging in the corequisite course was associated with their academic performance in the corequisite and gateway math courses. The study sought to answer two questions. First, what is the nature of the relationship between the change in students' sense of belonging in a corequisite math course and their academic performance in their corequisite and gateway math courses? Second, to what extent will the methods used for fostering sense of belonging impact students' sense of belonging?

This literature review of primarily peer-reviewed articles provides statistics explaining why the corequisite classroom was chosen as the setting for the study. It also looks at definitions of sense of belonging, discusses the importance of sense of belonging, and examines how sense of belonging can be promoted within postsecondary institutions. Finally, this chapter examines the effects of sense of belonging and considers deficiencies in the literature.

Review of Literature

The Prevalence of Remediation at Postsecondary Institutions

A National Center for Education Statistics (NCES) report by Chen (2016) provides an in-depth look at student demographics and outcomes for those taking remedial (developmental)

English or mathematics in 2- and 4-year public institutions of higher learning. The NCES report's

data was drawn from the 2004/09 Beginning Postsecondary Students Longitudinal Study that

followed a nationally representative sample of students who began their postsecondary education

in 2003-2004, ending in 2009.

An analysis of the large body of data showed that 68% of students who first enroll in a

public 2-year college take at least one remedial course in any field, with 59% of the same

population taking remedial courses in mathematics (Chen, 2016). Notably, most students taking

remedial mathematics enrolled in two or three remedial courses. Only 50% of students taking at

least one remedial math course successfully completed all their attempted courses (Chen, 2016).

Of the remaining students, 29% completed some remedial courses, while 20% completed none

(Chen, 2016).

The same report (Chen, 2016) reveals that remediation was more common in certain

demographic groups than others. Proportionally, more females (71%) took remedial courses than

males (65%). Seventy-eight percent of Black students and 75% of Hispanic students took

developmental courses versus 64% of White students. Fifty-nine percent of students in the

highest income group enrolled in remedial courses compared to 76% in the lowest (Chen, 2016).

The NCES report (Chen, 2016) also looks at how students taking developmental courses

performed in college-level mathematics courses. Seventy-one percent of those who successfully

completed all of their remedial courses at public 2-year colleges enrolled in at least one college-

level math course (Chen, 2016). Of those, 62% earned some credits in these courses. Among

students who successfully completed some but not all of their remedial coursework, 44%

enrolled in one or more college-level math courses (Chen, 2016), with 36% earning some credits.

Chen (2016) goes on to report that of the students requiring remediation who did not successfully

complete any developmental courses, the percentage of students enrolling in and earning some credits in college-level math courses was 32% and 18%, respectively.

The High School Longitudinal Study of 2009 (HSLS:09) (Chen et al., 2020) followed students who were in ninth grade in the fall of 2009 and began their postsecondary education in 2013-2014. The first-look report of postsecondary transcript data by Chen et al. (2020) indicated that 60% of students who attended a 2-year public college had taken one or more remedial courses in English or mathematics as of June 2016 (the data was not disaggregated by subject matter). These students took an average of 2.9 remedial courses, passing an average of 1.8 remedial course during this period (Chen et al., 2020). Furthermore, HSLS:09 data (Chen et al., 2020) revealed that 57% of Black students and 53% of Hispanic students took one or more remedial courses at 2- or 4-year, public or private, for-profit or nonprofit colleges compared to 34% of their White counterparts (the data was not disaggregated by institution type).

The studies mentioned above focused on two groups of students who started college a decade apart (2003-2004 vs. 2013-2014). The overall percentage of students enrolled in remedial courses dropped from 68% to 60% (Chen, 2016; Chen et al., 2020), but the proportion of students taking remedial coursework remained high. Furthermore, there were still a disproportionate number of Black and Hispanic students taking remedial coursework in the latter study. When the full report of the HSLS:09 is published, the disaggregated results should be compared to those in the 2016 NCES report (Chen et al., 2020). Regardless, the overall percentage of students requiring remediation continues to be cause for concern, and Black and Hispanic students are still disproportionately represented in remedial courses (Chen et al., 2020).

Corequisite Remediation in Mathematics

Statistics like those detailed in Chen (2016) and Chen et al. (2020) show that students are not only academically underprepared to enroll in a college-level math courses but that traditional mathematics remediation is not working. Consequently, remediation has been called an obstacle to completion (Cuellar Mejia et al., 2020; Whinnery & Pompelia, 2019). Accordingly, calls to change the way underprepared students are served are growing louder (Education Commission of the States, 2021; Smith, 2015). Corequisite remediation is one of the strategies recommended to increase student success (Cuellar Mejia et al., 2020; Ran & Lin, 2022; Smith, 2015; Whinnery & Pompelia, 2019). According to the Education Commission of the States (2021), 24 states have made corequisite remediation part of their developmental education policy. Other states offer corequisite remediation without specific policies mandating it (Education Commission of the States, 2021).

What is Corequisite Remediation?

One of the unique characteristics of corequisite remediation is the ability to customize corequisite support to meet the specific needs of the students at an institution (Kashyap & Mathew, 2017). As a result, corequisite remediation takes several forms depending on the institution where the corequisite is implemented (Kashyap & Mathew, 2017; Smith, 2015; Whinnery & Pompelia, 2019). For example, some colleges offer bridge programs, self-paced learning modules, or 8-week support courses (Kashyap & Mathew, 2017; Smith, 2015; Whinnery & Pompelia, 2019). The large variety of corequisite models provides a high level of flexibility for instructors to design and implement activities and teaching and learning strategies based on the needs of the students (Kashyap & Mathew, 2017).

Although there are varying models of corequisite support, the word *corequisite* means taking a course that is required to be taken simultaneously with another course (Merriam-

Webster, n.d.). The most common way corequisite mathematics courses are offered is based on

this definition. The majority of corequisite math courses involve students taking a college-level

math course while concurrently enrolled in a corequisite math course (Cuellar Mejia et al., 2020;

Logue et al., 2019; Whinnery & Pompelia, 2019). The corequisite course provides extra

academic support covering the specific remedial mathematics needed for the college-level

course.

Effects of Corequisite Remediation in Mathematics

Due to the relative newness of corequisite models of remediation, research on the

effectiveness of corequisite mathematics is just beginning to emerge. The results are promising.

Several studies show that students in a corequisite model are more successful than students in

traditional developmental courses (Boatman, 2021; Cuellar Mejia et al., 2020; Kashyap &

Mathew, 2017; Logue et al., 2019; Ran & Lin, 2022).

Tennessee introduced corequisite courses in some community colleges before 2015 (Ran

& Lin, 2022). In 2015, the corequisite model was brought full to scale in the state. Tennessee

became the first state in the nation to implement corequisite remediation statewide, affecting the

13 community colleges affiliated with the Tennessee Board of Regents (Ran & Lin, 2022).

Using Tennessee community college data from academic years 2011-12 to 2017-18, Ran

and Lin (2022) found that students taking part in corequisite remediation were 15% more likely

to pass college-level math within one year of enrollment than those who enrolled in traditional

developmental math courses. Logue et al. (2019) looked at the effects of corequisite support on

students enrolled in The City University of New York, a public university system in New York

City. Randomly assigned to either traditional or corequisite remediation, students in the

corequisite group were 14% more likely to pass the course than those in the traditional remedial group (Logue et al., 2019).

Another positive outcome for corequisite mathematics students includes being more likely to enroll in and pass a subsequent college-level math course than those who take traditional remedial courses (Logue et al., 2019). Ran and Lin (2022) found that corequisite students were also more likely to enroll in and pass a college-level math course than those who placed directly into college-level math courses (Ran & Lin, 2022). Logue et al. (2019) further found that after one year, students in the corequisite group had earned an average of 21.7 credits per student versus 17.7 credits for those in the traditional remedial course group. Moreover, the corequisite group outperformed the traditional remedial course group in every area studied, including completing their associate degree within three years (39% vs. 28%) and satisfying seven of the eight general education category requirements (Logue et al., 2019).

Cuellar Mejia et al. (2020) report that among California community college students, students in corequisite math courses were 30% more likely to complete a gateway math course in one term when compared to students who begin in a traditional remedial course. Overall, the percentage of corequisite students who completed a transfer-level math course increased by 20-25% among all racial and ethnic groups (Cuellar Mejia et al., 2020). In another study at a small liberal arts college, researchers Kashyap and Mathew (2017) found that the corequisite model was more effective in preparing students to succeed in a college-level quantitative reasoning course. Overall, 50% of students in the traditional developmental course completed quantitative reasoning with a grade of C- or higher, significantly lower than the 79% of corequisite students who met the same standard (Kashyap & Mathew, 2017).

The reported benefits of corequisite courses for minority and underrepresented populations are inconsistent. For instance, Logue et al. (2019) discovered that the effects of the corequisite intervention dissipated over time. However, the differences between the corequisite and traditional developmental groups were still statistically significant (Logue et al., 2019). Notably, the results were independent of race and ethnicity (Logue et al., 2019). In contrast, Cuellar Mejia et al. (2020) state that although all racial and ethnic groups saw progress, racial equity is still a concern. Students from underrepresented groups are more likely to be assigned to remediation than other students (Chen, 2016; Chen et al., 2020; Cuellar Mejia et al., 2020; Logue et al., 2019). Furthermore, an analysis of data revealed that corequisites had a more substantial positive effect for White students than for Latino and African American students (Cuellar Mejia et al., 2020).

Overall, placing students into corequisite courses instead of traditional remedial courses positively affects the completion rates of college-level math courses (Cuellar Mejia et al., 2020; Logue et al., 2019; Ran & Lin, 2022). Additionally, there is evidence that corequisite placement may lessen the racial and ethnic graduation rate gaps (Logue et al., 2019).

Sense of Belonging

Definitions of Sense of Belonging

Sense of belonging has been described in many ways and, as such, is often referred to using other words and phrases, including community, sense of community, mattering, fitting in, belongingness, and relatedness (Berger, 1997; D. R. Johnson et al., 2007; Nora, 2004; Rovai, 2002; Schlossberg, 1989; Strayhorn, 2019). Moreover, a review of extant literature reveals that sense of belonging is not consistently defined.

It is widely agreed upon that sense of belonging refers to feeling valued, included, and accepted (Goodenow, 1993; Hausmann et al., 2007; Hurtado & Carter, 1997; D. R. Johnson et al., 2007; Strayhorn, 2019; Tovar & Simon, 2010). Many assert sense of belonging indicates identification and affiliation within a specific group or community (Goodenow, 1993; Han et al., 2017; Strayhorn, 2019; Tinto, 2017; Tovar & Simon, 2010). For example, "the extent to which students feel personally accepted, respected, involved, and supported by others in the school social environment" (p. 80) is how Goodenow (1993) defines sense of belonging for middle school students. Baumeister & Leary (1995) describe sense of belonging as a need to form and maintain at least a minimum number of interpersonal relationships.

The definitions of sense of belonging often reflect the setting in which belonging occurs. According to Hurtado and Carter (1997), sense of belonging for college students "captures the individual's view of whether he or she feels included in the college community" (p. 327). Strayhorn (2019) defines sense of belonging for college students in the following manner:

> In terms of college, sense of belonging refers to students' perceived social support on campus, a feeling or sensation of connectedness, and the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the campus community or others on campus such as faculty, staff, and peers. (p. 4)

Others describe sense of belonging as the perception of valued involvement or a psychological sense of being valued in the college community (Hausmann et al., 2007; Hoffman et al., 2002).

Importance of Sense of Belonging

In his hierarchy of needs, Maslow (1943) identified only two things of more importance than sense of belonging: physiological needs (namely food, water, air, warmth, and rest) and the need to feel safe and secure. Many researchers consider sense of belonging to be a basic human

need and a fundamental human motivation (Baumeister & Leary, 2019; Goodenow, 1993;

Lahdenperä & Nieminen, 2020; Maslow, 1943; Strayhorn, 2019; Tinto, 2017).

There is evidence that sense of belonging engenders many positive outcomes, including

achievement, engagement, well-being, and happiness (Baumeister & Leary, 1995; Buskirk-

Cohen & Plants, 2019; Freeman et al., 2007; Han et al., 2017; Hausmann et al., 2007; D. R.

Johnson et al., 2007; Strayhorn, 2019; Tinto, 2017; Zumbrunn et al., 2014). By gathering a large

body of research findings, Baumeister and Leary (1995) found that belongingness can affect how

individuals process information about stimuli in the social environment. They also found sense

of belonging may improve students' mental well-being, serving as a buffer from stress

(Baumeister & Leary, 1995). Conversely, a sense of not belonging can undermine a college

student's motivation and persistence (Tinto, 2017).

Sense of belonging is based on students' perceptions of the interactions that take place

within the environment they find themselves (Goodenow, 1993; Strayhorn, 2019). Goodenow

(1993) reported that middle school students cannot attend to the tasks at hand until they have a

sense of how they fit into a particular setting. Similarly, Strayhorn (2019) found that higher-order

needs such as knowledge and fulfilling one's potential cannot be met until the need to belong has

been satisfied. Consequently, sense of belonging is particularly critical for those in the collegiate

setting where knowledge and reaching one's potential are desired outcomes (Strayhorn, 2019).

Fostering Sense of Belonging in the Educational Environment

Sense of belonging does not last forever. As Baumeister and Leary (1995) note, sense of

belonging must be maintained. To feel a sense of belonging, people need frequent personal

contact or interactions with others (Baumeister & Leary, 1995; Delahunty et al., 2013; Freeman

et al., 2007; Hill et al., 2009; Hoffman et al., 2002; Kraus & Sears, 2008; Ryman et al., 2009;

Solomon, 2007; Strayhorn, 2019). If the environment is perceived as caring, the need to feel

belonging is more likely to be satisfied (Baumeister & Leary, 1995; Berry; 2019; Freeman et al.,

2007; D. R. Johnson et al., 2007).

Belonging at the Institutional Level

Studies have found that sense of belonging at the institutional level is positively

associated with interactions with peers and faculty (Hausmann et al., 2007; Hurtado & Carter,

1997; D. R. Johnson et al., 2007) and the availability of social support when entering college

(Hausmann et al., 2007; Hurtado & Carter, 1997). Also positively associated with an

institutional-level sense of belonging is a smooth academic and social transition to college

(Hausmann et al., 2007; Hurtado & Carter, 1997; D. R. Johnson et al., 2007).

Strayhorn (2019) identifies seven core elements of sense of belonging for college

students. Among them are that sense of belonging is not only related to but a consequence of

mattering and that social identities affect college students' sense of belonging. Another core

element says Strayhorn (2019), is that sense of belonging takes on even more importance in

certain contexts (e.g., being new to a group) at certain times (e.g., attending college for the first

time) among certain populations (e.g., those who society marginalizes).

When it comes to a social transition to college, data analysis by D. R. Johnson et al.

(2007) revealed that regardless of race or ethnicity, when students felt their residence hall was a

supportive environment, they had a greater sense of belonging. Hypothesizing that being a part

of ethnic student organizations would positively impact belonging for Latino students, Hurtado

& Carter (1997) instead found that belonging to ethnic student organizations had no statistically

measurable impact on sense of belonging. On the other hand, the same study (Hurtado and

Carter, 1997) found that Latino students who belonged to religious organizations, fraternities or

sororities, social-community organizations, and sports teams had a greater sense of belonging than those who did not belong to these groups.

Many studies have shown that combining social and academic experiences leads to a greater sense of belonging (Hausmann et al., 2007; Hurtado & Carter, 1997; D. R. Johnson et al., 2007, Tinto, 2017; Strayhorn, 2019). Hurtado and Carter (1997) studied Latino students' sense of belonging in college by analyzing students' responses to Bollen and Hoyle's (1990) Sense of Belonging Scale. They found that students with a strong sense of belonging merged social and academic interactions (Hurtado & Carter, 1997). Inspired by Hurtado and Carter's (1997) research on Latino students' sense of belonging, D. R. Johnson et al. (2007) broadened the population of interest to include African American, Asian American, multi-racial, multi-ethnic, and White first-year college students. They discovered that regardless of race or ethnic group, students who made a smooth transition to college socially and academically were more likely to perceive a sense of belonging (D. R. Johnson et al., 2007).

To grow sense of belonging through the merging of social and academic interactions, researchers have identified the following student-initiated efforts to be effective: discussing course content with other students outside of class, interacting with faculty outside of class, finding academic help when needed, forming study groups, and tutoring other students (Hurtado & Carter, 1997, D. R. Johnson et al., 2007; Strayhorn, 2019).

Fostering Institutional-Level Sense of Belonging. Individual experiences influence sense of belonging in college students, but engagement in the classroom or campus at large in and of itself does not lead to belonging (Strayhorn, 2019; Tinto, 2017). Instead, it is how those interactions are perceived in the environment in which they occur that leads to a sense of belonging (Strayhorn, 2019; Tinto, 2017). Regarding students' sense of belonging at the

institutional level, researchers have concluded that students must learn and develop socially,

managing relationships with others (Hurtado & Carter, 1997). Developing sense of belonging is

not the sole responsibility of the student, however (Hurtado & Carter, 1997; D. R. Johnson et al.,

2007; Strayhorn, 2019; Tinto, 2017). Researchers have determined that integration into the

college environment is the responsibility of both the student and the institution (Hurtado &

Carter, 1997; D. R. Johnson et al., 2007; Tinto, 2017), with the college playing a critical role in

facilitating sense of belonging for their students.

Colleges and universities should promote activities that require shared academic and

social experiences to foster sense of belonging (Hurtado & Carter, 1997; D. R. Johnson et al.,

2007; Tinto, 2017). Such experiences include helping students set goals, building self-efficacy,

using learning strategies that require students to work together, and ensuring students find the

curriculum meaningful (Tinto, 2017). Creating an environment where all students get at least one

meaningful interaction with a staff member is another way colleges can foster students' sense of

belonging (Strayhorn, 2019).

Since sense of belonging changes as circumstances, contexts, and conditions change

(Goodenow, 1993; Strayhorn, 2019), sense of belonging must be continually satisfied

(Baumeister & Leary, 1995; Strayhorn, 2019; Tinto, 2017). This implies that colleges should not

become complacent about creating opportunities to promote sense of belonging.

Belonging in the In-Person Classroom

Evidence shows sense of belonging changes based on the environment (Goodenow, 1993;

Strayhorn, 2019); therefore, sense of belonging cannot simply be addressed at the campus level.

Sense of belonging in the classroom must also be considered. In the classroom setting, students'

sense of belonging is influenced by factors relating to the situation, context, and learning

environment (Goodenow, 1993; Lahdenperä & Nieminen, 2020). Students' sense of belonging is positively associated with interactions with the instructor (Freeman et al., 2007; St-Amand et al., 2017; Zumbrunn et al., 2014) and interactions with their peers (Lahdenperä & Nieminen, 2020; Zumbrunn et al., 2014).

Using a Likert-type scale, Goodenow (1993) developed the Psychological Sense of School Membership (PSSM) scale to quantitatively measure belonging in the middle school setting. Goodenow's (1993) research suggests that sense of belonging is influenced by personal traits as well as factors specifically relating to the situation or context. Zumbrunn et al. (2014) adapted the PSSM (Goodenow, 1993) for use in the college classroom and added two questions that were tested for validity ("I can talk to students if I have a problem" and "I am included in work group"). Survey results from students in an educational psychology course revealed academic and social support from instructors to be predictors of belonging for students (Zumbrunn et al., 2014).

Freeman et al. (2007) also used an adapted version of Goodenow's (1993) PSSM along with two other questionnaires that measured motivation for learning and student perceptions of learning and teaching in their study of first-year college students and sense of belonging. Quantitative analysis of survey responses led researchers to conclude that sense of belonging within the college classroom is strengthened when students perceive the instructor as supportive, warm, and organized (Freeman et al., 2007).

Lahdenperä and Nieminen (2020) conducted a mixed-methods study of sense of belonging among mathematics students in two research-intensive universities in Finland. They discovered sense of belonging was impacted by the learning environment, particularly when the course design and learning activities made it possible for students to interact socially

(Lahdenperä & Nieminen, 2020). Similarly, other research finds sense of belonging is enhanced when instruction is well-designed and well-implemented (Freeman et al., 2007).

Through a review of literature on sense of belonging at K-12 schools, St-Amand et al. (2017) found sense of belonging in the classroom was positively associated with two roles of teachers: teacher as person and teacher as instructional leader. The role of teacher as person is described by St-Amand et al. (2017) as supporting, building, and sustaining strong bonds that include being enthusiastic about learning, being proactive, and taking an interest in students' lives. The role of teacher as instructional leader involves using effective pedagogical strategies, emphasizing mastery learning, and avoiding comparisons among students (St-Amand et al., 2017).

Interpersonal relationships with peers are another key factor in sense of belonging (Lahdenperä & Nieminen, 2020; Zumbrunn et al., 2014). Researchers Lahdenperä & Nieminen (2020) found that sense of belonging was associated with the quality of students' relationships with their peers. Zumbrunn et al. (2014) followed up their quantitative survey with a qualitative phase to develop a more holistic understanding of students' sense of belonging in the classroom. The qualitative portion showed differences in student belonging beliefs related primarily to interactions with their classmates, not the instructor. Students who felt a strong sense of belonging reported that they related to their peers (Zumbrunn et al., 2014). Other research revealed that students who participated in activities including studying with friends, having warm interactions with instructors, and meeting with other students in study-related events or organizations (Lahdenperä & Nieminen, 2020) experienced an increased sense of belonging.

In contrast, students with a low sense of belonging felt different from their peers for various reasons, such as having disparate ideas or values or finding the course less meaningful

than their fellow students (Zumbrunn et al., 2014). Personal attributes such as shyness, social anxiety, and a feeling of being unable to approach instructors also negatively impacted sense of belonging (Lahdenperä & Nieminen, 2020).

Fostering Sense of Belonging in the In-Person Classroom. Many studies show that the most effective ways to foster a sense of belonging in the classroom are by encouraging student participation and providing students with the opportunity to interact with each other (Benander et al., 1990; Freeman et al., 2007; Lahdenperä & Nieminen, 2020; St-Amand et al., 2017; Zumbrunn et al., 2014).

To promote sense of belonging and reduce anxiety in a developmental mathematics class, Benander et al. (1990) used group problem-solving activities over the first two days of the class. These activities were designed to help students get to know one another, communicate with each other, and build group identity. Game-based learning has also been shown to have a positive impact on belonging (Gil-Doménech & Berbegal-Mirabent, 2019). Others recommend intentionally designing the course and developing activities that encourage social interaction through teamwork and cooperative learning, giving each student the chance to contribute to tasks in a meaningful way and be accepted by their peers (Lahdenperä & Nieminen, 2020; St-Amand et al., 2017).

Students' and teachers' perceptions of pedagogical techniques that are effective for building community in the classroom were the focus of research by Kraus and Sears (2008). Their findings revealed that, for students, techniques and activities that connect them to the classroom as a whole are more effective than those designed to be an individual effort (Kraus & Sears, 2008). On a 7-point scale where 1 was "makes me feel isolated from other students/faculty" and 7 was "makes me feel connected to other students/faculty," several

techniques had an average score greater than 5. Showing the course content to be relevant to students' lives, small- and large-group discussions, games and simulations, projects, homework, and movie clips were all rated highly in terms of students feeling connected to each other and to faculty (Kraus & Sears, 2008).

Extant peer-reviewed literature paints broad strokes about how to foster sense of belonging in the classroom. More targeted ways to foster belonging in the classroom can be found in published works in print and online, but these sources are not peer-reviewed. Instead, these resources are based primarily on personal experience or the experiences of others. Cavanaugh (2019) stresses the importance of learning students' names early in the semester. To help students learn each other's names, Darling (2019) and Nieto and Valery (2006) suggest that each student make a name tent (a piece of paper folded in half so that it stands on a desk) including a few drawings or words representing who they are. The students should introduce themselves and share what the drawings and words on their name tent reveal about them (Darling, 2019; Nieto & Valery, 2006). Belonging can also be promoted by sitting in a circle instead of rows, taking turns bringing treats for the class, and having students share ways the course topics are relevant to their lives (Nieto & Valery, 2006).

Instructors should also use diverse teaching strategies, making sure every student has the chance to contribute (Cavanaugh, 2019; Darling, 2019; Gooblar, 2019; Kraus & Sears, 2008; Nieto & Valery, 2006). Suggested strategies include asking a question unrelated to class when taking attendance, using think-pair-share to discuss course material, incorporating poll or clicker-type questions, and giving assessments that are a combination of individual and group effort (Cavanaugh, 2019; Darling, 2019; Gooblar, 2019; Nieto & Valery, 2006).

Belonging in the Online Classroom

Belongingness is a need when attending college classes in person, but it is perhaps an even greater need in online courses. Due to the largely asynchronous nature of online courses, it is not uncommon for students to experience disconnectedness and feel isolated from their instructor and peers (Akyol et al., 2009; Dawson, 2006; Rovai, 2002). Pilcher (2016) conducted a literature review that addresses whether college students can have a valuable educational experience in online courses. A sense of belonging or sense of community was found to be a critical factor in student success in the online environment (Pilcher, 2016).

Fostering Sense of Belonging in the Online Classroom. Interaction and dialogue within the online classroom are essential to developing a sense of community and connectedness (Berry, 2019; Darby, 2020; Delahunty et al., 2013; Dyer et al., 2018; Hill et al., 2009; Ryman et al., 2009; Yuan & Kim, 2014). In their research, Dyer et al. (2018) expressed the importance of increasing perceived proximity, defined in the online environment as the perception of mobility between the instructor and students to promote belonging. According to their study, there must be engagement between the student and the instructor, the student and other students, and the student and the course content (Dyer et al., 2018).

In order to promote sense of belonging in online courses, instructors must be "engaged, relational, and personal" (Dyer et al., 2018, p. 108), reaching out to the students early and often (Berry, 2019; Dyer et al., 2018). Darby (2020) says instructors should give meaningful support by explaining expectations, providing examples, and not leaving students in a position where they must guess what to do. Instructor feedback throughout the course is also critical to belonging (Dyer et al., 2018). Quality, personalized, constructive feedback, whether in written, audio, or video form, can strengthen the student-instructor relationship (Dyer et al., 2018; Borup et al., 2014; Portolese Dias & Trumpy, 2014).

Even though there is no physical contact in the online setting, social interaction is nevertheless a critical part of enhancing sense of belonging (Berry, 2019; Dyer et al., 2018). When students are encouraged to challenge each other during learning tasks, ask critical questions, and provide and respond to constructive feedback, sense of belonging increases (Barber & King, 2016). To help facilitate rich student interactions, instructors can use problem-based learning (Barber & King, 2016) and pose open-ended questions in a discussion forum (Gueldenzoph, 2003). Instructors can also encourage task-focused and socially-oriented discussions (Yuan & Kim, 2014). Instructors can plan synchronous meeting times (Berry, 2019) and establish learning communities (Yuan & Kim, 2014). Through the implementation of problem-based learning, Barber and King (2016) reported that students displayed the ability to collaborate, treat each other with respect, and recognize that everyone was an important part of the online classroom regardless of their strengths or weaknesses.

To feel they belong, students must participate in rich interactions with the course content (Dyer et al., 2018). Interaction with content can begin with students becoming comfortable finding their way around the online course itself (Darby, 2020). For instance, give students non-threatening assignments designed to help them become familiar with the types of tasks they will need to carry out in the weeks to come (e.g., converting a picture to a pdf and uploading it as an assignment or making a video and posting it to a discussion board). Guiding students through these essential skills can promote belonging (Darby, 2020).

Based on previously published research about online learning communities, Yuan and Kim (2014) provide four guidelines for establishing an online community of learners. First, creating learning communities should begin at the start of a course and continue through the end. Second, Yuan and Kim (2014) say that students and instructors should be involved in building

learning communities. Third, students and instructors should interact through both synchronous and asynchronous technologies. Lastly, instructors and students should use a variety of strategies to encourage discussions that are both task-focused and socially oriented, with students being assigned tasks that require collaboration amongst themselves (Yuan & Kim, 2014).

Berry (2019) studied belonging in an online doctoral program context. After conducting interviews with students, Berry (2019) analyzed their responses and found several themes that contributed to a student's sense of belonging in the class. A critical factor in students' sense of belonging was meeting synchronously, with minimal time spent lecturing to maximize time having discussions and time to share professional and personal updates with the class (Berry, 2019). Utilizing the virtual meeting platform features such as breakout rooms and chatting helped facilitate these interactions and helped students feel they were part of a learning community.

Outcomes of Student Sense of Belonging

What is the impact of sense of belonging on the lives of students? Researchers have measured the effects of students' sense of belonging at the institutional level (Bean & Eaton, 2001; Buskirk-Cohen & Plants, 2019; Gopalan & Brady, 2020; Han et al., 2017; Hausmann et al., 2007; Tinto, 2017) and in the classroom (Freeman et al., 2007; Hoffman et al., 2002; Zumbrunn et al., 2014).

Persistence and Retention

Multiple studies have shown sense of belonging is positively associated with persistence and retention (Bean & Eaton, 2001; Gopalan & Brady, 2020; Han et al., 2017; Hausmann et al., 2007). For example, a study by Bean and Eaton (2001) revealed that retention was more likely for students with sense of belonging than for those who felt they were not a part of the college

community. In their study on sense of belonging, Gopalan and Brady (2020) examined whether first-year students' sense of belonging predicted persistence. Although they found a positive association between a sense of belonging and persistence for first-year students at 4-year colleges, sense of belonging and persistence were not significantly associated for first-year students at 2-year colleges (Gopalan & Brady, 2020).

Researchers Han et al. (2017) studied the relationship between the academic mindsets of first-year university students and their academic success and retention. Students who scored highly in the mindsets of self-efficacy, academic motivation, and a sense of belonging within the college community had the highest retention rates (Han et al., 2017). Furthermore, belonging-oriented students had higher retention rates than those who were self-efficacy-oriented. Self-efficacy-oriented students, however, displayed better academic success than those who were belonging-oriented. (Han et al., 2017).

Hoffman et al. (2002) wanted to better understand why students persist or withdraw from college. The researchers developed, tested, and refined a sense of belonging instrument. It was then administered to two groups: students enrolled in traditional seminar classes and students who were part of a learning community. Hoffman et al. (2002) found that students in learning communities reported a higher sense of belonging and had higher retention than students enrolled in traditional classes.

In another study, Hausmann et al. (2007) focused on the role of sense of belonging on persistence among African American and White first-year college students. Using the Sense of Belonging Subscale (Bollen & Hoyle, 1990), a quantitative analysis of student survey responses found that students who perceive themselves as belonging are more willing to engage with others in ways that further persistence (Hausmann et al., 2007).

Academic Success

Sense of belonging has also been associated with academic success (Buskirk-Cohen & Plants, 2019; Freeman et al., 2007; Han et al., 2017; Strayhorn, 2019; Zumbrunn et al., 2014). For example, Strayhorn (2019) has carried out numerous studies that show sense of belonging in college leads to academic success among Latinos, ethnic gay males, first-year college students, STEM students of color, Black males, and graduate students. Zumbrunn et al. (2014) reported sense of belonging among students in an educational psychology class was positively associated with academic achievement.

Han et al. (2017) conducted a descriptive analysis of survey responses regarding academic mindsets combined with institutional data. They discovered that students who scored highly in the mindsets of self-efficacy, academic motivation, and sense of belonging showed the most academic success as measured by first-term GPA, the grade earned in a required first-semester writing course, and the number of credits earned in the first year (Han et al., 2017).

Buskirk-Cohen and Plants (2019) explored the relationship between sense of belonging (social acceptance, professors' pedagogical caring, and global university belonging) and academic success at a small, private, teaching-focused university. Previous studies about this relationship had been conducted at large institutions, but Buskirk-Cohen and Plants (2019) wanted to see if the findings could be generalized to small institutions. In agreement with research performed at large institutions, there was a significant correlation between sense of belonging and academic success as measured by GPA and academic commitment (Buskirk-Cohen & Plants, 2019). Moreover, when looking at the specific components of belonging, the data showed the strongest correlation between professors' pedagogical caring and academic success (Buskirk-Cohen & Plants, 2019).

Self-Efficacy, Motivation, and Other Outcomes

Persistence, retention, and academic success are not the only outcomes associated with a student's sense of belonging. Bean & Eaton (2001) found that college students who feel a sense of belonging both academically and socially developed self-efficacy and an internal locus of control.

As mentioned previously, Gopalan and Brady (2020) studied whether first-year students' sense of belonging predicted student persistence. The same study also considered whether sense of belonging was predictive of the use of campus services and student mental health. As was the case for sense of belonging and persistence, Gopalan and Brady (2020) discovered a positive association between sense of belonging and use of campus services and mental health among students at a 4-year college.

A published study by Freeman et al. (2007) examined associations between college students' sense of belonging within a single class (biology, psychology, or English) and academic motivation. Analysis of the data revealed that when students felt a sense of belonging in a particular class, they were more motivated in relation to that class (Freeman et al., 2007). Additionally, students with a sense of belonging in a class felt they could achieve their academic goals in that class and perceived the course material as useful and relevant. Freeman et al. (2007) did not find a significant association between sense of belonging in a particular class and overall GPA, however.

Through an extensive review of more than 60 studies, Tinto (2017) observed that the interaction among sense of belonging, student goals, self-efficacy, and perceived relevance of the curriculum led to higher levels of student motivation. Motivation, in turn, was found to be the key to student persistence.

Conducting their research among students taking educational psychology at a large

midwestern university, Zumbrunn et al. (2014) tested a complex model in which they

hypothesized instructor academic and social support to be a predictor of sense of belonging.

They further conjectured sense of belonging would lead to self-efficacy and increased task value.

In turn, self-efficacy and task value were thought to increase engagement in academic activities,

ultimately leading to higher levels of academic achievement. Within this sequence, every

variable was significant to the next one in the chain, except for task value and engagement in

academic activities; there was no significant relationship between those variables.

Deficiencies in the Literature

Extensive searches were conducted for studies on the impact of sense of belonging in a

particular class on academic performance in that class. Three search engines were used:

Education Resources Information Center (ERIC), EBSCO Information Services, and Google

Scholar. The terms "sense of belonging or sense of community," "college or university or

community college," "in-person or classroom," "online or e-learning," and "classroom

performance or course performance or course grade" were used in the search.

These searches led to articles about importance of sense of belonging in the educational

environment and, specifically, in college. Studies have examined the impact of an institutional

level sense of belonging on persistence, retention, academic achievement, motivation, self-

efficacy, and more. Fewer studies have addressed sense of belonging in the classroom. The

studies that have been conducted considered classroom-level sense of belonging and its

association with affective traits such as motivation and self-efficacy. There is conflicting

evidence on whether sense of belonging in the classroom is associated with overall academic

success. The search terms failed to uncover research addressing sense of belonging at the

classroom level and academic achievement in that particular class, let alone in a corequisite mathematics class.

As mentioned previously, empirical research on the effectiveness of targeted, specific strategies to increase belonging could not be found. Extant peer-reviewed literature focuses on broad themes for promoting a sense of belonging. It is left up to the instructor to determine exactly how to have meaningful interactions with students, encourage discussion, and create and deliver a well-designed and well-implemented course. Thus, the question remains: what teaching and learning strategies or in-person or online activities will yield the most significant return regarding sense of belonging and student achievement in a broad sense and in a topic-specific setting?

Summary

Taking place in a corequisite math class, this action research study examined the relationship between students' sense of belonging and academic performance in the corequisite and gateway math courses. This chapter presented information on the state of remedial education and the role corequisite courses play in helping students succeed in their gateway math course. It discussed sense of belonging, including the ways sense of belonging is defined, its importance, and factors that influence sense of belonging in the collegiate setting. Research pertaining to methods of fostering sense of belonging at the institutional level and in the classroom (both in-person and online) was presented. Finally, the outcomes associated with students' sense of belonging were shared. Chapter 3 details the study's research methodology, context, and methods, and addresses the ethical considerations and threats to validity.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

As a math professor at a community college in the Midwest, this researcher has many years of experience teaching developmental mathematics courses for college students. Unfortunately, the low success rates in remedial mathematics (Chen, 2016) do not come as a surprise to her. In addition to a lack of success, this instructor has observed that the students in a corequisite math class who do not form a connection with their classmates are, by and large, the same students who fail to complete the class successfully. The purpose of this study was to determine whether students' sense of belonging in a corequisite mathematics course was associated with their academic performance in the corequisite and gateway math courses. The study sought to answer two questions. First, what is the nature of the relationship between the change in students' sense of belonging in a corequisite math course and their academic performance in their corequisite and gateway math courses? Second, to what extent will the methods used for fostering sense of belonging impact students' sense of belonging?

This chapter describes the study's research methodology, discussing action research and its place in education. The chapter then addresses research designs and the context of this action research study. Finally, research methods are detailed, and ethical considerations and the anticipated threats to the validity of this study are examined.

Research Methodology

Within the first two weeks of beginning the doctoral program, this researcher read a lot about action research, a term and a process that was unfamiliar to her. After learning more about action research, this researcher penned these words in turquoise ink in the margin of a textbook:

"Action research is selfish research." What does that mean? It means that action research is done by the researcher for the researcher. It is practical. It is personal. It lets this professor and investigator focus on solving a problem in the setting where she spends most of her professional time: the classroom. Better yet, action research does not simply *let* the researcher focus on the classroom; it is *required*. The whole point is to see a problem, develop a strategy to address the problem, implement the strategy, and then collect and analyze data. The strategy is tweaked as necessary and then implemented in its adapted form. More data is collected and analyzed, and the cycle continues until the researcher is satisfied.

This investigator has been doing a similar, less formal cyclical process for years in the role of the professor: developing better ways to teach course content so that students understand it. Every semester, past and current students' scores are examined for evidence of improved outcomes. Until this study, the researcher operated on a hunch that a high sense of belonging leads to better course performance. Identifying tools to collect data on sense of belonging and then measuring whether there is a relationship between sense of belonging and course performance is the piece of the puzzle that has been missing – but it is not missing any longer.

Action Research

The primary goal of educational research is often to aid in comprehending educational issues, questions, and practices (Gay & Airasian, 2000). Historically, educational research has been conducted by professional researchers or outside academics trained to conduct research studies by observing others (Mertler, 2020; Schmuck, 1997). Much of the time, published articles in educational research do not resonate with classroom teachers (Johnson, 2008; Mertler, 2020). Teachers tend to find educational research published by university and college professors and researchers impractical, overflowing with high-level terminology, and exceedingly

descriptive (Johnson, 2008; Mertler, 2020). Professional researchers do not typically consider the realities of the classroom, which include limited resources, the constraints of a daily schedule, the student-to-teacher ratio, and the complexities of teaching a room full of students with a wide variety of abilities (Johnson, 2008; Mertler, 2020; Parsons & Brown, 2002).

Action research is different from traditional research in that it shifts the control from the professional investigator to those the professional investigator has typically studied (Herr & Anderson, 2015; Mertler, 2020; Mills, 2011). Action researchers are often positioned inside their professional setting, taking on the dual role of both practitioner and researcher. Notably, there is no one universal definition of action research. Despite that, most agree that

> action research is inquiry done *by* or *with* insiders to an organization or community, but never *to* or *on* them. It is a reflective process … deliberately and systematically undertaken, and generally requires that some form of evidence be presented to support assertions. (Herr & Anderson, 2015, pp. 3-4)

Stated succinctly, action research is the methodical investigation and analysis of one's practices (Johnson, 2008; Mertler, 2020).

Action Research in Education

Within the educational setting, Mills (2011) describes action research as systematic inquiry carried out by those with a vested interest in the teaching and learning strategies, processes, or environment in which they work. The goal of action research is to gather knowledge about student learning, instructional effectiveness, or some other area of interest within their specific school district, school, or classroom (Mertler, 2020; Mills, 2011).

Mertler (2020) states that "action research allows teachers to study their own classrooms … in order to better understand them and be able to improve their quality or

effectiveness" (p. 6). Mertler (2020) explains that action research within the educational setting

provides a process by which local-level problems of practice can be addressed, and answers can

be found. Problems of practice are specific to the educator's setting, students, and context. They

include particular strategies for addressing the issue or solving the problem in the very place

where the problem lies (Johnson, 2008; Mertler, 2020; Parsons & Brown, 2002).

Action research is practical and relevant (Johnson, 2008; Mertler & Charles, 2011;

Schmuck, 1997), yet it is not simply thinking about teaching in the usual way (Johnson, 2008;

Mertler & Charles, 2011; Mills, 2011; Schmuck, 1997). Action research is more systematic,

specifying a problem, developing something new, and critically reflecting on its effectiveness

(Johnson, 2008; Mertler, 2020; Mertler & Charles, 2011). Action research does not produce

results that are right or wrong. Instead, it provides tentative solutions whose strengths and

weaknesses should be appraised based on data collection, observations, analysis, and reflection

(Johnson, 2008; Mertler, 2020; Mertler & Charles, 2011; Mills, 2011; Schmuck, 1997). It

promotes empowerment as teachers collect data to help them make decisions about their students

and classrooms (Mertler, 2020). It provides an environment where taking risks by trying new

teaching strategies is not only permissible but encouraged (Mertler, 2020; Mills, 2011).

Ultimately, action research should strengthen education as teachers work to improve their

practices (Mertler, 2020; Mills, 2011).

Types of Action Research

There are two main categories of action research: participatory action research and

practical action research (Mertler, 2020). Participatory action research may also be called

community-based inquiry, collaborative action research, critical action research, emancipatory

action research, or youth participatory action research (Creswell, 2005; Fraenkel et al., 2012;

Gay et al., 2009; Mertler, 2020). Regardless of what it is called, the intent of participatory action research is to improve people's lives by empowering them to bring about some level of social change (Fraenkel et al., 2012).

This study is a practical action research study. Practical action research addresses a particular problem or need in a classroom, school, or community (Fraenkel et al., 2012; Mertler, 2020). Gay et al. (2009) provide three instructive assumptions about action research in the education setting:

- Educators (as an individual or a team) have the power to determine the nature of the action research being conducted.

- Action researchers are dedicated to continual learning via professional development and school improvement through the practice of critical thinking.

- Action researchers have the authority to choose the focus of the study, devise a system for carrying out the research, and create an action plan based on their findings.

The focus of this research study was born out of the researcher's personal observations after teaching a corequisite mathematics course every fall and spring semester for four years. This professor asks the students each semester to share why they elected to take the corequisite course. Their responses reveal that most students have struggled with math for a long time, and they do not believe they can succeed in a math course. This researcher has witnessed students often keeping to themselves, uncomfortable or perhaps unwilling to engage with their classmates or with this professor. Too many times, this practitioner has seen students isolate themselves, retreating into their private bubble. This professor cannot help but look for ways to encourage them to engage with each other, frequently wondering what would happen if the students felt a

sense of belonging. Would their academic performance improve? Would they find they actually *can* do math?

Research Designs

Before beginning an action research study, the researcher must carefully consider how the study will be planned and how the data will be collected and analyzed (Creswell & Creswell, 2018; McLean, 1995). The plan for conducting the research study is known as the research design. There are three basic research designs: qualitative, quantitative, and mixed-methods (Creswell & Creswell, 2018; Herr & Anderson, 2015; Mertler, 2020).

Qualitative studies are typically less structured than quantitative ones, addressing the research question using a broad, holistic approach (Creswell & Creswell, 2018; Mertler, 2020). Because qualitative research questions are often rather open-ended, action researchers may find it difficult to decide what specific methods they will use to collect and analyze data (Leedy & Ormrod, 2005). As data collection begins, the researcher will often find the responses given during interviews along with their observations refining their study's focus (Creswell & Creswell, 2018; Johnson, 2008; Mertler, 2020).

In quantitative research, all data are numerical, emphasizing objective measurements and the statistical analysis of data (Babbie, 2010; Creswell & Creswell, 2018). Data collection techniques for quantitative research may include surveys, questionnaires, and rating scales (Babbie, 2010; Creswell & Creswell, 2018; Leedy & Ormrod, 2005; Mertler, 2020). Quantitative research can feature a variety of designs, including descriptive, correlational, group comparison, and single-subject designs (Creswell & Creswell, 2018; Mertler, 2020).

A mixed-methods study involves collecting both qualitative and quantitative data to answer one or more research questions (Creswell & Creswell, 2018; Mertler, 2020). The

researcher must then analyze and interpret both data types (R. B. Johnson et al., 2007). The

benefit of a mixed-methods approach is that it allows the researcher to perform statistical

analyses on quantitative data while allowing individual participants to share their thoughts on the

research topic (Creswell & Creswell, 2018; R. B. Johnson et al., 2007; Mertler, 2020).

Quantitative Research Designs

In this study about sense of belonging and academic performance in the classroom, the

researcher employed quantitative data collection and analysis methods. This action research

study utilized several quantitative designs: descriptive design, correlational design, one-group

pretest-posttest design, and quasi-experimental design.

The purpose of descriptive research is to investigate a single variable (in this case, sense

of belonging) as it exists at the time (Leedy & Ormrod, 2005; Mertler & Charles, 2011; Mertler,

2020). The type of descriptive research design used was survey research. Survey research asks

individuals specific questions and tabulates their responses (Creswell & Creswell, 2018; Leedy

& Ormrod, 2005). Mertler (2020) points out that survey research represents a snapshot in time

and should not be interpreted as a constant for the participants surveyed.

Correlational research involves measuring two variables or sets of scores within a single

group of people (Creswell, 2012; Creswell & Creswell, 2018; Mertler, 2020). In a correlational

design, the researcher explores whether a statistically significant relationship exists between two

(or more) variables and the strength of any such relationship (Hawkes, 2019; Johnson, 2008;

Mertler, 2020; Pyrczak & Oh, 2018).

The relationship between the two variables is measured by calculating the Pearson

correlation coefficient, r (Hawkes, 2019; Pyrczak & Oh, 2018). The value of the correlation

coefficient ranges from -1.00 to 1.00, indicating both the strength and direction of the

relationship. A negative value of *r* signifies a negative correlation in which the value of one variable decreases when the other increases. On the other hand, a positive value of *r* indicates a positive correlation where both variables change in the same direction (Hawkes, 2019; Pyrczak & Oh, 2018). The closer the absolute value of the correlation coefficient is to 1.00, the stronger the relationship between the variables. An *r* value of zero signifies no relationship between the variables (Hawkes, 2019; Pyrczak & Oh, 2018).

The one-group pretest-posttest design allows for a comparison within a single group of participants (Leedy & Ormrod, 2005; Mertler, 2020). As the name suggests, a pretest is administered, and scores are recorded. Treatment of some sort is then implemented. Upon completion of the treatment, a posttest is given. The posttest scores are compared with the participants' pretest scores (Leedy & Ormrod, 2005; Mertler, 2020).

Designs in which the researcher has little to no ability to assign study participants to the treatment or control group randomly are known as quasi-experimental (Creswell & Creswell, 2018; Johnson, 2008). Mertler (2020) asserts that quasi-experimental designs are highly appropriate for classroom research because, most times, randomly assigning students to different treatments is not feasible.

How Quantitative Designs Were Employed in This Study. The descriptive design of this study was carried out when a survey designed to measure sense of belonging was administered. Study participants completed the survey on two different occasions. The aim was to capture the participants' sense of belonging near the beginning and end of the semester. The survey also asked participants to report their overall course grades each time they completed the survey.

The correlational design was used to determine whether there is a relationship between change in students' sense of belonging and the change in their course grades over the semester. A one-group pretest-posttest design was implemented to determine if there was a sense of belonging change from the semester's beginning to the end. In order to make comparisons between changes in sense of belonging for treatment and control groups, a group comparison design (Johnson, 2008; Mertler, 2020) similar to the one-group pretest-posttest design was used. Instead of comparing within a single group, the change in sense of belonging for both groups was examined to determine whether one group had a greater change in sense of belonging than the other.

Study Hypotheses

This study tested the hypothesis that students' sense of belonging in a corequisite mathematics course is associated with their academic performance in the corequisite and gateway mathematics courses. Knowing students' course grades are typically quite high in the early weeks of the semester, the expectation was that the course grades would decrease between weeks four and 15. Due to this assumption, the researcher hypothesized a negative linear relationship between change in sense of belonging and change in course grades. The researcher also hypothesized an inverse relationship between change in sense of belonging and course grades. In other words, the larger the increase in sense of belonging over the semester, the smaller the decrease in overall course grade in the corequisite and gateway math courses.

In addition, the study considered the extent to which the methods used for fostering a sense of belonging in the corequisite classroom impacted the students' sense of belonging. The hypothesis was that sense of belonging would increase for the treatment group and the control

group. Further, it was hypothesized that the increase in sense of belonging would be greater for the treatment group than for the control group.

Theoretical Perspective

The hypotheses in this study find their foundation in sense of belonging theory. Maslow (1943) identified only two things of more importance than sense of belonging: physiological needs (food, water, air, warmth, and rest) and the need to feel safe and secure. Other researchers have found sense of belonging to be a basic human need and a fundamental human motivation (Baumeister & Leary, 1995; Goodenow, 1993; Lahdenperä & Nieminen, 2020; Strayhorn, 2019; Tinto, 2017).

Several studies have shown that for college students, sense of belonging is positively correlated with academic success as measured by overall GPA (Bean & Eaton, 2001; Buskirk-Cohen & Plants, 2019; Strayhorn, 2019; Zumbrunn et al., 2014). Baumeister and Leary (1995) found that sense of belonging may improve students' mental health within the educational setting. Goodenow (1993) concluded that students cannot focus on the task at hand until they know how they fit into a particular setting. Furthermore, higher-order needs such as knowledge and fulfilling one's potential cannot be met until the need to belong has been satisfied (Strayhorn, 2019).

This study sought to examine sense of belonging and academic performance at the classroom level. By conducting research in a corequisite mathematics course, this researcher intended to foster sense of belonging among students who often lack confidence in their mathematical abilities. As mentioned above, many studies show sense of belonging positively impacts academic success when measured by GPA. However, the researcher could not find

extant literature that addressed sense of belonging and academic performance within a specific

classroom. It was that lack of research that inspired the current study.

Research Context

Setting

This action research study took place at a community college in the Midwest. In

particular, the research was conducted within four sections of a corequisite math course during

the Fall 2021 and Spring 2022 semesters. The corequisite course provides extra academic

support specifically focused on the prerequisite mathematical knowledge needed for success in a

liberal arts gateway math course. The courses were taught either in-person or fully online, as

determined by the college. The corequisite and gateway math courses must be taken

concurrently. Should a student withdraw from one course, they must also withdraw from the

other.

Participants

Students were eligible to participate in this study if they were enrolled in the corequisite

course during the Fall 2021 or Spring 2022 semester. Each semester, the researcher invited every

student in two corequisite sections to participate in the study using a prepared script (see

Appendix A). Due to the nature of the corequisite course, the maximum enrollment is 12

students per section. The researcher presented the opportunity to participate in this study in

person or during a synchronous online class period, in accordance with course modality.

Convenience sampling means that the students who were allowed to participate in this

study were chosen based on their convenience and availability (Creswell & Creswell, 2018).

Since students enroll in whichever section of the corequisite they want based on their

preferences, randomly assigning students to a section is impossible. The inability to randomly

assign students to a section combined with the course capacity of 12 students necessitated the use of convenience sampling.

Informed consent in either written or electronic form was obtained from all students willing to participate in the study (see Appendix B). If a student did not wish to be part of the study, they could indicate they did not agree to participate on the consent form. In addition, students could opt out of the action research study at any time during the semester without ramifications. The consent letters were provided to students during the fourth week of the semester. Signed consent forms were required before the first survey was administered.

Confidentiality

An individual who chose to participate in this research study is only identifiable via the informed consent form. No participant names appear on the surveys administered during the study. Demographical information (see Appendix C) was reported in aggregate for each corequisite section.

Since the change in both sense of belonging and course grades were being measured, a method was needed to pair a student's week four survey with their week 15 survey. To facilitate pairing each participant's surveys, participants were asked to create a unique identifier when completing the belonging survey during week four (see Appendices D & E). That identifier was requested again when taking the survey in week 15.

Research Methods

Materials and Procedures

Each participant was given a demographic questionnaire developed for this study. Additionally, each participant completed one of the following quantitative instruments: an

adapted version of the Psychological Sense of School Membership scale (Goodenow, 1993) or the Classroom Community Scale (Rovai, 2002).

Variables

A quasi-experimental pretest-posttest control group design was used to evaluate the effectiveness of the methods used for fostering sense of belonging in the classroom. Using a pretest-posttest design, each student's sense of belonging was measured during the fourth week of the semester and again during week 15. The independent variable is the corequisite section (treatment or control group) in which the student enrolled. The dependent variable is the participants' belonging score as determined by an adapted version of the Psychological Sense of School Membership scale (Goodenow, 1993) or the Classroom Community Scale (Rovai, 2002).

When determining the nature of the relationship between a student's sense of belonging and their academic performance in the corequisite and the gateway math course, the independent variable is the sense of belonging score. The dependent variables are the student's current grade in each course (reported as a percentage). Students reported their course grades in the corequisite and gateway math courses as part of the belongingness survey.

Demographic Questionnaire

Students were asked their age, gender, ethnicity, and whether they were full-time or part-time students. Their reason for taking the corequisite course also appeared on the questionnaire: placement test score, adviser recommendation, self-placement, or other (see Appendix C).

The demographic questionnaire was administered during the fourth week of the semester at the same time as the initial belongingness survey. When the demographic questionnaire was administered in person, it was printed separately from the sense of belonging survey. This ensured that the demographical information could not be tied to a particular belongingness

survey. A link was embedded in the course website for those completing the questionnaire online.

Belongingness Surveys

Since the college determines the course modality, the potential difference in the modalities prompted the researcher to explore belonging surveys that are statistically reliable in a given modality. Two surveys were identified: the Psychological Sense of School Membership scale (Goodenow, 1993) and the Classroom Community Scale (Rovai, 2002).

Goodenow (1993) created the 18-item Psychological Sense of School Membership (PSSM) scale to assess students' perceptions of belonging in middle school. As measured by Cronbach's $\propto$, internal consistency reliability for the PSSM ranged from 0.77 to 0.88, depending on the sample.

For the sections of the course taking place in the in-person setting, an adapted version of the PSSM was used to evaluate students' sense of belonging within the classroom (e.g., "People at this school are friendly to me" was changed to "People in this class are friendly to me"). Participants rated each of the 18 statements using a 5-point Likert-type scale ranging from "Not at all true" to "Completely true" (see Appendix D).

Rovai (2002) developed the Classroom Community Scale (CCS) to measure students' sense of belonging for online classes. The 20 items on this survey assessed students' overall sense of belonging in a fully online course. Ten items specifically address belonging in terms of feeling connected to others in the course (e.g., "I feel that this course is like a family"). The other ten items focus on belonging as it relates to learning (e.g., "I feel uneasy exposing gaps in my understanding"). Participants rated each statement using a 5-point Likert-type scale ranging from

"Strongly agree" to "Strongly disagree" (see Appendix E). Cronbach's $\propto$ for the CCS is 0.93, indicating very high reliability.

Regardless of course modality, the demographic questionnaire and the PSSM or CCS were administered during the fourth week of the semester. The PSSM or CCS was given again during the 15th week of the semester.

Security of Data

When surveys were administered in person, paper surveys were distributed and completed during class. (The instructor stepped out of the room.) When students completed their demographical questionnaire and belonging survey, they placed them in a large manila envelope labeled with the semester, group (control or treatment), and week (four or 15). The envelopes containing surveys completed in person were locked in a filing cabinet in the researcher's office. The envelopes were first opened after official course grades were posted. Long-term, all printed surveys are being stored in the locked filing cabinet previously mentioned for 3 years after the conclusion of this study.

When the surveys were completed online, the researcher provided a website link (e.g., SurveyMonkey, Google Forms). In all, four links were utilized—one for informed consent, one for the demographic questionnaire, and two for the belonging surveys. The survey links were embedded into the course website during the week of the semester when the data collection was taking place. All online survey responses were anonymous. Access to the responses was password-protected using a randomly-generated password known only to the researcher.

Data were entered into a spreadsheet either by hand (for paper surveys) or by downloading survey data from the survey website. The data is stored on an internal server at the college where the research takes place. The server is only accessible to those with a faculty or

staff username and is password-protected. Faculty and staff members do not have access to each

other's files.

Experimental Design

As stated, designs in which the researcher has little to no ability to assign study

participants to the treatment or control group randomly are quasi-experimental (Creswell &

Creswell, 2018; Johnson, 2008). Furthermore, Mertler (2020) argues that quasi-experimental

designs are appropriate for classroom research because, most times, randomly assigning students

to different treatments is not feasible. In this study, random assignment of students to a specific

section of the corequisite was impossible since no two sections meet simultaneously. Students

signed up for whichever corequisite and gateway math course pairing fit into their schedule

based on factors such as avoiding conflicts with other courses, work schedules, family

responsibilities, and the availability of public transportation. For this reason, this action research

study is quasi-experimental.

Control Group

The control group was taught by a colleague who was the second person to teach the

corequisite course upon its creation. She conducted her course section using the historically

employed methods of a combination of lecture and group work. This researcher did not attempt

to influence how the control group was taught. The researcher had no presence in the control

group classroom except for the few minutes when presenting the students with the invitation to

participate in this research study.

Treatment Group

This instructor led the treatment group, purposefully striving to promote sense of

belonging among the students in the corequisite class. The extant research regarding which

teaching and learning strategies are effective at fostering sense of belonging in the classroom

provides broad guidelines such as encouraging participation and providing opportunities for

students to interact with one another (Freeman et al., 2007; Lahdenperä & Nieminen, 2020; St-

Amand et al., 2017; Zumbrunn et al., 2014). Empirical research detailing what specific activities

or instructional methods to incorporate into the learning environment to encourage a sense of

belonging was not found.

Many articles, books, and websites are dedicated to sharing strategies to increase

classroom belonging, whether in-person or online. These sources are not peer-reviewed and are

based on the authors' personal experiences, the experience of others, and anecdotal evidence.

Using these sources, this professor-researcher assembled a list of activities, strategies, and best

practices to implement in the treatment group (see Appendix F).

The list (see Appendix F) played a vital role in this professor's day-to-day interactions

with the students in the corequisite class. This instructor is not someone who plans out every

minute of each class period, preferring a high level of flexibility when teaching the corequisite

course. Instead, the norm is to enter a class session with several options in mind and use those

that will be the most effective after quickly assessing the students' needs on that day.

Analysis of Data

The mean and standard deviation for belonging scores, course grade in the corequisite,

and course grade in the gateway math course at week four and week 15 were calculated for each

group. These statistics were used to measure the extent to which students' sense of belonging

increased throughout the semester.

A paired-sample *t*-test was conducted to determine whether there is evidence that sense

of belonging increased within each group over the semester. In addition, a one-way ANOVA was

performed to compare the effect of the teaching and learning strategies employed in the

treatment and control groups on the change in sense of belonging. The one-way ANOVA

allowed the researcher to evaluate whether the treatment group experienced a statistically

significant increase in belonging compared to the control group.

A Pearson product-moment correlation test was conducted to assess whether students'

change in their sense of belonging is associated with the change in their course grades. This test

was performed on the difference between the week 15 belonging score and the week four

belonging score and the difference in course grade in the corequisite course over the same

period. The test was also performed for change in belonging score and change in the gateway

math course grade.

Ethical Considerations

The importance of conducting research that holds to the highest ethical standards cannot

be emphasized enough. Hilsen (2006) stresses that a researcher's ethical foundation is displayed

through the practices carried out by the researcher. Mertler (2020) emphasizes four ethical

principles to consider when planning for action research: the principle of accurate disclosure, the

principle of beneficence, the principle of honesty, and the principle of importance.

Principle of Accurate Disclosure

The principle of accurate disclosure addresses the need to describe the research study and

explain what the participants would be doing in terms of activities and the time required for each

one (Mertler, 2020). At no time should participants be intentionally deceived by the researcher

(Mills, 2011). To ensure accurate disclosure was present in this study, an informed consent letter

was created to explain the purpose of the research (Creswell & Creswell, 2018; Herr &

Anderson, 2015; Leedy & Ormrod, 2005). The letter specified that participants were voluntarily

taking part in the study. Furthermore, the letter stated that each participant could opt out of the study at any time without repercussion. The purpose of the demographic questionnaire and the survey of belonging was explained fully. The consent letter also specifically stated that participants' course grades would not be impacted in any way regardless of whether they participated in the research study (see Appendix B).

Principle of Beneficence

The principle of beneficence states that "research should be done in order to acquire knowledge about human beings and the educational process; in other words, it should benefit someone or some group of people" (Mertler, 2020, p. 112). Research should never serve as a means to harm or denigrate anyone, nor should research stifle academic progress (Herr & Anderson, 2015; Mertler & Charles, 2011; Mertler, 2020). The research conducted in this study benefits the corequisite mathematics students and instructors at the institution in which the research took place. This action research study also contributes to the body of research as a whole.

Principle of Honesty

Essential to every research study is honesty (Creswell & Creswell, 2018; Herr & Anderson, 2015; Mertler, 2020), beginning with the purpose of the study, continuing throughout the data collection and analysis phases, and extending to the conclusions drawn from the study. Honesty and transparency were at the heart of this study. The research purpose was disclosed to all students in each corequisite section and, as promised, participants retained their anonymity with each survey completed. No data was altered or tampered with in any manner. All paired data were included in the analysis.

Principle of Importance

The principle of importance emphasizes that the findings of an action research study should in some way add to human knowledge in general or be useful within a specific field of interest (Herr & Anderson, 2015; Mertler, 2020). This researcher could not uncover exigent research on sense of belonging and its relationship with academic performance within a mathematics classroom, let alone a corequisite math course. This research study addresses a gap in published works and will ideally lead to similar studies in many disciplines.

Researcher Positionality

The researcher chose to study students' sense of belonging and academic performance within a corequisite course she teaches. Since the researcher was also the professor in the course, the researcher's position within the study was that of an insider (Herr & Anderson, 2015). More specifically, this researcher served as a practitioner-researcher. Practitioner-researchers, according to Herr and Anderson (2015), desire to "study the outcomes of a program or actions in their own setting" (p. 42). Herr and Anderson (2015) are quick to point out that practitioner-researchers should embrace the role of an insider "fully committed to the success of the actions under study" (p. 42) rather than treating their professional self as an outsider looking in.

The positionality as both instructor and researcher introduced the possibility that students in the practitioner-researcher's course sections might feel obligated to participate in the study. It was also feasible that a student could assume there would be negative consequences for choosing not to participate (e.g., stricter grading), despite what the letter of consent states. This professor and researcher continually reiterated that participation was voluntary, and that all data collected would remain confidential. It was emphasized that students' names would never be used should they choose to participate and that all data would be reported in aggregate. The researcher

reminded participants they had control over their unique identifier, allowing them to remain

anonymous while providing a way to pair their two belonging surveys.

Risk Assessment

Study participants faced no risk during the study. Demographical information was

collected separately from the sense of belonging surveys. The surveys were identified by their

group but not by the individual participant. No harm came to the students in either group as

instructional strategies did not involve taking risks beyond interacting with the course content,

other class members, and the instructor.

<div align="center">

Threats to Validity

</div>

There are internal and external threats to the validity of any study but conducting research

during a global pandemic brought much uncertainty, potentially increasing the likelihood that the

study's validity was compromised in one or more ways. The researcher sought to foresee

potential threats and took care to compensate for them whenever possible.

According to Creswell & Creswell (2018), internal threats to the validity of a study are

"experimental procedures, treatments, or experiences of the participants that threaten the

researcher's ability to draw correct inferences from the data about the population in an

experiment" (pp. 169-170). External threats to validity, however, "arise when experimenters

draw incorrect inferences from the sample data to other persons, other settings, and past or future

situations" (Creswell & Creswell, 2018, p. 171). The threats identified in this study are disclosed

in the paragraphs that follow.

Internal Threats

During the planning stages, this researcher anticipated two threats to the study's internal

validity: study attrition and uncertainty surrounding course modality.

Study Attrition

One threat to this study's internal validity was that a study participant might complete the first belonging survey but not the second. The loss of a study participant is called study attrition (Creswell & Creswell, 2018). In this study, attrition would occur when a participant withdrew from the course or opted out of the study between weeks four and 15. A plan was created to address possible attrition before data collection began.

If a student dropped out of the study, it would be impossible to remove the participant's demographical questionnaire due to anonymity. The same would not be true for the belonging survey, however. Using a unique identifier to pair a participant's week four and week 15 belonging surveys allowed the researcher to pinpoint the week four belonging survey that did not have a match when data analysis begins. If one or more participants left the study, the week four belonging surveys that were not part of a pairing were removed before conducting a statistical test involving paired data.

Course Modality

This study occurred when there were many unknowns regarding course modality. Prior to the pandemic, the college did not offer corequisite courses online. But, as we are now aware, the world as we knew it changed in March 2020 due to the Covid-19 pandemic. Internal data for the college showed success rates for math students needing remediation were very low during the two semesters in which all math classes were held online because of the pandemic. There was much debate about whether developmental math courses, including corequisite courses, should be offered in multiple modalities or only in person.

If the corequisite sections identified for this study were held in different modalities, it would necessitate using both belonging surveys during the first semester of data collection: an

adapted version of the PSSM (Goodenow, 1993) for the in-person section and the CCS (Rovai, 2002) for the section held online. Utilizing two different belonging surveys would make comparing the control group and treatment group difficult at best.

External Threats

In addition to internal validity threats, the researcher identified two external threats to the validity of this study.

Interaction of Setting and Treatment

The first external threat was the interaction of the setting and treatment. Creswell and Creswell (2018) describe this type of threat as follows: "Because of the characteristics of the setting of participants in an experiment, a researcher cannot generalize to individuals in other settings" (p. 172). To address such a threat, the researcher should conduct additional experiments in new settings, comparing the results of the original study setting with the new settings (Creswell & Creswell, 2018). The setting for this study was a corequisite math course during a global pandemic. The researcher planned for data collection over two consecutive semesters without knowing the course modality while in the planning stages. Despite this threat, there was still an opportunity to determine whether the results were consistent should course modality be the same for both groups. Nevertheless, the researcher was cognizant of this threat and knew that the results of this study should not be generalized to individuals in other settings.

Interaction of History and Treatment

Since the results of an experiment are time-bound, the interaction of history and treatment was a second external threat to the validity of this action research study. With this study taking place during the pandemic, the results of this study could not be generalized to situations in the past or the future (Creswell & Creswell, 2018). For the findings to be generalized, the study

would need to be repeated in the future under different circumstances to ascertain if the results remain the same as in the initial study (Creswell & Creswell, 2018). Due to this threat, this study's findings should not be generalized to other times, past or future.

Summary

This chapter described action research and explained the study's quantitative research design. Research methods, including the study context, surveys employed, experimental design, and data analysis methods, were presented in detail. Ethical considerations and threats to validity were also addressed. Chapter 4 presents an analysis of data and the results of the action research study.

CHAPTER 4

STUDY RESULTS AND DISCUSSION

Introduction

This study's research problem stemmed from the practitioner-researcher's anecdotal observations. Namely, students in a corequisite math class who appear to be socially isolated in the classroom are not as academically successful as their peers who seem to have bonded with each other. The purpose of this action research study was to determine whether there is a relationship between students' sense of belonging in a corequisite mathematics class and their academic performance in the corequisite and gateway math courses. Secondarily, the study sought to determine if the teaching and learning strategies chosen to promote sense of belonging positively impacted sense of belonging. This action research study sought to answer two questions.

1. What is the nature of the relationship between the change in a student's sense of belonging in a corequisite math course and their academic performance in

   a. the corequisite course?

   b. the gateway math course?

2. To what extent will the methods used for fostering a sense of belonging in the treatment group impact students' sense of belonging compared to the control group?

As part of the research process, the researcher made the following hypotheses:

- There is a negative linear relationship between the change in sense of belonging and the change in course grades.

- There is an inverse relationship between change in sense of belonging and course grades. In other words, the larger the increase in sense of belonging over the

semester, the smaller the decrease in overall course grade in the corequisite and gateway math courses.

- Sense of belonging would increase for the treatment group and the control group.

- The increase in sense of belonging would be greater for the treatment group than for the control group.

This chapter provides an analysis of data collected during this study. Descriptive statistics are provided and the results of the paired samples *t*-test and the one-way ANOVA about change in sense of belonging are shared. The Pearson product-moment correlation test results are detailed. A discussion of the study's results concludes the chapter.

Data Analysis

Students taking a corequisite mathematics course during the Fall 2021 or Spring 2022 semesters were given the opportunity to participate in this quantitative action research study. The practitioner-researcher taught the treatment group using teaching and learning strategies intended to foster sense of belonging. A researcher's colleague taught the control group using a combination of group work and lectures.

There were two corequisite sections in the Fall 2021 semester. The institution determined course modality. The treatment group was conducted in person while the control group was taught synchronously online. Five of the six students in the in-person course consented to participate in the study and signed a consent form (see Appendix B). None of the students enrolled in the online section chose to participate.

Two in-person sections of the corequisite course were held in the Spring 2022 semester. Once again, the instructor for the treatment group was the practitioner-researcher. A colleague taught the control group. All four students in the corequisite section serving as the treatment

group agreed to participate in the action research study. Three of the seven students in the control

group section opted into the study. Every participant signed the consent form.

For both semesters of data collection, each student who consented to participate filled out

a brief demographic questionnaire (see Appendix C). In addition, participants completed a

belonging survey during weeks four and 15 of the semester. The belonging survey administered

(see Appendix D) was an adapted version of the Psychological Sense of School Membership

scale (Goodenow, 1993). The Classroom Community Scale (Rovai, 2002) was ultimately not

used in the study since no one taking the corequisite course online agreed to participate (see

Appendix E).

Demographics

Demographical information was collected to allow the researcher to compare the make-

up of the study participants to the student body as a whole. Institutional data available on the

college website was used for this comparison. The responses for the demographical

questionnaire disaggregated by semester and group appear in Table 1. Study-wide totals are also

included.

Table 1

Demographic Characteristics of Study Participants

Characteristic	Fall 2021 treatment	Spring 2022 control	Spring 2022 treatment	Total
Sample size	5	3	4 [a]	12 [b]
Age				
18	0	1	0	1
19-24	2	2	3	7
25-34	0	0	0	0
35-44	2	0	0	2
45-64	1	0	1	2

Characteristic	Fall 2021 treatment	Spring 2022 control	Spring 2022 treatment	Total
Gender				
Female	4	2	4	10
Male	1	1	0	2
Race/ethnicity				
White	4	2	3	9
Black/African American	0	0	1	1
Two or more	1	1	0	2
Enrollment status				
Full-time	3	2	2	7
Part-time	2	1	2	5
Reason for taking the corequisite [c]				
Placement test	2	2	2	6
High school transcript	1	0	0	1
Adviser recommendation	1	2	1	4
I chose to take the corequisite	2	0	2	4

Note. Characteristics that were on the demographic questionnaire with a total of zero were not included in Table 1. For a complete list of characteristics on the demographic questionnaire, see Appendix C.

[a] The Spring 2022 treatment group began with four participants, but one withdrew from the course mid-semester. Due to anonymity, there was no way to determine which demographic questionnaire corresponded to that participant. [b] Study attrition in Spring 2022 resulted in 11 study participants. [c] Participants selected all that applied.

A few things stood out to the researcher. First, the ratio of female to male participants was 5:1. At the institutional level, the ratio of female to male students was 3:2 at the time data was collected. Regarding part-time and full-time students, nearly 73% of students at the

institution were part-time students. Just 42% of study participants indicated they were part-time students.

One other piece of information from the demographical survey was notable to the researcher because of a change in placement methods at the institution where the study occurred. Multiple measures for placement were brought to scale for the 2021-2022 academic year, with high school transcripts being the preferred tool for placement. This researcher was disconcerted to find that just one of the 12 participants indicated that their high school transcript played a role in their placement. With eight participants between the ages of 18 and 24, the researcher expected more people to report their high school transcripts were used for placement.

Descriptive Statistics

Study attrition was identified as a potential internal threat to the validity of this study. In the Spring 2022 semester, one participant in the treatment group withdrew from the course mid-semester. Change in sense of belonging and course grades were a critical component of this study. Because a personal identifier was requested for each belonging survey, there was one week four survey which could not be paired with a week 15 survey. Therefore, the lone week four survey was removed from consideration since a change in belonging and grades could not be calculated.

Sense of Belonging

To calculate the sense of belonging score, a numerical value was assigned to each response on the adapted PSSM survey (see Appendix C), with 1 indicating no sense of belonging and 5 indicating a high sense of belonging. For statements such as "People in this class are friendly to me," the response "completely true" indicated a high sense of belonging. Therefore, "completely true" was scored as 5, while "not at all true" was scored as 1. Other statements were

reverse scored. For example, a student who said the statement "It is hard for people like me to be accepted here" was completely true did not feel a sense of belonging. Therefore "completely true" was assigned a score of 1, with "not at all true" earning a score of 5, indicating a high sense of belonging.

The mean of a participant's response values is the participant's belonging score. The closer a belonging score is to 1, the lower the student's sense of belonging in the corequisite class. Similarly, the closer a student's belonging score is to 5, the higher their sense of belonging. Belonging scores are reported by semester and group in Table 2.

Table 2

Means and Standard Deviations of Belonging Scores by Semester and Group

Semester/Group		Week 4		Week 15	
	n	*M*	*SD*	*M*	*SD*
Fall 2021/treatment	5	4.40	0.54	4.54	0.37
Spring 2022/control	3	4.44	0.44	4.90	0.12
Spring 2022/treatment	3	3.72	0.29	4.78	0

Note. One study participant in the Spring 2022 treatment group withdrew from the course mid-semester and was not included in these calculations.

When planning this study, the researcher expected week four belonging scores to be between 3.5 and 4.0. She also anticipated week four belonging scores to be somewhat higher for the treatment group than the control group. The researcher's conjectures were accurate for the Spring 2022 treatment group only: the week 4 mean belonging score of 3.72 fell into the

anticipated range. The researcher was surprised that the control group had the highest belonging

scores at both weeks four and 15.

Course Grades

Students self-reported their course grades in the corequisite and gateway math courses as

part of the belonging survey. The means and standard deviations at weeks four and 15 appear in

Table 3.

Table 3

Means and Standard Deviations of Course Grades by Course, Semester, and Group

Semester/Group	Grade in corequisite course (%)				Grade in gateway course (%)			
	M_4	SD_4	M_{15}	SD_{15}	M_4	SD_4	M_{15}	SD_{15}
Fall 2021/treatment	94.8	3.6	79.2	29.5	86.2	4.5	77.6	13.6
Spring 2022/control	94.3	4.0	87.9	2.5	100	0	80.7	15.5
Spring 2022/treatment	78.5	14.5	78.0	16.3	73.5	17.4	58.5	5.9

Note. One study participant in the Spring 2022 treatment group withdrew from the course mid-

semester and was not included in these calculations.

Course grades at the beginning of the semester are often higher than those at the end

because the first unit of instruction has historically been a strong one for students. Experience

shows that students' course grades at the end of the semester are lower than at the end of the first

unit of study. The statistics in Table 3 support this researcher's past anecdotal observations.

Also, when data collection in week four of Spring 2022 occurred, the control group

instructor let the researcher know the first exam in the gateway course had not yet been

administered. This is notable because change in the gateway course grades was a variable in this

study. With the only grades in week 4 being for homework where students were allowed

unlimited attempts to get each question correct, student's course grades as reported in week 4

were presumably higher than what they would have been had the first exam been taken prior to

the week four belonging survey being completed.

Change in Sense of Belonging and Course Grades

This study's hypotheses focused on the change in sense of belonging and the change in

course grades over the semester. Table 4 features the change in belonging scores and course

grades over the semester for each group.

Table 4

Change in Mean Belonging Score and Mean Course Grade From Week 4 to Week 15

Semester/Group	Change in mean belonging score	Change in mean corequisite course grade	Change in mean gateway course grade
Fall 2021/treatment	+0.14	-15.6%	-8.6%
Spring 2022/control	+0.46	-6.4%	-19.3%
Spring 2022/treatment	+1.06	-0.5%	-15.0%

Note. One participant in the Spring 2022 treatement group withdrew from the course mid-

semester. As a result, no week 15 data was collected for this participant. The participant's week

four scores were not used in these calculations.

Results

Change in Sense of Belonging

Using a matched pairs *t*-test to determine whether the difference between two dependent

population means is statistically significant requires the samples to be matched pairs. Also, since

the number of pairs of sample data is small ($n < 30$), the differences must be approximately

normally distributed (Hawkes, 2019). In this study, the week four and week 15 belonging scores

for each participant were matched. Normal probability plots were created to determine whether

the paired differences could be assumed to come from a normally distributed population (see

Figure 1).

Figure 1

Normal Probability Plots for Change in Participant Belonging Scores From Week 4 to Week 15

A

B

C
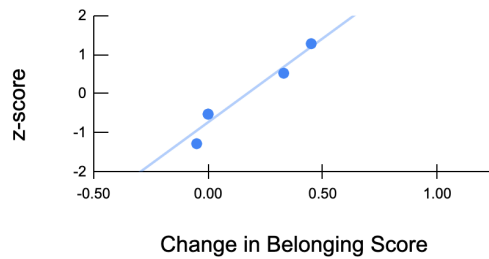
Note. Panel A: Fall 2021 treatment group, $r = .97$. Panel B: Spring 2022 control group. $r = .87$.

Panel C: Spring 2022 treatment group, $r = 1.00$. Due to one study participant withdrawing from

the Spring 2022 treatment group mid-semester, this participant was not included.

The normal probability plots for each set of paired data show that the individual differences in belonging scores between week four and week 15 are approximately linear. Therefore, it was reasonable to assume the differences come from a normally distributed population (Hawkes, 2019).
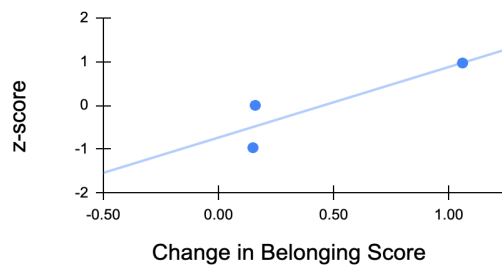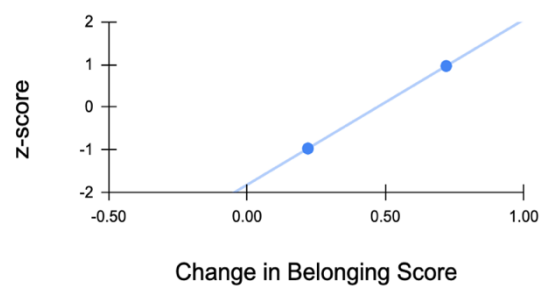
Since the assumption of normality was reasonable, Excel was used to run a paired two-sample *t*-test for means to determine if there was a significant change in belonging scores over the semester for each section of the corequisite course. The null hypothesis was that there was no change in belonging score from week four to week 15 (the difference is zero). The alternative hypothesis was that the belonging score in week 15 would be greater than in week four. The results of the *t*-tests are found in Table 5.

Table 5

Paired Two-Sample t-test for Mean Belonging Scores

Semester/Group	Value	*df*	*t*	*p*
Fall 2021/treatment	0.14	4	1.43	0.112
Spring 2022/control	0.46	2	1.52	0.135
Spring 2022/treatment	1.06	2	6.32	0.012

Note: Due to one study participant withdrawing from the Spring 2022 treatment group mid-semester, the participant was not included when conducting the test of significance.

The researcher hypothesized that, for all groups, belonging scores would increase from week four to week 15. Although there was an increase in sense of belonging across all sections

of the corequisite course, the test of significance shows that the Spring 2022 treatment group is the only group that showed a statistically significant increase in sense of belonging at the $\alpha = .05$ level of significance.

The researcher also wanted to test the hypothesis that the treatment group would experience a more significant increase in sense of belonging than the control group for the Spring 2022 semester. A one-way ANOVA was performed to compare the change in sense of belonging between the groups. The one-way ANOVA revealed there was no statistically significant difference in the change in sense of belonging between the two groups ($F = 3.00$, $p = .159$).

Relationship Between Change in Sense of Belonging and Change in Course Grade

A scatterplot for each group of participants was constructed to determine whether there was a linear relationship between a student's change in sense of belonging and the change in their course grade from week four to week 15. For the scatterplots (see Figure 2), each pair of vertically aligned points represents an individual study participant. A participant's belonging score is their mean score on an 18-item adapted version of the Psychological Sense of School Membership scale (Goodenow, 1993). Course grades were self-reported. The change in course grade was calculated by subtracting the week four grade from the week 15 grade.

Figure 2, Panel A shows the scatterplot for the Fall 2021 participants. Linear regression reveals the Pearson's correlation coefficient to be $r = .30$ for the corequisite course and $r = .44$ for the gateway math course. Referring to a critical value table for r (Siegle, 2015)*,* neither relationship is statistically significant.

One study participant's data points for both courses were outliers. This participant had no change in belonging with a 65% decrease in the corequisite and a 27% decrease in the gateway

course grade. Removing the outlier and repeating the linear regression resulted in $r = -.62$ and $r = .34$ for the corequisite and gateway courses, respectively. Even with the outlier removal, the results are insignificant at the $\alpha = .10$ level of significance.

Figure 2

Change in Sense of Belonging and Change in Course Grade

A

B

C
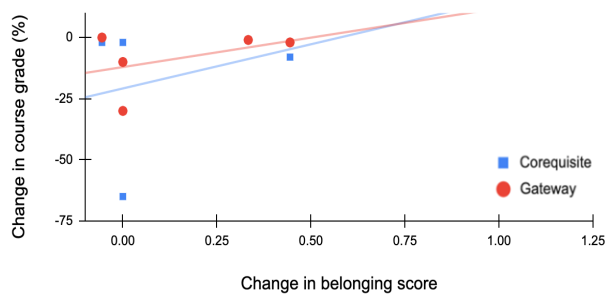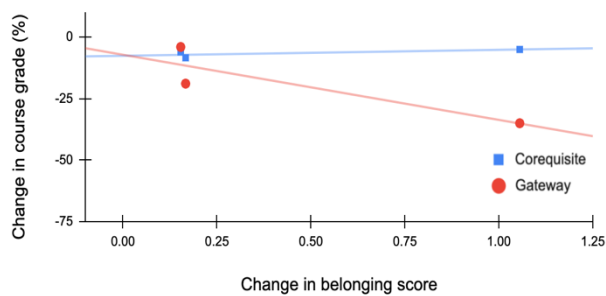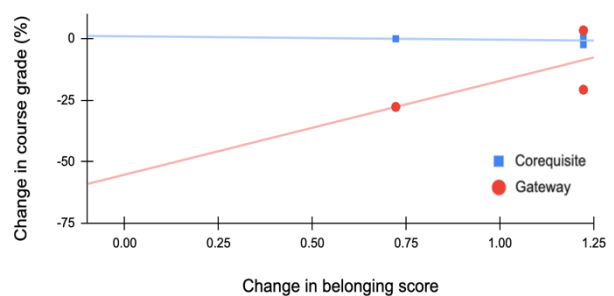
Note. Panel A: Fall 2021 treatment group. Panel B: Spring 2022 control group. Panel C: Spring 2022 treatment group. Due to one study participant withdrawing from the Spring 2022 treatment group mid-semester, this participant was not included.

Although the linear relationship between change in sense of belonging and change in course grade for each course is stronger than that seen in the Fall 2021 treatment group, the

values of r do not meet the minimum threshold for significance for a sample size of $n = 3$ (Siegle, 2015). For the Spring 2022 control group, linear regression revealed that $r = 0.72$ for the corequisite course. For the gateway course, $r = -.88$ (see Figure 2, Panel B).

The scatterplot for the Spring 2022 treatment group is pictured in Figure 2, Panel C. Performing a linear regression for the treatment group resulted in $r = 0.23$ in the corequisite course. Linear regression for the gateway course reveals $r = -.67$. Again, there was no statistically significant linear relationship between the change in sense of belonging and the change in course grade.

Discussion

The primary purpose of this study was to explore the relationship between sense of belonging and academic performance in the corequisite course and gateway math course. Additionally, this researcher wanted to see if students in the corequisite course experienced a significant change in sense of belonging from the beginning of the semester to the end.

Years of experience and anecdotal information led the researcher to believe that overall course grades between week four and week 15 tend to decrease as the course material gets more difficult. The researcher hypothesized that students' change in sense of belonging would be negatively associated with course grades but that overall course grades would decrease less for students with the greatest increases in sense of belonging. An analysis of data showed no significant linear relationship between sense of belonging and course grade in either the corequisite or gateway math course.

For the change in sense of belonging, the researcher hypothesized that both groups would increase in belonging over the semester. Furthermore, she hypothesized that the treatment group would have a greater increase in sense of belonging than the control group.

After testing for normality, a paired-sample *t*-test showed that the only group of study participants with a significant increase in sense of belonging was the Spring 2022 treatment group. This study does not indicate why the sense of belonging increased significantly for the Spring 2002 treatment group. It simply indicates that the change was large enough that the increase should not be attributed to mere chance.

A one-way ANOVA was conducted for the Spring 2022 data to determine if the change in sense of belonging for the treatment and control groups was significantly different. The results indicated that the change in belonging was not significantly greater for the treatment group than the control group.

Some readers may question why the researcher did not combine the data from the Fall 2021 and Spring 2022 treatment groups. The decision to keep the two treatment groups separate was made for several reasons. First, many of the statements on the belonging survey specifically referenced others in the class. Two examples of such statements are "I feel very different from most other students here" and "People in this class know I can do good work" (Goodenow, 1993). The participants in each treatment group had their own unique experiences in the corequisite course, and each group had its own set of dynamics.

Second, the treatment groups did not take the corequisite course during the same semester, and the conditions were very different. Masking and social distancing were mandatory in the fall, but masking was optional during the spring semester. Also, an unexpected event occurred early in the third week of the Fall 2021 semester, just before data collection began. At the time, it was the researcher's opinion that the students formed a strong bond with this professor and, in turn, with each other. This opinion gained credence when comparing the

belonging scores in week four for the Fall 2021 and Spring 2022 treatment groups. The mean

belonging score for Fall 2021 was 0.68 higher than Spring 2022.

The decision to keep the treatment groups separate is also supported by the literature.

Research on sense of belonging provides evidence that students' sense of belonging is influenced

by the learning environment, context, and situation (Goodenow, 1993; Lahdenperä & Nieminen,

2020; Strayhorn, 2019). Additionally, students' sense of belonging is associated with interactions

with their peers (Lahdenperä & Nieminen, 2020; Zumbrunn et al., 2014) and with the instructor

(Freeman et al., 2007; St-Amand et al., 2017; Zumbrunn et al., 2014). Furthermore, the

researcher believes combining the two treatment groups could be interpreted as tampering with

the data, violating the principle of honesty (Creswell & Creswell, 2018; Herr & Anderson, 2015;

Mertler, 2020).

Conclusion

This study tested the hypothesis that students' sense of belonging in a corequisite

mathematics course is associated with their academic performance in the corequisite and

gateway mathematics courses. It also examined the extent to which the methods used for

fostering belonging impacted students' sense of belonging. A statistically significant change in

sense of belonging for the Spring 2022 treatment group is this study's only statistically

significant finding. There was no significant difference in the increase in sense of belonging for

the control and treatment groups, nor was there evidence of a linear association between change

in sense of belonging and change in course grade. Chapter 5 will conclude this study's report by

discussing implications for practice and providing recommendations for future research.

CHAPTER 5

CONCLUSIONS

Introduction

This action research study was born out of the researcher's anecdotal observations that often, the students in her remedial math courses who do not appear to form relationships with their classmates are the same students who fail to complete the course successfully. This chapter provides a synthesis of the action research study, discusses the implications for practice, introduces suggestions for future research, and addresses the study's limitations.

Synthesis of Study

The purpose of this action research study was to explore whether there is a relationship between students' sense of belonging in a corequisite mathematics class and their academic performance in the corequisite and gateway math courses. The following questions were the focus of this study:

1. What is the nature of the relationship between the change in a student's sense of belonging in a corequisite math course and their academic performance in

    a. the corequisite course?

    b. the gateway math course?

2. To what extent will the methods used for fostering a sense of belonging in the treatment group impact students' sense of belonging when compared to the control group?

    In Fall 2021 and Spring 2022, study participants completed a belonging survey during weeks four and 15 of the semester. They also self-reported their corequisite and gateway math course grades at the time the survey was administered. A Pearson product-moment correlation was calculated to determine if there was an association between the change in participants' sense

of belonging and the change in their course grades over the semester. No statistically significant relationship between the variables existed. Although all groups experienced an increase in sense of belonging over the semester, a matched pairs *t*-test revealed the Spring 2022 treatment group to be the only one with a statistically significant increase.

Implications for Practice

It would be easy to see this study as a failure, yet this instructor and researcher does not see it that way. A group of corequisite students saw a significant increase in sense of belonging over the semester. Those students participated in a class where this instructor selected teaching and learning activities and strategies intended to foster sense of belonging. The Spring 2022 treatment group's sense of belonging increased by more than one point from week four to week 15. That is remarkable.

As the instructor and researcher, I had also anticipated a significant increase in the Fall 2021 treatment group's belonging. Not only was the increase not statistically significant, but it was the smallest increase among the three groups. It took very little time for me to arrive at a possible explanation. An unexpected event occurred early in the third week of the Fall 2021 semester, just before data collection began. As a result, this professor-researcher felt a sense of belonging in relation to the students, unlike any I have ever experienced. Anecdotally, I also saw evidence of a deep bond between the students. I watched students hug, hive-five, and cheer for each other when they did well on a test. I listened as students shared their struggles with their classmates and marveled at the support they gave each other. When the week four belonging score was 4.40, there was no room for a statistically significant improvement in belonging. Their sense of belonging was very high from the beginning.

The time in history in which this study took place is also important. Due to Covid-19, students had been isolated, becoming accustomed to interacting online. Fall 2021 was the first semester when all students had the option to take classes in person instead of online. Masking and social distancing were required throughout the fall and more than halfway through the Spring 2022 semester. Establishing and simply maintaining sense of belonging is a cause for celebration, but to show slight increases in sense of belonging during a global pandemic is incredible.

Another aspect of this study was the relationship between the change in sense of belonging and the change in course grade. Again, the results were not statistically significant, but I will say this: in the Fall of 2021, every student in the corequisite and gateway courses earned a C or better. In my opinion, that is not a coincidence. In a section where sense of belonging started high and ended a bit higher, no one earned less than a C in the course. I cannot recall any course in any semester when every student performed so well academically.

Research shows sense of belonging positively impacts college students in terms of GPA, persistence, self-efficacy, and more. But what can be learned from this study? As the instructor-researcher, I believe instructors should be intentional about fostering sense of belonging in the classes they teach. Conducting this study in a corequisite math course, this researcher did not uncover as many statistically significant results as I had hoped. Nevertheless, as the professor, I am fully committed to fostering sense of belonging in every class I teach, regardless of course and modality. The methods used to promote belonging will vary, as will the level of sense of belonging felt by each student. As this study shows, a student's sense of belonging and course grades may not be associated, but a student's sense of belonging will likely positively impact them in other ways.

Suggestions for Future Research

Many studies have focused on the importance of sense of belonging for college students. However, no research was found addressing a classroom-level sense of belonging and academic achievement in that particular class. This action research study attempted to address that gap in the literature. The practitioner-researcher calls for continued study of the relationship between sense of belonging in the classroom and academic performance in that class. Studies should stem well beyond corequisite mathematics, considering developmental and college-level courses in all disciplines and modalities.

Additionally, the researcher recommends empirical research investigating the effectiveness of targeted, specific strategies to increase belonging. Extant literature primarily discusses broad themes for promoting a sense of belonging. The researcher believes there would be great value in studying which teaching and learning strategies yield the biggest return. For example, do video and written discussion posts promote a similar sense of belonging, or does one foster a greater sense of belonging than the other? Does low-stakes group work foster a different level of belonging than high-stakes group work? Is there a greater increase in sense of belonging when students are assigned a group versus choosing their group? What teaching and learning activities and strategies do students report having helped them feel a sense of belonging in the classroom?

Another suggested research topic is comparing students' sense of belonging in in-person and online classes now to students' sense of belonging in each modality several years from now. With the prevalence of technology in our daily lives, will students' sense of belonging in the physical classroom setting decrease as time goes on? Will sense of belonging be affected in any way as more and more courses are offered online? Are students able to feel they belong in an

online class, and, if not, do the perceived benefits of online learning outweigh the basic need to

belong?

Limitations

Every research study has its limitations; this study is not an exception. Several limitations

of this study are examined in this section, followed by ways the limitations can be minimized or

perhaps even eliminated in future studies.

Sample Size

The small sample size in this study is a limitation that cannot be underestimated. Entering

the 2020-21 academic year amid a pandemic, the expectation nationally was that enrollment at

community colleges would boom following enrollment trends during tough economic times

(Gardner, 2020). As we know now, community colleges across the nation saw drastic enrollment

declines, with many having their lowest enrollment numbers in more than a decade (Insight Into

Diversity, 2022; Krantz, 2021).

What is the impact of small sample size on a research study? As Sauro (2013) explains,

"just because you don't have a large sample size doesn't mean you cannot use statistics…[but]

you are limited to detecting large differences between designs or measures" (para. 8). It is also

possible that a statistically nonsignificant result could be due to an inadequate sample size

(Andrade, 2020). While this researcher used statistical techniques appropriate for sample sizes

less than 30, it is possible that the nonsignificant results in this action research study were a

consequence of the small sample size.

Research Design

In hindsight, a limiting factor of this research is the quantitative design of the study.

Since I was not only the researcher but the course instructor, I believed a qualitative approach

could have been a detriment to the study. Some of the qualitative data collection would have

been about my choices as the course instructor. My concerns centered around students'

perceptions of whether they could respond honestly to open-ended questions. I did not want

students to temper their responses thinking any criticism might impact their grade. Consequently,

I decided as the researcher to use a quantitative study design.

Control Group Influence

A third limitation of this study is this researcher's perception that my colleague actively

promoted sense of belonging in the control group. I have no firsthand knowledge of how the

course was conducted from week to week. I was only in the control group classroom long

enough to offer students the opportunity to participate in this research study and answer any

questions they had. As students completed the consent form, my colleague stated that students

who interact with each other do better in the course. Her comment could have influenced

students' willingness to actively engage with their classmates, thereby influencing their sense of

belonging.

Next Steps: The Action Plan

Action research is non-linear and recursive in nature (Mertler, 2020), often described as a

cyclical or spiral process (Calhoun, 1993; Melrose, 2001; Stringer & Ortiz Aragón, 2021). The

action research study presented in these pages describes the first iteration of a cycle. I am

planning on conducting this study again, adjusting to address the limitations described in the

previous paragraphs and expanding the scope of the study.

I will expand the study to include students in the gateway math course to address the

small sample size. With a gateway course capacity of 30 students, a small sample size should no

longer be an issue. I often teach two or three sections of the gateway course, at least one of

which is paired with a corequisite section. Including those taking the gateway course would also allow me to explore whether sense of belonging differs for those taking the corequisite course compared to those enrolled in the gateway course only. I will be the only instructor taking part in the study; there will be no control group. I will actively seek to promote sense of belonging in each section of the course, hoping to find that the higher a student's sense of belonging, the more likely they are to successfully complete the course.

As the researcher, I was confident in the quantitative design of the original study, but the foundation of that confidence was based on pre-pandemic assumptions. If I could have predicted the drastic decline in corequisite enrollment, I would have chosen a mixed-methods design. In the next cycle of this study, I will collect both qualitative and quantitative data at roughly the same time in the data collection process. This will give me the ability to give equal weight to both forms of data and combine the strengths of both qualitative responses and quantitative statistics (Ivankova, 2015; Mertler, 2020). If the two data sets lead to the same or similar conclusions, that will lend more credibility to the study (Mertler, 2020).

In addition to continuing to study the impact of sense of belonging on course-level academic performance, I will also explore what strategies are most effective at promoting belonging and what strategies lead to student success. I will do this quantitatively by asking students to rank activities and strategies regarding how well they feel each one promotes a sense of belonging. I will also ask students to rank the same activities and strategies based on how they felt each one helped them to perform better in the course. I will gather qualitative data from the students through interviews, class discussions, and other feedback methods. The results and findings from this part of the study will aid in future planning for the course, helping to establish

a set of best practices for use in the classroom. The findings would also begin to fill a gap in the existing body of literature on how to best promote sense of belonging in the classroom.

Conclusion

This researcher set out to investigate the relationship between students' sense of belonging and their academic performance a corequisite mathematics course and the simultaneous gateway mathematics course. As the course instructor, the researcher sought to positively influence sense of belonging over the semester as part of the study. No association between sense of belonging and academic performance in the mathematics courses was found, All participants had an increase in belonging, yet only the Spring 2022 treatment group had a statistically significant increase.

The words on these pages represent a snapshot in time. They describe the beginning of a research process that will continue to evolve as this mathematics professor and researcher seeks to find ways to not only help her students find a sense of belonging but to succeed in the mathematics classroom. It is the researcher's hope that this study will encourage college faculty to foster students' sense of belonging in the classroom. We may never know the extent to which sense of belonging impacts each student, but we can rest assured our efforts to foster belonging will help fulfill a basic human need.

REFERENCES

Andrade, C. (2020). Sample size and its importance in research. *Indian Journal of Psychological Medicine, 42*(1), 102-103.

Akyol, Z., Garrison, D. R., & Ozden, M. Y. (2009). Development of a community of inquiry in online and blended learning contexts. *Procedia Social and Behavioral Sciences*, *1*(1), 1834-1838.

Babbie, E. R. (2010). *The practice of social research* (12th ed.). Wadsworth Cengage.

Barber, W., & King, S. (2016). Teacher-student perspectives of invisible pedagogy: New directions in online problem-based learning environments. *Electronic Journal of E-Learning*, *14*(4), 235–243.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497-529.

Bean, J., & Eaton, S. (2001). The psychology underlying successful retention practices. Journal of College Student Retention, 3(1), 73–89. https://doi.org/10.2190/6R55-4B30-28XG-L8U0

Benander, L., Cavanaugh, L., & Rubenzahl, I. (1990). Ideas in practice: A new equation in developmental mathematics. *Journal of Developmental Education, 14*(1), 26-28.

Berger, J. B. (1997). Students' sense of community in residence halls, social integrations, and first-year persistence. *Journal of College Student Development, 38*(5), 441-452.

Berry, S. (2019). Teaching to connect: Community-building strategies for the virtual classroom. *Online Learning*, *23*(1), 164–183. https://files.eric.ed.gov/fulltext/EJ1210946.pdf

Boatman, A. (2021). Accelerating college remediation: Examining the effects of math course

 redesign on student academic success. *The Journal of Higher Education,* 92(6), 927-960.

Bollen, K. A., & Hoyle, R. H. (1990). Perceived cohesion: A conceptual and empirical

 examination. *Social Forces, 69*(2), 479-504.

Borup, J., West, R. E., Thomas, R., & Graham, C. R. (2014). Examining the impact of video

 feedback on instructor social presence in blended courses. *International Review of*

 Research in Open and Distributed Learning, 15(3), 232-256.

 https://www.irrodl.org/index.php/irrodl/article/view/1821

Buskirk-Cohen, A. A., & Plants, A. (2019). Caring about success: Students' perceptions of

 professors' caring matters more than grit. *International Journal of Teaching and*

 Learning in Higher Education, *31*(1), 108–114.

Calhoun, E. (1993). Action research: Three approaches. *Educational Leadership, 51*(2), 62-65.

Cavanagh, S. R. (2019). How to make your teaching more engaging. *Chronicle of Higher*

 Education. https://www.chronicle.com/article/how-to-make-your-teaching-more-

 engaging

Chen, X. (2016). *Remedial coursetaking at U.S. public 2- and 4-year institutions: Scope,*

 experiences, and outcomes. National Center for Education Statistics.

 https://nces.ed.gov/pubs2016/2016405.pdf

Chen, X., Duprey, M.A., Ritchie, N.S., Caves, L.R., Pratt, D.J., Wilson, D.H., Brown, F.S., and

 Leu, K. (2020). *High school longitudinal study of 2009 (HSLS:09): A first look at the*

 postsecondary transcripts and student financial aid records of fall 2009 ninth-graders.

 National Center for Education Statistics.

 https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2020003

Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (2nd ed.). Merrill/Prentice Hall.

Creswell, J. W. (2012). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (4th ed.). Merrill.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Cuellar Mejia, M., Rodriguez, O., & Johnson, H. (2020, November). *A new era of student access at California's community colleges.* Public Policy Institute of California. https://www.ppic.org/wp-content/uploads/a-new-era-of-student-access-at-californias-community-colleges-november-2020.pdf

Darby, F. (2020). How to be a better online teacher. *The Chronicle of Higher Education*, 12-23. https://www.chronicle.com/article/how-to-be-a-better-online-teacher/#1

Darling, F. (2019). *Teachin' it! Breakout moves that break down barriers for community college students.* Teachers College Press.

Dawson, S. (2006). A study of the relationship between student communication, interaction, and sense of community. *Internet and Higher Education, 9*(3), 153-162.

Delahunty, J., Verenikina, I., & Jones, P. (2013). Socio-emotional connections: Identity, belonging and learning in online interactions. *Technology, Pedagogy and Education, 23*(2), 243-265.

Dyer, T., Aroz, J., & Larson, E. (2018). Proximity in the online classroom: Engagement, relationships, and personalization. *Journal of Instructional Research*, *7*, 108–118.

Education Commission of the States. (2021). *Developmental educational policies: Is corequisite support addressed? If so, is it required?* Retrieved August 29, 2022, from https://reports.ecs.org/comparisons/developmental-education-policies-05

Fraenkel, J. R., & Wallen, N. E., & Hyun, H. (2012). *How to design and evaluate research in education* (8th ed.). McGraw-Hill.

Freeman, T. M., Anderman, L. H., & Jensen, J. M. (2007). Sense of belonging in college freshmen at the classroom and campus levels. *Journal of Experimental Education*, *75*(3), 203–220.

Gardner, L. (2020, December 8). *How the pandemic worsened – and highlighted – community colleges' chronic challenges: Why the sector took a hit when so many expected a windfall.* The Chronicle of Higher Education. https://www.chronicle.com/article/how-the-pandemic-worsened-and-highlighted-community-colleges-chronic-challenges

Gay, L. R., Mills, G. E., & Airasian, P. (2009). *Educational research: Competencies for analysis and application* (9th ed.). Merrill/Prentice Hall.

Gay, L. R., & Airasian, P. (2000). *Educational research: Competencies for analysis and application* (9th ed.). Merrill/Prentice Hall.

Gil-Doménech, D., & Berbegal-Mirabent, J. (2019). Stimulating students' engagement in mathematics courses in non-STEM academic programmes: A game-based learning. *Innovations in Education and Teaching International*, *56*(1), 57–65. http://dx.doi.org/10.1080/14703297.2017.1330159

Gooblar, D. (2019). *The missing course: Everything they never taught you about college teaching.* Harvard University Press.

Goodenow, C. (1993). The psychological sense of school membership among adolescents: Scale development and educational correlates. *Psychology in the Schools*, *30*(1), 79–90.

Gopalan, M., & Brady, S. T. (2020). College students' sense of belonging: A national

    perspective. *Educational Researcher*, *49*(2), 134–137.

Gueldenzoph, L. E. (2003). The integration of constructivist theory and socialization to distance

    (online) learning. *Delta Pi Epsilon Journal, 45*(3), 173-182.

Han, C., Farruggia, S. P., & Moss, T. P. (2017). Effects of academic mindsets on college students'

    achievement and retention. *Journal of College Student Development*, *58*(8), 1119–1134.

    https://doi.org/10.1353/csd.2017.0089

Hausmann, L., Schofield, J., & Woods, R. (2007). Sense of belonging as a predictor of intentions

    to persist among African American and white first-year college students. Research in

    Higher Education, 48(7), 803–839. https://doi.org/10.1007/s11162-007-9052-9

Hawkes, J. S. (2019). *Discovering statistics and data* (3rd ed.). Hawkes Learning.

Herr, K., & Anderson, G. L. (2015). *The action research dissertation: A guide for students and*

    faculty (2nd ed.). SAGE Publications.

Hill, J. R., Song, L., & West, R. (2009). Social learning theory and web-based learning

    environments: A review of research and discussion of implications. *American Journal of*

    Distance Education, 23(2), 88-103.

Hilsen, A. I. (2006). And they shall be known by their deeds: Ethics and politics in action

    research. *Action Research, 4*(1), 23-36.

Hoffman, M., Richmond, J., Morrow, J., & Salomone, K. (2002). Investigating "sense of

    belonging" in first-year college students. *Journal of College Student Retention: Research,*

    Theory & Practice, 4(3), 227-256. https://doi.org/10.2190/DRYC-CXQ9-JQ8V-HT4V

Hurtado, S., & Carter, D. F. (1997). Effects of college transition and perceptions of the campus

    racial climate on Latino students' sense of belonging. *Sociology of Education*, *70*(4),

    324–345. https://www.jstor.org/stable/2673270

Insight Into Diversity. (2022, January 14). *College enrollment continues to drop during*

    pandemic, community colleges hit hardest. https://www.insightintodiversity.com/college-

    enrollment-continues-to-drop-during-pandemic-community-colleges-hit-hardest/

Ivankova, N. V. (2015). *Mixed methods applications in action research: From methods to*

    community action. SAGE Publications.

Johnson, A. P. (2008). *A short guide to action research* (3rd ed.). SAGE Publications.

Johnson, D. R., Soldner, M., Leonard, J. B., Alvarez, P., Inkelas, K. K., Rowan-Kenyon, H. T.,

    & Longerbeam, S. D. (2007). Examining sense of belonging among first-year

    undergraduates from different racial/ethnic groups. *Journal of College Student*

    Development, *48*(5), 525-542.

Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed

    methods research. *Journal of Mixed Methods Research, 1*(2), 112-133.

Kashyap, U., & Mathew, S. (2017). Corequisite model: An effective strategy for remediation in

    freshmen level quantitative reasoning course. *Journal of STEM Educaiton: Innovations &*

    Research, 18(2), 23-29.

Krantz, L. (2021, November 30). *Community colleges see double-digit declines in enrollment as*

    students struggle to return to their pre-pandemic studies. Boston Globe.

    https://www.bostonglobe.com/2021/11/29/metro/community-college-students-struggle-

    return-their-studies/

Kraus, S., & Sears, S. (2008). Teaching for the millennial generation: Student and teacher perceptions of community building and individual pedagogical techniques. *Journal of Effective Teaching*, *8*(2), 32–39.

Lahdenperä, J., & Nieminen, J. H. (2020). How does a mathematician fit in? A mixed-methods analysis of university students' sense of belonging in mathematics. *International Journal of Research in Undergraduate Mathematics Education*, *6*(3), 475–494. https://doi.org/10.1007/s40753-020-00118-5

Leedy, P. D., & Ormrod, J. E. (2005). *Practical research: Planning and design* (8th ed.). Merrill/Prentice Hall.

Logue, A. W., Douglas, D., & Watanabe-Rose, M. (2019). Corequisite mathematics remediation: Results over time and in different contexts. *Educational Evaluation and Policy Analysis*, *41*(3), 294–315.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*(4), 370–396.

McLean, J. E. (1995). Improving education through action research: A guide for administrators and teachers. In J. J. Herman & J. L. Herman (Eds.), *The practicing administrator's leadership series.* Corwin Press.

Melrose, M. J. (2001). Maximizing the rigor of action research: Why would you want to? How could you? *Field Methods, 13*(2), 160-180.

Merriam-Webster. (n.d.) Corequisite. In Merriam-Webster.com dictionary. Retrieved January 10, 2021, from https://www.merriam-webster.com/dictionary/corequisite

Merriam-Webster. (n.d.) Remediation. In Merriam-Webster.com dictionary. Retrieved August 24, 2022, from https://www.merriam-webster.com/dictionary/corequisite

Merriam-Webster. (n.d.) Remedy. In Merriam-Webster.com dictionary. Retrieved August 24,

    2022, from https://www.merriam-webster.com/dictionary/corequisite

Mertler, C. (2020). *Action research: Improving schools and empowering educators* (6th ed.).

    SAGE Publications.

Mertler, C. A., & Charles, C. M. (2011). *Introduction to educational research* (7th ed.). Allyn &

    Bacon.

Mills, G. E. (2011). *Action research: A guide for the teacher researcher* (4th ed.). Pearson.

Nieto, J., & Valery, S. (2006). Creating a sense of community in the classroom. *Journal of*

    Pedagogy, Pluralism, and Practice, *3*(3), Article 5.

    https://digitalcommons.lesley.edu/jppp/vol3/iss3/5

Nora, A. (2004). The role of habitus and cultural capital in choosing a college, transitioning from

    high school to higher education, and persisting in college among minority and non-

    minority students. *Journal of Higher Education, 3*(2), 180-208.

Parsons, R. D., & Brown, K. S. (2002). *Teacher as reflective practitioner and action researcher.*

    Wadsworth/Thomson Learning.

Pilcher, A. J. (2016). Establishing community in online courses: A literature review. *College*

    Student Affairs Leadership, *3*(1), Article 6.

Portolese Dias, L. & Trumpy, R. (2014). Online instructor's use of audio feedback to increase

    social presence and student satisfaction. *Journal of Educators Online, 11*(2). doi:

    10.9743/JEO.2014.2.5

Pyrczak, F., & Oh, D. M. (2018). *Making sense of statistics: A conceptual overview* (7th ed.).

    Routledge.

Ran, F. X. & Lin, Y. (2022). The effects of corequisite remediation: Evidence from a statewide

      reform in Tennessee. *Educational Evaluation and Policy Analysis, 44*(3), 458-484.

Rovai, A. P. (2002). Development of an instrument to measure classroom community. *Internet

      and Higher Education*, *5*(3), 197–211.

Ryman, S., Burrell, L., & Richardson, B. (2009). Creating and sustaining online learning

      communities: Designing environments for transformative learning. *International Journal

      of Pedagogies and Learning, 5*(3), 46-58.

Sauro, J. (2013, August 13). *Best practices for using statistics on small sample sizes.* Measuring

      U. https://measuringu.com/small-n/

Schmuck, R. A. (1997). *Practical action research for change.* SkyLight Professional

      Development.

Schlossberg, N. K. (1989). Marginality and mattering: Key issues in building community. *New

      directions for student services*, *48*(1), 5-15.

Siegle, D. (2015, February 24). *r critical value table*. Neag School of Education, University of

      Connecticut. https://researchbasics.education.uconn.edu/r_critical_value_table/

Smith, A. A. (2015, May 8). Legislative fixes for remediation. *Inside Higher Education.*

      Retrieved August 29, 2022 from

      https://www.insidehighered.com/news/2015/05/08/states-and-colleges-increasingly-seek-

      alter-remedial-classes

Solomon, Y. (2007). Not belonging? What makes a functional learner identity in undergraduate

      mathematics? *Studies in Higher Education, 32*(1), 79–96.

St-Amand, J., Girard, S., & Smith, J. (2017). Sense of belonging at school: Defining attributes,

      determinants, and sustaining strategies. *IAFOR Journal of Education*, *5*(2), 105–119.

Strayhorn, T. L. (2019). *College students' sense of belonging: A key to educational success for all students* (2nd ed.). Routledge.

Stringer, E. T., & Ortiz Aragón, A. (2021). *Action research* (5th ed.). SAGE Publications.

Tinto, V. (2017). Through the eyes of students. *Journal of College Student Retention: Research, Theory & Practice*, *19*(3), 254–269.

Tovar, E., & Simon, M. A. (2010). Factorial structure and invariance analysis of the sense of belonging scales. *Measurement and Evaluation in Counseling and Development, 43*(3), 199-217.

Whinnery, E., & Pompelia, S. (2019, March). *Common elements of developmental education policies* [Policy brief]. Education Commission of the States. https://www.ecs.org/wp-content/uploads/Common-Elements-of-Developmental-Education-Policies.pdf

Yuan, J., & Kim, C. (2014). Guidelines for facilitating the development of learning communities in online courses. *Journal of Computer Assisted Learning*, *30*(3), 220–232. https://doi.org/10.1111/jcal.12042

Zumbrunn, S., McKim, C., Buhs, E., & Hawley, L. R. (2014). Support, belonging, motivation, and engagement in the college classroom: A mixed method study. *Instructional Science: An International Journal of the Learning Sciences*, *42*(5), 661–684.

APPENDIX A

SCRIPT FOR RECRUITMENT OF PARTICIPANTS

Hi, my name is Dawn Peterson, and I am a math professor at {name of institution}. I am conducting a study on whether there is a relationship between a student's sense of belonging and their grades in Math X and Math Y. Since you are taking Math X, if you are 18 years of age or older, you are invited to participate in the study.

If you choose to participate, you will first be asked to sign a consent form. You will then be given a demographic survey (name, age, gender, race, if you are a full-time or part-time student, and why you are taking Math X). This information will be used to see how Math X students compare to the student body as a whole. During weeks 4 and 15 of the semester you will be asked your opinion on 18-20 statements designed to determine how you feel you fit in in Math X. You will also be asked your course grade in Math X and Math Y. The survey should take no more than 5 minutes to complete.

All information will remain anonymous and will be reported as class statistics. No individual scores will be shared in any way. You will, however, be asked to create a personal identifier (think of this as your user ID) so your surveys in week 4 and week 15 can be paired together. I won't know what your personal identifier is – if you decide to use DogLover as your identifier, I won't know that you are DogLover. I will only know that DogLover is someone in this particular section of Math X.

Your participation in this study is not required. Your grade in Math X and Math Y will not be affected by your decision regarding whether or not to participate. It is my intention to use the results of this study to add to the published research on sense of belonging, but most importantly, I want to use this study to improve the classroom experience for Math X students.

Before deciding whether or not you'd like to participate, I invite you to ask any questions you may have. (Pause to allow students can ask questions.) If you think of questions later, you are welcome to contact me in person (share office location), by email, or by phone. My contact information is found on the consent form and on the (institution) website.

Thank you for your time and your consideration.

Note. Before making this script available to the reader, care was taken to remove identifying information that could be used to reveal the site of this research study. Instead of Math X or Math Y, the researcher referred to the actual course numbers at the institution (e.g., Math 100). In this appendix, Math X refers to the corequisite course. Math Y is the gateway math course.

APPENDIX B

INFORMED CONSENT FOR EXEMPT STUDIES WITH MINIMUM RISK

The Impact of Students' Sense of Belonging in a Corequisite Math Class on Course Performance

You are invited to participate in a research study. The purpose of this study is to determine whether students' sense of belonging in the corequisite mathematics course has an impact on academic performance in the corequisite mathematics course and the gateway mathematics course. If you choose to participate in the study, you will be asked to complete a demographic questionnaire and take a sense of belonging survey during the fourth week of the semester. The survey will be completed a second time during week 15. The sense of belonging survey will also ask you to report your course grade in the corequisite mathematics course and the gateway mathematics course at the time of the survey.

Your participation in this study will take approximately 10 minutes each time the survey is given. All information will be anonymous. Demographical data will be used to compare the characteristics of study participants to those of {insert name of institution here} students as a whole. Participants will choose a unique identifier when completing the belongingness survey. The identifier will be used to pair the participants' responses during week 4 to those in week 15. No identifiable information will be published in this study.

Taking part in this study is voluntary. Your decision whether or not to participate will not interfere with your course grade or current or future relationships with your instructor. You may choose to withdraw from the study at any time.

Questions about this study may be directed to Professor Dawn Peterson, the researcher in charge of this study: Dawn Peterson, {phone number} or {email address}. If you have general questions about being a research participant, you may contact the Committee on the Use of Human Subjects office at Bradley University at {phone number}.

You are voluntarily making a decision to participate in this study. Choosing "AGREE" below means that you have read and understand the information presented, have decided to participate, and all of your questions have been answered to your satisfaction. Choosing "DO NOT AGREE" means that you do not wish to participate. If you think of any additional questions, please contact the researcher.

I   **AGREE**   **DO NOT AGREE**   (circle one)   to participate in this research study.

Participant's name (please print): _____ Date: _____

Participant's signature: _____

APPENDIX C

DEMOGRAPHIC QUESTIONNAIRE

The information here will be used for the purposes of comparing the demographics of the study participants to the demographics of the study body as a whole. It will not be used to identify an individual in any way. All categories are in alignment with the information found at {insert website here}. The reason for taking the corequisite course is unique to this questionnaire.

1. What is your age?

   ____ 18
   ____ 19-24
   ____ 25-34
   ____ 35-44
   ____ 45-64
   ____ 65 and over

2. What is your gender?

   ____ Female
   ____ Male
   ____ Prefer not to say

3. Race/ethnicity

   ____ White
   ____ Black/African American
   ____ Hispanic (any race)
   ____ Asian
   ____ American Indian/Alaskan Native
   ____ Non-resident alien
   ____ Two or more
   ____ Unknown

4. Enrollment status
   ____ Full-time
   ____ Part-time

5. Reason for taking the corequisite course (check all that apply)
   ____ My placement test score was used to determine the course I should enroll in
   ____ My high school transcript was used to determine the course I should enroll in
   ____ My adviser recommended the course
   ____ It was my decision to enroll in the course
   ____ Other (please give reason in the space below)

APPENDIX D

BELONGING SURVEY FOR IN-PERSON COURSE: ADAPTED PSSM

For purposes of this study, you will create your own personal identifier (a word, series of numbers, etc.) that is familiar to you. (You will need this identifier again at the end of the semester.) The identifier will be used solely to compare your survey responses at the start of the semester with your responses at the end of the semester. Your identifier will in no way be used to identify who you are as an individual.

Your personal identifier: _____

Each statement below should be considered in the context of the corequisite math class in which you are enrolled. Place an X in the box that best describes how true each statement is for you.

	Not at all true	Somewhat true	Neither true nor false	Mostly true	Completely true
1. I feel like a real part of this class.					
2. People here notice when I'm good at something.					
3. It is hard for people like me to be accepted here.					
4. Other students take my opinions seriously.					
5. My instructor is interested in me as a person.					
6. Sometimes I feel as though I don't belong here.					
7. I feel I can talk to my instructor if I have a problem.					
8. People in this class are friendly to me.					
9. The instructor is not interested in people like me.					
10. I am included in classroom activities.					

	Not at all true	Somewhat true	Neither true nor false	Mostly true	Completely true
11. I am treated with as much respect as the other students.					
12. I feel very different from most other students here.					
13. I can really be myself in this class.					
14. The instructor respects me.					
15. People in this class know I can do good work.					
16. I wish I were in a different section of this course.					
17. I feel proud to belong to this class.					
18. Other students like me the way I am.					

Survey questions adapted from Goodenow's Psychological Sense of School Membership (PSSM) scale.

What is your current grade (rounded to one decimal place) in the corequisite course? _____

What is your current grade (rounded to one decimal place) in the gateway course? _____

Goodenow, C. (1993). The psychological sense of school membership among adolescents: Scale

development and educational correlates. *Psychology in the Schools*, *30*(1), 79–90.

APPENDIX E

BELONGING SURVEY FOR ONLINE COURSE: CCS

For purposes of this study, you will create your own personal identifier (e.g., a word or series of numbers) that is familiar to you. (You will need this identifier again at the end of the semester.) The identifier will be used solely to compare your survey responses at the start of the semester with your responses at the end of the semester. Your identifier will in no way be used to identify who you are as an individual.

Your personal identifier: _____

Each statement below should be considered in the context of the corequisite math class in which you are enrolled. Place an X in the box that comes closest to indicating how you feel about the course. Please respond to all items.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. I feel that students in this course care about each other.					
2. I feel that I am encouraged to ask questions.					
3. I feel connected to others in this course.					
4. I feel that it is hard to get help when I have a question.					
5. I do not feel a spirit of community.					
6. I feel that I receive timely feedback.					
7. I feel that this course is like a family.					
8. I feel uneasy exposing gaps in my understanding.					
9. I feel isolated in this course.					
10. I feel reluctant to speak openly.					

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
11. I trust others in this course.					
12. I feel that this course results in only modest learning.					
13. I feel that I can rely on others in this course.					
14. I feel that other students do not help me learn.					
15. I feel that members of this course depend on me.					
16. I feel that I am given ample opportunities to learn.					
17. I feel uncertain about others in this course.					
18. I feel that my educational needs are not being met.					
19. I feel confident that others will support me.					
20. I feel that this course does not promote a desire to learn.					

What is your current grade (rounded to the nearest percent) in the corequisite course? _____

What is your current grade (rounded to the nearest percent) in the gateway course? _____

Rovai, A. P. (2002). Development of an instrument to measure classroom community. *Internet and Higher Education*, *5*(3), 197–21.

APPENDIX F

TEACHING AND LEARNING STRATEGIES TO PROMOTE SENSE OF BELONGING

This appendix contains a list of the teaching and learning strategies for promoting belonging. The strategies come from a variety of sources including strategies picked up at conferences or through professional reading, ideas hashed out with colleagues, and things pulled out of thin air out of necessity to meet the immediate needs of the students. The practitioner-researcher is not claiming credit for any of these ideas as she cannot identify where each originated after two decades of teaching. For those interested in learning more about belonging strategies, a list of recommended resources is included at the end of this appendix.

In the first week (or two or three) of the semester

- Have students post a short video introducing themselves. Provide very clear instructions about how to do this from start to finish. This will help students get to know each other and they'll learn something about technology, too

- Learn students' names (This includes students learning each other's names.)

- Class discussion about working in groups, the pros, the cons, what they like and don't like. Final product is a list of expectations for working in groups created by the students.

- Get a quick overview of student level of confidence about critical skills.

    o Create a checklist of prerequisite skills. Format as table, skills in column 1. (Place value, rounding, order of operations, use calculator to evaluate complex expressions, solve linear equations, reduce fractions, scale fractions up, convert from percent to decimal and decimal to percent, write fractions as decimals and percents)

- o Columns 2-5 are labeled *I know how to do this*, *I think I know how to do this*, *I am unsure how to do this*, *I don't remember how to do this*. Students check the column that describes their comfort with the mathematical skill listed.

- What is something you used to struggle doing but are now good at doing? How did you become good at it? (The point here is to get students to realize that becoming good at math takes time and practice, just like anything else.)

- Discuss what the actual goal is
  - o The goal is NOT to solve problems "the way the teacher wants"
  - o The goal is to SOLVE PROBLEMS
    - Yes, the solutions need to be mathematically sound
    - No, the solutions do not have to be arrived at in the same way
    - It is entirely possible that there is not one right approach or even one right answer to the problem at hand (this can be hard for students to accept)
  - o Introduce low- or no-stakes collaborative activities to establish what problem-solving means in this class

Establish a classroom culture of belonging

- Arrive at least 5 minutes early each day. Take the time to visit with the students and ask about their lives outside of class.

- Start each class by acknowledging I have a plan for the day, but emphasize their needs are far more important than my plan. What questions do you have for me? (Note the question is not *Do you have any questions?*) How can I best help you feel more confident about your mathematical skills what we are doing in 110?

- Everyone needs grace at some point. Give it freely.

- Celebrate together (course-related, school-related, and life-in-general-related)

Weave throughout the course

- Partner work/group work

- Make thinking out loud part of course culture

    o Instructor routinely demonstrates her thought processes by thinking out loud

    o Encourage students to think out loud when working on problems together, even if it means they state they don't know how to begin. This can be done in pairs, small groups, or as a whole class.

    o Thinking should prompt questions. Ask them!

- Create assignments based on student needs. If this means unassigning something you spent time creating, then so be it. Replace what you had planned to assign with something that meets the needs of the students on that day.

- Discuss the similarities and differences, pros and cons of how students (and the instructor) solved a problem

- Exit tickets: questions posed at the end of class, students respond on a notecard and turn it in as they leave class

    o What questions do you have from class that are still unanswered?

    o What is something you didn't understand at the beginning of class that you now understand?

    o Ask for feedback on how the course is being conducted in the form of Keep doing…/start doing…/stop doing…

    o What topics/questions do you want/need the most help with as you prepare for the next exam?

- Working in groups, have students solve a problem at least two different ways

- Put the professor in the hot seat. Have students create or bring a mathematical problem to class for the professor to solve. (Note to professor: employ the problem-solving skills you want the students to use…think out loud, draw a diagram, model with an equation, Google it, etc.)

- For online course

  o Connect with the students through weekly announcements (mix it up and make video announcements)

  o For synchronous course, use breakout rooms as a way to facilitate group problem-solving

- When a problem is causing difficulties for multiple students, post a video providing hints, tips, or a full solution

Questions to ponder as a class (can be used as discussion board topics as well)

- Are you doing problems to get them done or are you doing problems to understand? Is there a difference?

- When is memorization a good thing? When is it not?

- How do you study for a math test? How is it similar and different than studying for other subjects?

- Choose a problem on the test (or quiz or assignment) that you got wrong. Explain where your thinking went off track and explain how you would now approach the problem. Then work the problem again to arrive at a correct solution.

- Choose a problem on the test (or quiz or assignment) that makes your heart happy. Share why that problem is one you feel good about.

- Provide a problem that is solved incorrectly. Ask students to identify the error and explain how to correct the mistake.

- Post an inspirational or motivational quote on the course website each week. Ask students to share their thoughts about the quote, or to share another quote that inspires or motivates them.

Recommended Reading and Listening

Benander, L., Cavanaugh, L., & Rubenzahl, I. (1990). Ideas in practice: A new equation in developmental mathematics. *Journal of Developmental Education, 14*(1), 26-28.

Cavanagh, S. R. (2019, March 11). How to make your teaching more engaging. *The Chronicle of Higher Education.* https://www.chronicle.com/article/how-to-make-your-teaching-more-engaging/

Darby, F. (2019, April 17). How to be a better online teaching: Advice guide. *The Chronicle of Higher Education.* https://www.chronicle.com/article/how-to-be-a-better-online-teacher/

Darling, F. (2019). *Teachin' it! Breakout moves that break down barriers for community college students.* Teachers College Press.

Gooblar, D. (2019). *The missing course: Everything they never taught you about college teaching.* Harvard University Press.

Honeycutt, B. (Host). (2019-present). *Lecture breakers* [Audio podcast]. https://barbihoneycutt.com/pages/lecture-breakers-podcast-landing-page

Kane, J., & Mushtare, R. (Hosts). (2017-present). *Tea for teaching* [Audio podcast]. https://teaforteaching.com/

Nieto, J., & Valery, S. (2006). Creating a sense of community in the classroom. *Journal of*

    Pedagogy, Pluralism, and Practice, 3(3), Article 5.

    https://digitalcommons.lesley.edu/jppp/vol3/iss3/5

Stachowiak, B. (Host). (2014-present). *Teaching in higher ed* [Audio podcast].

    https://teachinginhighered.com/episodes/

Weimer, M. (Ed.). (2009, December). Building student engagement: 15 strategies for the college

    classroom. *The Teaching Professor, 23*(10), Article 6.

    https://www.facultyfocus.com/?s=15+strategies