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The Role of Teaching Presence on Academic Achievement in Fully Online Asynchronous and Hybrid Undergraduate Mathematics Courses

Shaghayegh Azadi Setayesh
The University of Texas Rio Grande Valley

THE ROLE OF TEACHING PRESENCE ON ACADEMIC ACHIEVEMENT IN FULLY ONLINE ASYNCHRONOUS AND HYBRID UNDERGRADUATE MATHEMATCIS COURSES

A Dissertation

by

SHAGHAYEGH AZADI SETAYESH

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COMMITTEE MEMBERS

Dr. Mariaelena Corbeil
Chair of Committee

Dr. Rene Corbeil
Committee Member

Dr. James Telese
Committee Member

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ABSTRACT

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This study was designed to investigate how mathematics student perceptions of teaching presence differ by course delivery mode and student achievement. Online learning has had a steady growth in higher education, and mathematics courses are also offered in fully online and hybrid modes, but the research on online mathematics learning and academic achievement is limited. In order to contribute to the body of research in this field, the focus of this study was on *teaching presence* and *academic achievement* in two delivery modes: fully online asynchronous, and hybrid.

The *Community of Inquiry* was the theoretical framework of this study, where the three elements, namely: social presence, cognitive presence, and teaching presence, are interrelated and learning is at the intersection of these main elements (Garrison et al., 2000). This study takes place at a four-year university in South Texas. Participants are students enrolled in fully online or hybrid sections of College Algebra, Math for Liberal Arts, or Elementary Statistics. The *Teaching Presence Scale* (Shea et al., 2006) is used to collect student perceptions of *teaching presence*. The results show that mathematics students in hybrid courses perceive their instructors' *teaching presence* higher than fully online asynchronous mathematics students, and that there is a statistically significant positive relationship between student perceptions of *teaching presence* and *academic achievement* in both course delivery modes. The relationship between student perceptions of each subscale of *teaching presence* (instructional design and organization, facilitation, and direct instruction) and *academic achievement* shows that *facilitation* is the best predictor of *academic achievement* in fully online asynchronous mathematics courses and *instructional design and organization* is the best predictor in hybrid mathematics courses.

Based on the results of this study, implications and recommendations to improve *teaching presence* in undergraduate fully online and hybrid mathematics courses are discussed and ideas for future studies in the related field are shared.

DEDICATION

This journey would not have been possible without the love, patience, and support of my loved ones. To my grandparents who taught me invaluable lessons, to my parents who motivated me to never stop learning, to my husband who wholeheartedly supported me to accomplish my goal, to my children who are my inspiration, and to my sister whose courage taught me to stay strong and not to give up: Thank you for being the most amazing support system.

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CHAPTER I

INTRODUCTION

Online learning has been growing in higher education and students view online courses as an alternative to traditional courses and a way to facilitate obtaining a college degree. According to the Horizon Report (2017), online and blended learning have been positively accepted and used by learners and educators in higher education for the past few years. Kelly (2017) reports in Campus Technology that in 2016, approximately 71% of higher education faculty used technology and online contents in their teaching. Similarly, from a 13-year data study on online learning, Allen and Seaman (2017) reported that online learning has experienced a steady growth, with a 7% increase from 2012 to 2014. According to the report, in 2014, about 14% of all higher education students took only fully online courses, and another 14% took some of their courses in online settings with the majority of that population being undergraduate students (Allen & Seaman, 2017).

In the United States, mathematics courses are among the undergraduate courses that have found a place in online and hybrid learning environments. Undergraduate mathematics courses, such as college algebra, contemporary mathematics, and elementary statistics, are a few of the general education courses that all undergraduate students, regardless of their field of study, must complete in order to graduate. As a result, in recent years, more colleges have offered online and hybrid or blended mathematics courses to meet the demand. However, there is not as much research on online mathematics courses as there is research on courses in other areas, such as English and profession-specific careers, such as nursing.

Mathematics is not generally a favorable subject for many students, but lower level mathematics college courses, such as college algebra, are considered core courses in General Education and students pursuing higher education degrees must successfully complete the requirement of mathematics. Freshman level mathematics courses are taken by millions of undergraduate students each year (Gordon, 2008), but the low passing rates and high dropout rates have raised concerns among educators and researchers. Jaggars (2013) examined the outcomes of online learning in lower level math and English courses and reported, “Again, failure and withdrawal rates for online gatekeeper courses were substantially higher than those for face-to-face gatekeeper courses” (p. 2). Gordon (2008) and Ganter and Haver (2011) reported that overall, only about half of the students enrolled in college algebra successfully pass the course.

Need for the Study

The concerns and struggles students have in mathematics courses in hybrid and online environments have negative and financial effects on students. More importantly, they may cause students to dropout from college. The growth of online and blended learning in higher education, lower academic achievement in online courses, and students’ struggles with mathematics are factors that combined, pose a problem for online mathematics courses. Haynie (2014) reported that students’ major complaint about online math courses is the lack of teacher presence. Therefore, further research on undergraduate mathematics courses in fully online and hybrid courses is warranted to find ways to improve the learning environments of the courses, and increase student academic success rate. The results of this study will contribute to the body of knowledge regarding online and hybrid mathematics courses and student academic achievement.

Purpose of the Study

The purpose of this study is to investigate how mathematics student perceptions of teaching presence differ by course delivery mode and student achievement.

Research Questions

The purpose of this study, as previously stated, led to the development of the following research questions:

1. How do student perceptions of *teaching presence* differ in undergraduate fully online asynchronous and hybrid mathematics courses?
2. What is the relationship between *teaching presence* and *academic achievement* as measured by students' expected end-of-course grades in undergraduate fully online asynchronous and hybrid mathematics courses?
3. Which one of the *teaching presence* subscales: *instructional design and organization*, *facilitation*, and *direct instruction*, is the best predictor of *academic achievement* as measured by students' expected end-of-course grades in undergraduate fully online asynchronous and hybrid mathematics courses?

Definitions of Terms

For the purpose of this study, the following terms are operationally defined:

Teaching Presence. The term *teaching presence* is defined by Anderson, Rourke, Garrison, and Archer (2001) as: "The design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educational worthwhile learning outcome"

(p. 5). According to Anderson, et al. (2001), *teaching presence* has three areas: instructional design and organization, facilitation of discourse, and direct instruction.

Academic Achievement. For the purpose of this study, *academic achievement* is defined as a student's expected end-of-course grade. The grade that a student receives for the course, as recorded in the official transcript, is a weighted grade calculated from the results from assessments such as, homework, quizzes, labs, and tests. Thus, the course grade is not solely based on the final exam grade. A student's expected end-of-course grade is the course grade that a student expects to receive at the end of the semester, based on the student's grades on the assignments and assessments up to the time of participating in this research study.

Hybrid Course. The term *hybrid course* refers to a course that is a blend of face-to-face and online learning environments and activities. According to the definition provided by Texas Higher Education Coordinating Board (THECB), students and the instructor meet in a face-to-face setting, but between 50% and 85% of the course content and instruction time, such as presentations, lecture videos, online assignments, and discussion boards are available online in a learning management system such as Blackboard. Since hybrid courses are a blend of face-to-face and online teaching and learning activities, they are also referred to as blended courses. For the purpose of the study, these courses will be referred to as *hybrid courses*.

Online Course. For this study, the definition of *online course* as used by THECB is adopted. This term refers to a course that is delivered fully online, with all the instruction and assignments delivered and completed online. Online course may require some in-person sessions, such as orientation and tests, but that must not exceed 15% for the instructional time. Two types of online delivery are asynchronous and synchronous. An *asynchronous online course* refers to an online course which does not require any simultaneous online meetings between students and instructor. A *synchronous online course* is defined as an online course which has scheduled online live class sessions. This study focuses on asynchronous online courses.

Organization of the Dissertation

This dissertation contains five chapters. Chapter One includes an introduction of the topic, description of the need for the study, purpose of the study, research questions, definitions of terms, and organization of the dissertation. The second chapter provides a literature review. Chapter Three describes the methodology of the research study. It includes the research design, participants, setting, instrumentation, reliability and validity, data collection procedures, data analysis procedures, and limitations of the study. Chapter Four presents the results of the study. Chapter Five describes the conclusion, interpretations, and implications of the obtained results.

CHAPTER II

LITERATURE REVIEW

The world of technology is growing and has entered many fields, including education, and online learning is now everywhere (Kaser & Hauk, 2016; Palloff & Pratt, 2013). All the effort, research, debates, and reforms focused on online education is due to the benefit of providing access to quality education at all levels, including higher education, to many learners. According to O'Neil (2013), the U.S. government has proposed several acts that were designed to encourage colleges and schools to offer online courses of high quality and low tuition to the students in order to prepare them for a 21st century economy. Research confirms that online learning reaches a larger population who cannot pursue higher education in a traditional form, due to geographical location, lack of access to transportation, having physical disabilities, suffering from social anxiety or mental disorders, serving in the army, are caregivers to a family member, are co-parents or single parents, or simply those who prefer the convenience of learning at their own pace and from their own locations (Cercone, 2008; Crawford et al., 2014; Lim et al., 2014; Park & Choi, 2009; Rice, 2006; Ritt, 2008; Rose, 2014). In addition, the growth of online and hybrid courses provides the opportunity for adult learners to maintain their full-time jobs and support their families, yet having access to high quality higher education (Ashong & Commander, 2012; Huang, 2002). Therefore, developing quality online experience for the learners is important. This study is designed to contribute to the body of research in online education, and specifically in mathematics online learning.

The purpose of this study was to investigate how mathematics student perceptions of teaching presence differ by course delivery mode and student achievement. This chapter presents a review of literature concerning online learning and mathematics education, specifically: (1) the *Community of Inquiry Framework*; (2) online and hybrid undergraduate mathematics education; and a (3) summary.

Community of Inquiry Framework

With the birth and growth of distance learning, use of technology in higher education, and the increased access to education through online learning environments, the attention of educators and researchers has shifted to developing conceptual and theoretical frameworks to support quality design and delivery. Garrison, Anderson, and Archer (2000) were among the first researchers who found potential in "computer-mediated communication" (p. 87) for higher education. In doing so, they also acknowledged a gap in the body of research and knowledge in that field, stepped further in research and through a series of investigations laid out *Community of Inquiry framework* (CoI) as a conceptual framework for higher education in general, and examined it for education in online learning environment. They focused on how the essential elements presented in the framework can be employed and maintained in an online learning environment. To explain the framework, Garrison et al. (2000) introduced three overlapping and interrelated main elements: *cognitive presence, social presence,* and *teaching presence*. According to Garrison et al. (2000), knowledge and educational experience are constructed through the interaction of these three elements (See Figure 1 below).

Figure 2. 1. Community of Inquiry Framework. "Critical inquiry in a text-based environment: Computer conferencing in higher education model," by Garrison, Anderson, and Archer, 2000.

The *Community of Inquiry Framework* has its base in the constructivist theory of John Dewey (1933), and its requirement of social interactions are also supported by the social constructivist work of Vygotsky (1978) (Armellini & De Stefani, 2016; Garrison, 2007; Garrison & Arbaugh, 2007; Huang, 2002). Garrison and Arbaugh (2007) reported that this framework has increasingly become popular among researchers in online learning. Since its development, the *Community of Inquiry Framework* has been used in both the research and development of online and hybrid courses (Garrison, Cleveland-Innes, & Fung, 2010).

According to Garrison et al. (2000), in this framework each presence has its own importance and role and without one, learning does not take place, but *teaching presence* is considered the "binding element" (p. 96). Shea and Bidjerano (2009) confirmed that a relationship between the three elements of *Community of Inquiry* exists, so that in order to create *cognitive presence*, effective *teaching presence* and strong *social presence* are needed. In addition, a strong *social presence* in online learning environment cannot be achieved without effective *teaching presence* (Garrison et al., 2000). Interrelation of the three elements, and the cohesiveness role of teaching presence in the *Community of Inquiry* was further investigated by Garrison et al. (2010) and they confirmed that *teaching presence* influences *social presence*, and together, they have a significant impact on *cognitive presence.*

Teachers and learners were considered the main participants of an educational experience in the *Community of Inquiry* framework (Garrison et al. 2000). Shea and Bidjerano (2012) referred to *Aptitude-Treatment Interaction Framework* of Cronbach and Snow (1977) which suggested that a combination of teacher and learner characteristics enhances learning more than focusing on each one of the two in isolation. Out of several learner attributes, differences in self-regulated learning provided the most meaningful explanation of the instruction-learning relationship, therefore, learning presence was suggested as an added component of the *Community of Inquiry* framework (Shea & Bidjerano, 2012). Adding learning presence to the framework, put the learner at the center of the design and purpose of online and hybrid courses. Learner-centered teaching in online environment was also suggested by Kaser and Hauk (2016) who noted that a difference between traditional and online teaching was to move away from teacher-centered lectures and adapt the learner-centered teaching approaches. Such shift in teaching, focuses on how students learn and the ways that enhance in-depth learning so students retain and use the gained knowledge to receive more information (Weimer, 2002). Learner-centered teaching is aligned with Shea and Bidjerano's (2012) idea of self-regulation learning aspects of goal setting and executing plans to achieve them along with evaluating own's work and reflecting on it. This brings the two ideas of learner presence and learner-centered teaching together.

To better understand the *Community of Inquiry Framework,* a closer look at its three main elements: *social presence*, *cognitive presence*, and *teaching presence*, are presented here.

Social Presence

Social presence was originally defined as learners' ability to present themselves "socially and emotionally, as 'real' people" (Garrison et al., 2000, p. 94). The initial definition of *social presence* has since evolved to focus more on the ability of learners to identify with the learning environment, communicate with other participants, and build a relationship in order to form a learning community (Garrison, 2009).

When Garrison et al. (2000) introduced the *Community of Inquiry* framework, they referred to *social presence* as a "direct contributor" (p. 89) of success in learning with its main function defined as a support for the development of *cognitive presence*. The indicators of *social presence* in an educational experience are categorized as emotional expression, open communication, and group cohesion (Garrison et al., 2000; Garrison & Arbaugh, 2007). Such elements lead to building online learning communities and promoting a sense of belonging. *Social presence* is a vital element and a predecessor of the development of an online learning community (Palloff & Pratt, 2011). According to Brown (2001), a sense of belonging to a learning community begins with becoming acquainted with the environment and other participants, continues to feeling of being a part of the community, and progresses to the fellowship and camaraderie. In addition, according to Palloff and Pratt (2011), building a learning community for online learners allows them to develop a sense of belonging, which in return decreases the feeling of isolation and enhances learning.

Garrison and Arbaugh (2007) stated that in order to establish *social presence* in online learning environments, open communication develops trust and brings comfort to participants, which motivates them to form personal relationships and eventually evolve into academic fellowship and discussion. Through interaction, inquiry, and collaboration in online learning environment, educational goals can be achieved, meanings can be constructed, and that is the main purpose of *social presence* in an educational experience in an online environment (Garrison et al., 2000; Garrison & Arbaugh, 2007).

Cognitive Presence

Another element of the *Community of Inquiry*, is *cognitive presence*. According to Garrison et al. (2000), *cognitive presence* is considered the most essential factor of success and one of the primary goals of the higher education experience. To understand this element of the framework, Garrison et al. (2000) defined *cognitive presence* as learners' ability to construct meaning through inquiry, interaction and discussion, and reflection. The indicators of *cognitive presence* in a learning experience are categorized as: (1) triggering event, where an issue is identified for inquiry, (2) exploration, the stage where the issue is being explored, (3) integration, where meaning construction of the ideas developed during exploration takes place, and (4) resolution, which is the application stage of the new knowledge (Garrison et al., 2001; Garrison & Arbaugh, 2007).

While *social presence* establishes a learning community, its aspects of creating mutual responsibility, participation in activities, and working collaboratively toward a common goal encourage the development of *cognitive presence* (Palloff and Pratt, 2011). *Social presence* prepares the base for building higher order discourse and thinking, but the elements of *teaching presence* are crucial in developing *cognitive presence* (Garrison & Arbaugh, 2007). The learners' interactions with the environment and other members of the community are necessary to construct meaning in online learning environments. This involvement directly relies on how the course is designed and what learning activities the learners interact with, which is how *cognitive presence* is intertwined with *teaching presence* (Garrison, 2009; Shea & Bidjerano, 2009).

Teaching Presence

The element of *Community of Inquiry* that binds all the elements together is *teaching presence*, as its effectiveness enhances social and cognitive presences and create a successful learning experience (Garrison et al., 2000). Creating a strong *teaching presence* contributes to the development of *social presence* and *cognitive presence* (Armellini & De Stefani, 2016; Boettcher & Conrad, 2010; Ko & Rossen, 2010). Anderson, Rourke, Garrison, and Archer (2001) later defined *teaching presence* as: “The design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educational worthwhile learning outcome” (p. 5).

As a result, *teaching presence* is composed of three domains: (1) *instructional design and organization*, (2) *facilitation of discourse*, and (3) *direct instruction* (Anderson et al., 2001).

Instructional design and organization. The *instructional design and organization* component of *teaching presence* is described as the planning and designing of a clear, concise, and consistent structure of a course, and all the activities and assessments that promote interaction resulting in learning (Anderson et al., 2001; Garrison & Arbaugh, 2007). This domain of *teaching presence* is developed prior to the beginning of the semester and is exclusively executed by the instructor or collaboration of the instructor and the instructional designer (Boettcher & Conrad, 2010; Garrison & Arbaugh, 2007). The *instructional design and organization* of a course determines the course activities, through which student engagement and *social presence* takes shape. Consequently, this impacts construction of meaning and *cognitive presence* (Garrison & Arbaugh, 2007; Garrison et al., 2000; Garrison et al., 2010). Ralston-Berg, Buckenmeyer, Barczyk, and Hixon (2015) found that students perceived *instructional design and organization* of the online course as "essential" (p. 47) to students' success. Wojciechowski and Palmer (2005) examined different factors and student characteristics to find their relationships to academic success in online undergraduate business courses. A part of their findings showed that students' overall Grade Point Average (GPA) is highly correlated to academic success, followed by receiving an orientation to the online course. *Instructional design and organization* domain of *teaching presence* is where orientation, introductory videos, syllabus and how to navigate an online course are developed.

According to Boettcher and Conrad (2010), to compensate for the lack of physically meeting and immediately receiving instruction and guidance, an online instructor must dedicate a sufficient amount of time to designing the course, or serving as the content expert of an instructional design team, so that upon entering the online learning environment, the learners begin developing the sense of belonging. In addition to designing a course that is visually attractive and easy to navigate, *instructional design and organization* includes creating clear course expectations, learning activities, assessments, and policies, which according to Boettcher and Conrad (2010), are important elements of *instructional design and organization*.

Facilitation. The second domain of *teaching presence*, *facilitation of discourse*, is conceptualized as the means of student engagement and interaction to build on the knowledge and information that is presented in the course (Anderson et al., 2001). The instructor's role as a facilitator is to guide and move the discussions in the right direction, raise questions that engage students in a discussion, identify the areas of agreement and disagreement, comment on students' responses, and prevent activities and discussions that are unrelated to the topic or inappropriate (Anderson et al., 2001; Garrison & Arbaugh, 2007). The role of a facilitator is aligned with the constructivist ideas of Dewey (1933), suggesting that an instructor should be a guide and facilitator in order to give the learners an opportunity to learn from interaction with their environment.

According to Kaser and Hauk (2016), accepting the role of a facilitator is the shift from teacher-centered to learner-centered pedagogy that is required for an online environment. Becoming an online facilitator is not always an easy task for the instructors; as Hoyte (2010) describes it: "Online facilitation has its own unique rules, challenges, and rewards" (p. 49). Palloff and Pratt (2011) added that as a facilitator, an online instructor guides and allows learners to gain control over their own learning, by providing opportunities for students to collaborate with others and by engaging them in activities that promote and enhance learning. Through facilitation, *teaching presence* is established by acknowledging students' efforts, initiating the discussions, identifying agreements and disagreements to reach consensus, and monitoring the activities (Armellini & De Stefani, 2016; Boettcher & Conrad, 2010; Ko & Rossen, 2010; Palloff & Pratt, 2011). In addition, according to Kupczynski, Mundy, & Ruiz (2013), the facilitator role of an online instructor can be enhanced through cooperative learning activities, which can help strengthen social and cognitive presences. Hoyte (2010) suggested that continuing research in finding and creating methods for online facilitation is imperative in online learning research.

Direct instruction. *Direct instruction* is described as an instructor's sharing of knowledge and sources of information, checking for understanding, directing discussions, and providing explanatory feedback (Anderson et al., 2001; Garrison & Arbaugh, 2007). This element helps establish *teaching presence* through presenting the content, assessing students' understanding, providing feedback, and assisting students with better understanding of the content. According to research (Armellini & De Stefani, 2016; Boettcher & Conrad, 2010; Garrison & Arbaugh, 2007; Ko & Rossen, 2010), these aspects of *direct instruction* are applicable to all formats of course delivery (asynchronous, synchronous, and hybrid).

Shea, Li, and Pickett (2006) argued that the interactivity of the three domains is at the core of creating collaborative opportunities for learners. Online instructors have the responsibility of making their presence felt by the students by caring for their needs, promoting active learning that strengthens students' sense of belonging to the learning community, increasing the sense of connectedness and being supported by the instructor and their classmates, in order to significantly improve the strength and depth of learning outcome (Garrison & Arbaugh, 2007; Palloff & Pratt, 2011; Shea et al., 2006). *Teaching presence* is a key component of an online learning environment and its effect on student satisfaction, sense of belonging to an online learning community, and learning outcomes is evident in results of many research studies (Anderson et al., 2001; Atchely, Wingenbach, & Akers, 2013; Bush, Castelli, Lawrence, & Lawrence, 2010; Garrison & Arbaugh, 2007; Shea, Li, & Pickett, 2006).

Overall, *instructional design and organization* domain of *teaching presence* can only be effectively done if the online instructor is an expert in the content and has expertise in the *direct instruction* and delivery of the knowledge. Similarly, being a guide and *facilitator* cannot be fully achieved if the online instructor lacks enthusiasm, or does not establish and maintain a respectful and safe environment for all adult learners from a diverse cultural background. Focusing on the needs, specific characteristics, learning methods, and limitations of adult learners is important to this study because adult learners and nontraditional students are a part of the targeted population of the study and the implications and suggestions based on the result are made considering the needs of this group of learners. Wlodkowski (2008) categorized adult learners according to their age in three groups and described characteristics of mainly working adult (between 25 and 64 years old) as those who have responsibilities of jobs, families, and issue of a delay in pursuing higher education so that obtaining a college degree has extra challenges for them.

Developing a sense of belonging to an online learning community is essential to online leaning and higher-level thinking and learning are among the goals of online learning. The interactions, discussions, and opportunities for reflection that an online instructor establishes, helps develop the sense of belonging to an online learning community. According to Garrison et al. (2000), the importance of *teaching presence* is highlighted further when failure in learning in an online environment is connected to a lack of effective *teaching presence*. Achieving learning goals becomes difficult if *teaching presence* is not established or is not effectively carried out through the online learning experience (Garrison & Arbaugh, 2007). *Teaching presence* is shown to be a strong factor of student satisfaction and sustaining knowledge in online courses, such that, students who were satisfied with the course and learned knowledge, perceived *teaching presence* in higher level than those who were not satisfied with the course or the knowledge acquirement (Bush et al., 2010). The same study suggested that improving *teaching presence* in both online and hybrid courses may increase student satisfaction and therefore enhance learning experience. Hoyte (2010) described the learning environment and the role of the instructor: “Although online can provide a comfortable forum for adults to learn successfully without fear, much of the burden of this success lies with the faculty” (p. 49).

Shifting the focus to another important topic of this research study, next section discusses online and hybrid mathematics education in higher education.

Online and Hybrid Undergraduate Mathematics

Freshman level mathematics courses are taken by millions of undergraduate students each year (Gordon, 2008), but the low passing rates of those courses is a concern of educators and researchers, for example, Gordon (2008) and Ganter and Haver (2011) reported that overall, only about half of the students enrolled in college algebra successfully pass the course. In addition to not favoring math courses, according to Taylor (2008), students may have developed a general negative attitude towards mathematics based on previous experiences, may not be college ready for mathematics, or may suffer from math anxiety and low self-efficacy. Undergraduate mathematics courses are not limited to traditional delivery format, but online and hybrid math courses are offered by many higher education institutions.

The survey findings of the reports of Instructional Technology Council (2010) identified some science and technology courses, such as biology, mathematics, and those requiring hands-on practices as the most challenging courses to offer online. According to Davis (2016), although online learning has been growing and many courses in higher education are offered either in fully online or hybrid formats, research on mathematics online learning is very limited. The complexity of issues related to math learning and the challenges associated with online learning environments often times result in low performance and high attrition rate of students. Although specific research regarding student academic achievement in undergraduate online mathematics learning was not found, research studies in science and quantitative-based online courses were considered. In a study comparing student academic success rates in face-to-face versus online undergraduate biology courses, Garman (2012) found that academic success rate for online students was lower than face-to-face. Guirdy (2013) sought to find the best predictors of student success in online and face-to-face quantitative-based courses. Gathering data from 176 face-to-face students and 128 online students enrolled in a finance course, with prerequisite of statistics course, it was reported that for online students, ACT math scores were the best predictor of academic success in the quantitative course. The number of withdrawals was inversely related to academic success of face-to-face students in the course. The results of Guirdy's study (2013) were supported by other research confirming that "students in online versions do not perform as well as those enrolled in the lecture class of quantitatively oriented material" (p. 7).

In general, issues of low achievement rates and lower course completion in online education compared to face-to-face courses have been concerning (Atchely, Wingenbach, & Akers, 2013; Park & Choi, 2009). Since math students have additional struggles, such as math anxiety (Bessant, 1995), online mathematics students may need extra attention, support, or special design and course delivery methods. According to the *Rovai's Composite Persistence Model* (2003), successful online learners are highly disciplined, motivated, and self-directed. Clearly, not all adult learners in online courses possess these characteristics, which may be the reason for failure and dropout in online learning (Park, 2007). Park and Choi (2009) confirmed that to be successful in online learning, adult learners need special support, relevance, and connection to the content and life experiences in order to complete their online courses. Therefore, there are some of learning strategies that directly affect students' success in online math courses (Wadsworth, Husman, Duggan, & Pennington, 2007). Wadsworth et al. (2007) explained that *direct instruction*, one of the three categories of *teaching presence* in online teaching, could affect learning strategies, thus supporting additional research on *teaching presence* in online mathematics courses.

Summary

This chapter presented the review of literature on the *Community of Inquiry Framework*, mathematics education, and online and hybrid mathematics education. The next chapter will present the methodology of this study.

CHAPTER III

METHODOLOGY

The purpose of this study was to investigate how mathematics student perceptions of teaching presence differ by course delivery mode and student achievement. The following research questions were addressed:

1. How do student perceptions of *teaching presence* differ in undergraduate fully online asynchronous and hybrid mathematics courses?
2. What is the relationship between *teaching presence* and academic achievement as measured by students' expected end-of-course grades in undergraduate fully online asynchronous and hybrid math courses?
3. Which one of the *teaching presence* subscales: *instructional design and organization*, *facilitation*, and *direct instruction*, is the best predictor of academic achievement as measured by students' expected end-of-course grades in undergraduate fully online asynchronous and hybrid mathematics courses?

In this chapter, the methodology used to conduct the study is described in the following sections: (1) Research Design, (2) Setting, (3) Participants, (4) Instrumentation, (5) Data Collection, (6) Validity and Reliability, and (7) Data Analysis.

Research Design

To address the research questions, a quantitative design utilizing inferential and correlational techniques were used. The variables were measured using instruments and statistical procedures were employed to analyze the numbered data, therefore, a quantitative design was appropriate (Creswell, 2014). In addition, according to Gay, Mills, and Airasian (2012), in quantitative research “noninteractive instruments” (p. 7) are used, and none of the data for this research study required interaction between the researcher and the participants.

The first research question was designed to compare perceptions of two groups of mathematics students regarding teaching presence. The two groups of students differed in the type of course they are enrolled in (fully online asynchronous or hybrid). The independent variable was the type of course delivery (fully online asynchronous versus hybrid), and the dependent variable was mathematics students’ teaching presence scores as measured by *Teaching Presence Scale* (Shea, Li, & Pickett, 2006).

The second research question was designed to determine if a relationship existed between mathematics students’ perceptions of teaching presence and academic achievement as measured by students’ expected end-of-course grades in undergraduate fully online asynchronous mathematics courses and hybrid mathematics courses. The independent variable was the mathematics students’ teaching presence scores as measured by *Teaching Presence Scale* (Shea et al., 2006), and the dependent variable was students’ academic achievement, as measured by expected end-of-course grades. In order to determine the strength and direction of this relationship, a correlational research design was used. A correlational study is used when the purpose is to determine whether a relationship exists among variables, and if it does, determine the degree and strength of the relationship, and furthermore, to be able to make predictions based on the relations (Bordens & Abbott, 2010; Creswell, 2014; Gay, Mills, & Airasian, 2012; Leedy & Ormrod, 2013).

The third research question was designed to find the best predictor of students' academic achievement, as measured by expected end-of-course grades, among the three subscales of teaching presence from the as measured by *Teaching Presence Scale* (Shea, et al., 2006): (1) *instructional design and organization*, (2) *facilitation*, and (3) *direct instruction*. For this question, the predictor (independent) variable were the three subscales of teaching presence and the criterion (dependent) variable was students' academic achievement, as measured by expected end-of-course grades.

Setting

This research study took place in a university located in South Texas with two main campuses. According to the data found in 2016 United States Census Bureau, one of the cities where the university campus is located at has an estimated population of 183,000. Over 93% of the population were of Hispanic or Latino ethnicity. The median household income was $34,255, with over 32.8% of the population living in poverty. The data shows that 63.8% of the population over the age of 25 has graduated from high school or a higher institution. The second campus of this university is about 60 miles away from the first city.

Data from 2016 United States Census Bureau indicates that the second city with the other university campus has an estimated population of 87,000, of which 88.2% were reported to be Hispanic or Latino. The median household income is $43,760, with 26.6% of the people living in poverty. The data also shows that 77.3% of the population over the age of 25 has graduated from high school or a higher institution. Students may take all their classes in one semester in one of the two campuses, or travel between the two campuses using the university shuttles or personal transportation.

Participants

The participants of the study were drawn from a population of 475 undergraduate students enrolled in fully online asynchronous or hybrid higher education mathematics courses in College Algebra, Math for Liberal Arts, or Elementary Statistics Methods. Students' enrollment in online or hybrid sections was by students' choice or by the availability of the sections. Although the aforementioned courses are lower level university mathematics courses, they are a part of a general education core of courses and students may enroll in them at any point of their academic study, as a freshman, sophomore, junior, or senior.

Based on the latest available statistics, the total enrollment at the university was 27,560, with undergraduate students composing 89% of the population. The average age of undergraduate students was 22.

The participants of this study were asked about their age in the following format: Under 25; Between 26 and 30; Between 31 and 35; Between 36 and 40; and 41 or older. The age distribution of the participants from the fully online asynchronous students is shown in Figure 3.1 below and from the hybrid mathematics courses in shown in Figure 3.2 below.

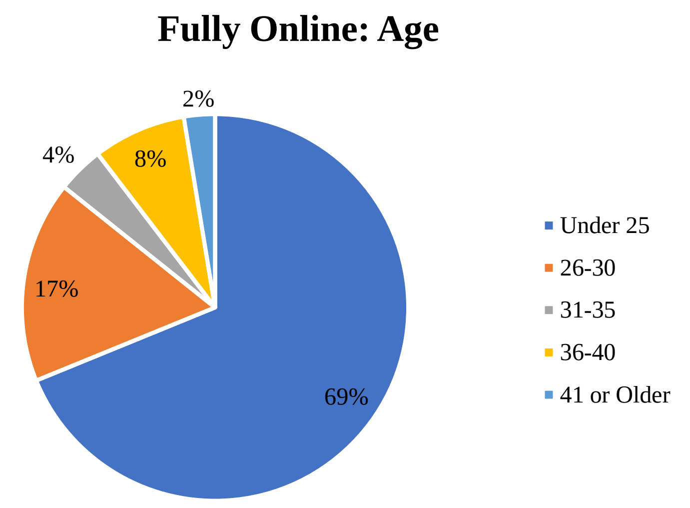

Figure 3. 1. Age distribution for fully online participants

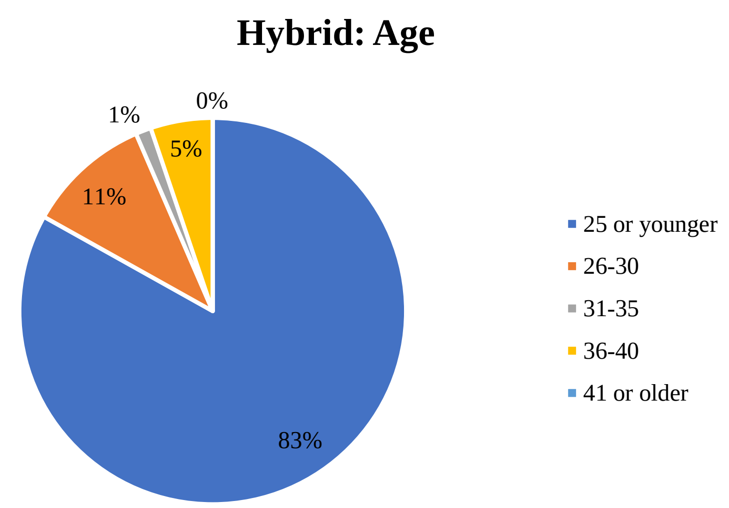

Figure 3. 2. Age distribution for hybrid participants

Participants answered a question about their gender (male or female). Results are shown in Figure 3.3 and 3.4 below for fully online asynchronous and hybrid students, respectively.

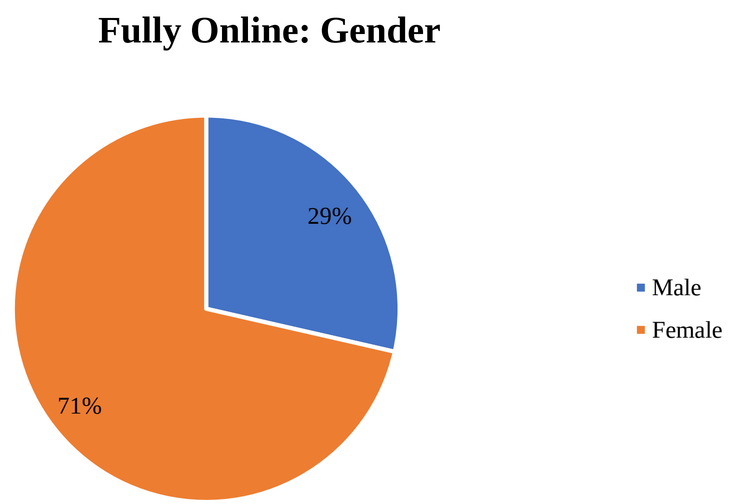

Figure 3. 3. Gender of fully online participants

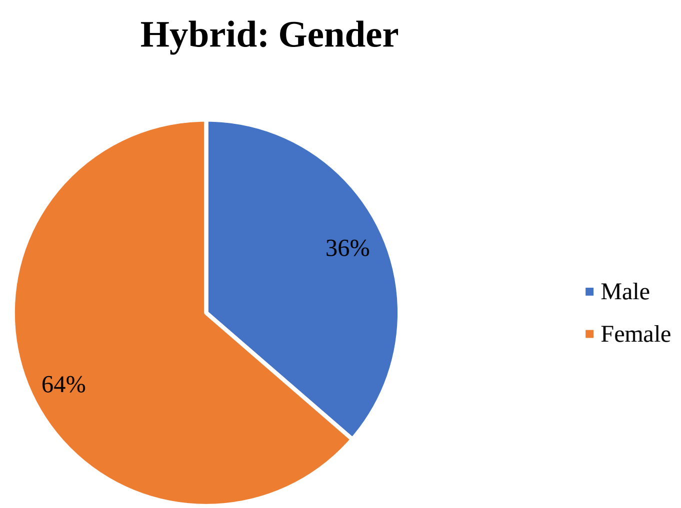

Figure 3. 4. Gender of hybrid participants

Participants' employment status was questioned with answer choices of: Full-time; Part-time; and Unemployed. Figures 3.5 and 3.6 below present the status for fully online asynchronous and hybrid mathematics students, respectively. The results show that 66% of fully online students and 55% of hybrid students were either full-time or part-time employees.

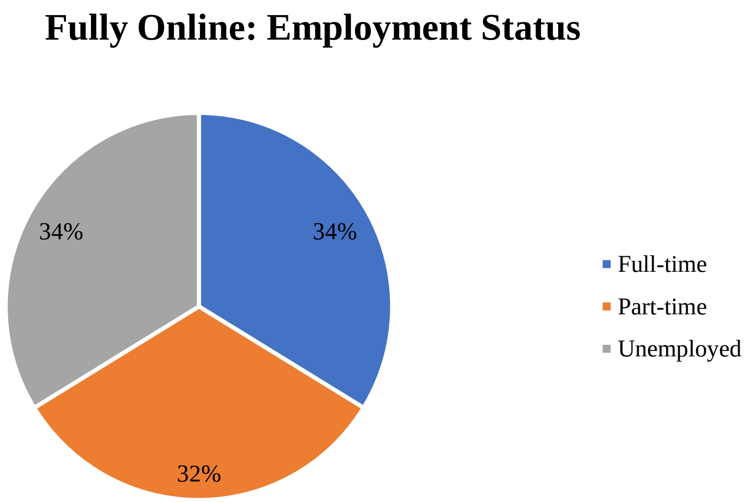

Figure 3. 5. Employment status of fully online participants

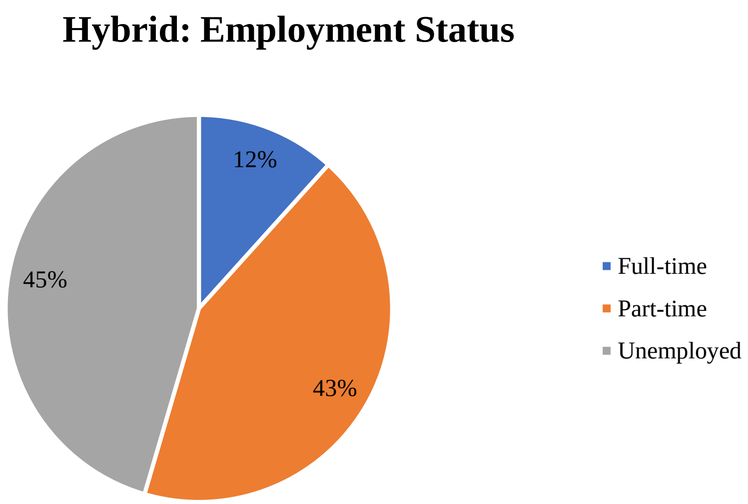

Figure 3. 6. Employment status of hybrid participants

Instrumentation

Two instruments were used to collect data for this study: (1) *Teaching Presence Scale*, (2) *Expected End-of-Course Grades*. The instruments are described below.

Teaching Presence Scale

The *Teaching Presence Scale (TPS)*, developed by Shea, Li, and Pickett (2006), was used to collect mathematics students' perceptions of the teaching presence of their fully online asynchronous and hybrid instructors. The *Teaching Presence Scale* (Shea et al., 2006) consists of 3 subscales that address the three domains of teaching presence, developed by Garrison et al. (2000): (a) *instructional design and organization,* (b) *facilitation,* and (c) *direct instruction*. Each subscale was rated using a six-point Likert-type rating ranging from one to six: *I choose not to answer this question (1), Strongly Disagree (2), Disagree (3), Neutral (4), Agree (5), and Strongly Agree (6)*. By finding the sum of the scores from the three subsections, a single score ranging from six to 102 was obtained from each participant. A higher score indicated a higher student perception of the instructor's teaching presence in the corresponding fully online asynchronous or hybrid mathematics course.

The *Instructional Design and Organization subscale* (Shea et al., 2006) has six items, that collect data regarding student perception of how clearly the instructor: (1) communicated course goals; (2) communicated course topics; (3) guided students on how to participate in online activities of the course; (4) communicated due dates; (5) provided guidance on how to utilize the course online environment; and (6) defined acceptable online learning behavior (Shea et al., 2006). The scores for this subscale range from six to 36.

The *Facilitation subscale* consists of six items, that collects student perception of how the instructor of the course: (1) successfully identified points of agreement or disagreement in discussions; (2) guided the students to understand the course topics; (3) acknowledged students' participation in a positive manner; (4) encouraged the students to explore new topics; (5)

engaged the students in course discussion and activities; and (6) kept the students on task (Shea et al., 2006). The scores of the *Facilitation subscale* range from six to 36.

The *Direct Instruction subscale* consists of five items, that collects student perception of how the instructor: (1) presented the content; (2) kept the discussions over the relevant issues; (3) provided explanatory feedback; (4) helped students revise their thinking; and (5) provided a variety of sources of information. The scores for this subscale range from six to 30.

Expected End-of-Course Grades

Student mathematics academic achievement was measured by using the student-reported expected end-of-course grades of the fully online asynchronous and hybrid courses: College Algebra, Math for Liberal Arts, and Elementary Statistical Methods. Syllabus of each course showed that students were assessed throughout the semester through online homework assignments, online quizzes, midterm or chapter tests, and then at the end of the semester through a final exam. The syllabi reviewed for mathematics courses identified for this study indicated a weighted grading system, where final exam weights ranged between 15% to 25% of the course grade. Therefore, the course grade did not depend solely on the final exam. The data for this study were collected in the last few weeks of the semester. At the time of data collection, all the students' grades for the completed assignments, quizzes, and tests for the identified mathematics courses for this study were posted online in the learning management system gradebook. Students had access to their gradebooks and their current updated grades based on the weight distribution described in the syllabus of each of the identified mathematics courses for this study. Therefore, students were able to have a good estimation of their end-of-course grades. Based on those estimated grades, students reported their expected-end-of-course grades in letter form, A (90-100), B (80-89.9), C (70-79.9), D (60-69.9), or F (below 60).

The survey used for data collection was online and began with a welcome message, describing the purpose of the study, the time needed to complete the survey, the voluntary-based participation, and the researcher's name and contact information. Students who chose to participate in the study, chose the option of "I agree" and were directed to the next page. Students who chose not to participate, selected the option of "I do not agree" and were directed to a "thank you" page. Upon selecting the option of "I agree", the next page contained questions about the participants': (1) age; (2) gender; (3) employment status; (4) delivery mode of the mathematics course they were enrolled in (fully online asynchronous or hybrid); (5) whether they planned to complete the course; and (7) end-of-course grades to the best of their knowledge. After this portion, students were directed to the next page where the 17 questions of the *Teaching Presence Scale* (Shea et al., 2006) were listed. After answering the last question, participants were directed to a page where they received a message that their participation was appreciated.

From this point on in this research study, the "survey" refers to the survey described above, with the demographic questions preceding the *Teaching Presence Scale* (Shea et al.,2006).

Data Collection

Data collection for this study was during spring 2018 semester. All the undergraduate students enrolled in the sections of fully online asynchronous and hybrid courses of College Algebra, Math for Liberal Arts, and Elementary Statistics Methods were invited to participate in the study. After obtaining the letter of support from the Director of School of Mathematical and Statistical Sciences (SMSS), the researcher contacted the instructors of the identified mathematics courses by email. The instructors were informed about the research study, its purpose, the support of the Director of SMSS, and the Institutional Review Board (IRB) approval to proceed with the data collection. The researcher asked the instructors to assist the data collection process by posting the invitation to participate message and the link to the survey on the learning management system message board for all the students in the mathematics courses identified for this study in fully online asynchronous and hybrid courses. With the support of the Director of SMSS and IRB approval, the researcher also asked the instructors to provide their end-of-course de-identified grade books for comparison with students' expected grades and for future studies.

The invitation message informed the students about the purpose of the study and the length of time required to complete the survey. They were also informed that participation was voluntary and they could opt out at any time without any consequences. Choosing not to participate had no negative effect on students' grades or academic standing in the class. To avoid coercion, no incentives were offered, such as a gift card or extra credit. Based on the recommendations of Gay et al., (2012), the answers to the survey were submitted anonymously, the end-of-course grades were collected without any student names or other identifiers, as they had been de-identified by the course instructor before they were shared with the researcher. All data have been secured in a file on the researcher's computer and protected by a passcode.

A total of 327 students responded to the *Teaching Presence Scale* (Shea et al., 2006). After removing the incomplete responses from the data collected, there were 77 student responses from students enrolled in the fully online asynchronous mathematics courses and 245 from hybrid mathematics courses. A random sample of 77 was taken from the student responses of hybrid mathematics courses in order to have equal number of data from both types of course delivery modes.

Mathematics Courses

The mathematics courses of College Algebra, Math for Liberal Arts, and Elementary Statistical Methods were available for undergraduate students at the university in face-to-face, fully online asynchronous, and hybrid modes, but for the purpose of this study, only fully online asynchronous and hybrid mathematics courses were included in the data collection. Table 3.1 below shows a breakdown of enrollment of the courses in spring 2018, the semester that data were collected for this study.

Table 3. 1

Spring 2018 Enrollment in Fully Online Asynchronous and Hybrid Mathematics Courses

Undergraduate Math Course	Fully Online Asynchronous	Hybrid
College Algebra	107	173
Math for Liberal Arts	33	17
Elementary Statistics Methods	113	285
Total	253	475

Validity and Reliability

According to Gay et al. (2012) and Leedy and Ormrod (2013), validity of an instrument refers to the extent that the instrument accurately measures the variable, reliability of the instrument refers to consistency of results from using an instrument.

The *Teaching Presence Scale (TPS)* (Shea et al., 2006) measures all three domains of teaching presence as presented in the *Community of Inquiry* framework (Garrison et al., 2000). For the *Instructional Design and Organization* subsection of *Teaching Presence Scale* (TPS), the items addressed setting the curriculum, designing methods, time, utilization of the medium, and establishing netiquette; the *Facilitating Discourse* subsection sought to get students perceptions in the areas such as whether the instructor created a learning environment, effectively reinforced students' participation and contributions, identified points of agreement and disagreement and sought to reach consensus; the *Direct Instruction* section consisted of items that measured whether the instructor presented content, focused the discussion on specific points, confirmed student understanding of the content, clarified any misunderstanding, and presented knowledge from different resources (Shea et al., 2006, Appendix A). The detailed questions regarding three domains of teaching presence are highly consistent with the definition of teaching presence by Anderson et al. (2001).

According to Shea et al. (2006), a reliability analysis was applied and determined the internal consistency of the scale, with reported Cronbach's Alpha .98 for teaching presence scale, .97 for the component of instructional design and organization, and .93 for combined directed facilitation.

Data Analysis

To address the research questions, data collected data from the survey, including the students' reported *expected end-of-course grades* and students' perception scores from the *Teaching Presence Scale* (Shea et al., 2006), were analyzed. Students' responses to the *Teaching Presence Scale* in each of the fully online asynchronous and hybrid mathematics courses of College Algebra, Math for Liberal Arts, and Elementary Statistics Methods were converted from the 6-point Likert scale to assigned scores ranging from 17 to 102.

Participants reported their *expected end-of-course grades* based on their academic standing in the course by the time the data were collected for this study, which was the last four weeks of the 15-week semester. Each course used a point system of a percentage, but all course grades were determined with a weighted scale. Students reported their *expected end-of-course* *grades* from an updated online gradebook after completion of the majority of their online homework, online quizzes, chapter tests or midterm, other activities and projects, and were pending on only a few more online homework assignments and quizzes, and the final exam. Therefore, their *expected end-of-course grades* did not greatly differ from the actual *end-of-course grades*.

The collected data were analyzed using: (1) t-test to compare the mean scores of student perception of the teaching presence between fully online asynchronous and hybrid mathematics students; (2) bivariate analysis using the Pearson product-moment correlation to determine the strength and direction of the relationship between teaching presence and students' *expected end-of-course grades* in fully online asynchronous and hybrid undergraduate mathematics courses; and (3) multivariate analysis using multiple regression to determine the best predictor of students' *expected end-of-course grades* among the three subscales of *teaching presence*: (1) *Instructional Design and Organization*, (2) *Facilitation*, and (3) *Direct Instruction*, in both fully online asynchronous mathematics courses and hybrid mathematics courses.

Summary

In this chapter the setting and participants of the present study were described. The demographic information, age, gender, and employment status, were shown in Figures 3.1 to 3.6. Instruments, methods of data collection, and procedures for data analyses were also explained. In the next chapter, the results of data analyses are presented.

CHAPTER IV

RESULTS

The purpose of this study was to investigate how mathematics student perceptions of teaching presence differ by course delivery mode and student achievement. In order to achieve this purpose, research questions were developed and tested. Bivariate correlational procedure and multiple regression, as described in Chapter Three, were applied to the research questions and collected data were analyzed. In this chapter, the results obtained from the data analysis are presented.

Results Obtained for Research Question One

Research Question One was to determine if the student perceptions of teaching presence differ in undergraduate fully online asynchronous and hybrid math courses. An independent t-test was applied to the dependent variable, that was the total score of student perceptions of teaching presence obtained from the *Teaching Presence Scale* (Shea et al., 2006) in two groups with respect to the course delivery mode and learning environment: fully online asynchronous and hybrid. The scores were collected from 77 fully online and 77 hybrid student responses, with highest possible score of 102.

Table 4.1 below shows the mean scores and standard deviation obtained from the independent t-test on the total scores of student perception of teaching presence. The mean scores ranged between 17 and 102. The mean scores were converted into percentage, as also shown in Table 4.1. Table 4.2 below depicts the results of Leven’s test for equality of variances and Table 4.3 shows the results of the t-test for equality of means with 95% confidence interval. Figure 4.1 below depicts the results of the mean scores converted to percentage, that are shown in Table 1, in a bar graph for fully online asynchronous and hybrid mathematics courses.

Table 4. 1

Student Perception of Teaching Presence

	N	Means	Standard Deviation
Fully Online Asynchronous	77	77.5844 (76.06%)	14.3374
Hybrid	77	87.3896 (85.68%)	12.3279

Table 4. 2

Levene's Test for Equality of Variances

	F	Significance
Equal variances assumed	4.099	.05

Table 4. 3

t-test for Equality of Means

t-test for Equality of Means					
				95% Confidence Interval of the Difference	
	df	Significance (2-tailed)	Mean Difference	Lower	Upper
Equal Variances Assumed	152	.000	-9.80519	-14.06252	-5.54787
Equal Variances Not Assumed	148.661	.000	-9.80519	-14.06328	-5.54711

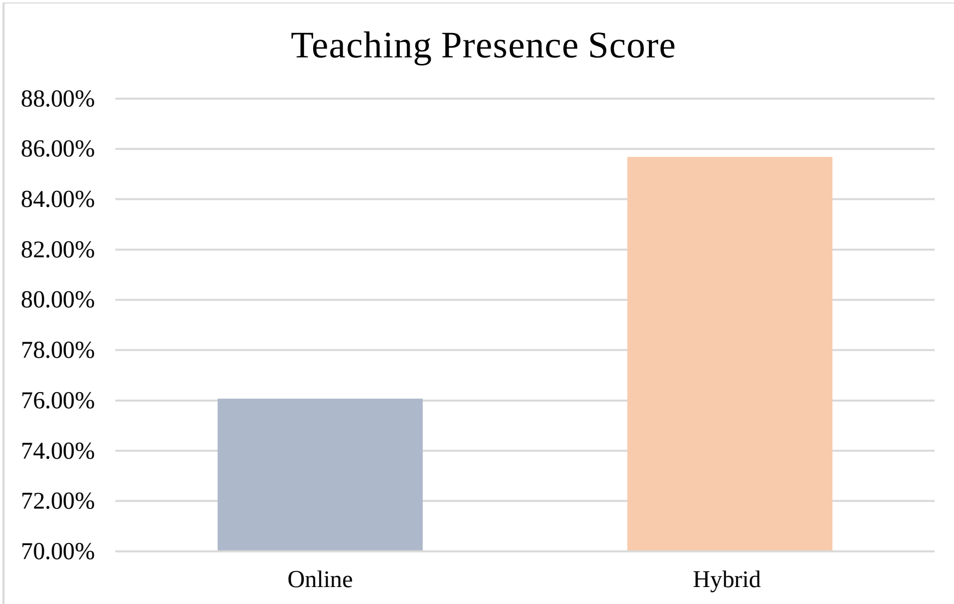

Figure 4. 1. Bar graph of the mean scores (percentage) of student perceptions of the teaching presence in both modes of delivery.

Results Obtained for Research Question Two

Research Question Two intended to determine the existence, strength, and direction of the relationship between teaching presence and academic achievement, as measured by students' expected grades, in undergraduate fully online asynchronous and hybrid mathematics courses. The participants reported their expected end-of-course grades in letter form: A, B, C, D, or F, as this is the university's grade reporting system. For the purpose of data analysis, the letter grades were converted into the following numeric scale: A = 5, B = 4, C = 3, D = 2, and F = 1. The data for student perception of teaching presence and student expected end-of-course grades were analyzed using the Pearson Product-Moment Correlation Method. Table 4.4 below shows the results of the analysis for fully online asynchronous students and Table 4.5 below presents the results for hybrid students. Figure 4.2 illustrates the scatterplot of teaching presence score versus expected end-of-course grades from student responses in fully online asynchronous mathematics courses. Figure 4.3 shows the scatterplot from data collected from students in hybrid mathematics courses.

Table 4. 4

Correlation Coefficient for Student Perceptions of Teaching Presence and Academic Achievement in Fully Online Mathematics Courses (N=77)

Means and Standard Deviations		
Variable	M	SD
Expected Course Grade	3.25	1.183
Teaching Presence Score	77.5844	14.3374
Correlation Coefficient		
	r	p
Expected Course Grade vs. Teaching Presence Score	.612	< .01

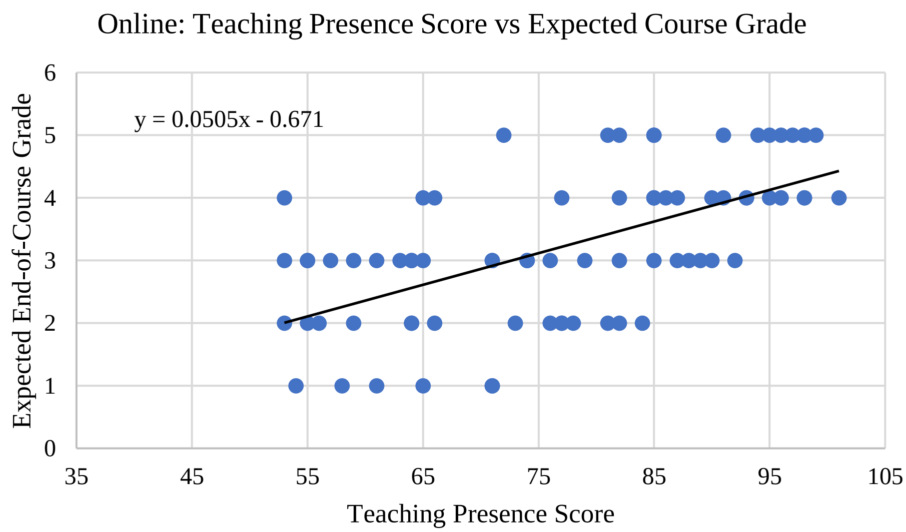

Figure 4. 2. Scatterplot of the relationship between teaching presence score and student expected end-of-course grades in fully online asynchronous mathematics courses.

Table 4. 5

Correlation Coefficient for Student Perceptions of Teaching Presence and Academic Achievement in Hybrid Mathematics Courses (N=77)

	Means and Standard Deviations	
Variable	M	SD
Expected Course Grade	3.71	.916
Teaching Presence Score	87.3896	12.3279
	Correlation Coefficient	
	r	p
Expected Course Grade vs. Teaching Presence Score	.387	< .01

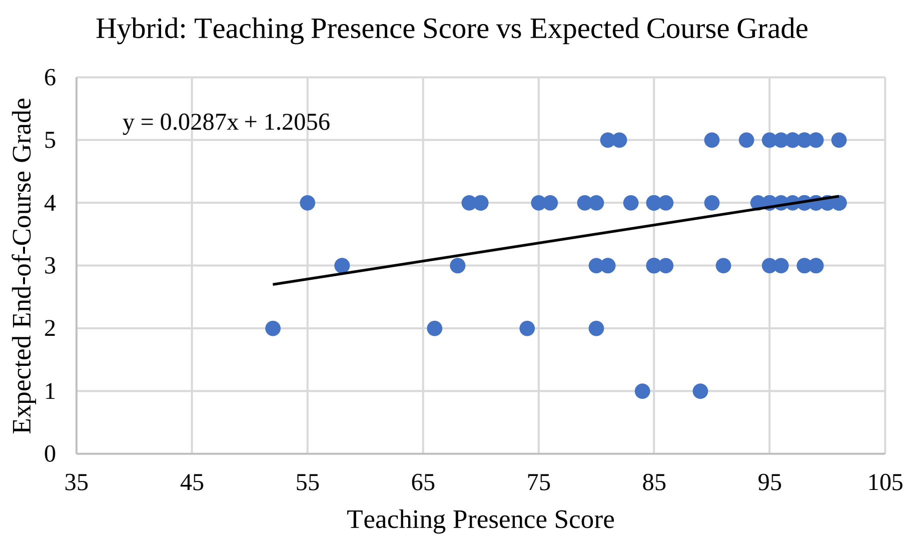

Figure 4. 3. Scatterplot of the relationship between teaching presence score and student expected end-of-course grades in hybrid mathematics courses.

The results of the analysis show that there is a statistically significant positive relationship between teaching presence and academic achievement, as measured by student expected course grades, in fully online asynchronous courses, $r = .612, p < .01$, and in hybrid courses, $r = .387, p < .01$.

Results Obtained for Research Question Three

Research Question Three was intended to determine which one of the teaching presence subscales: *instructional design and organization*, *facilitation,* and *direct instruction*, is the best predictor of academic achievement, as measured by students' *expected end-of-course grades*, in undergraduate fully online asynchronous and hybrid mathematics courses. A multivariate analysis using multiple regression technique was used to analyze the data. Table 4.6 below shows the descriptive statistics and the results of the Pearson Product-Moment Correlation between the student perception scores of the three subscales of *teaching presence* and *academic achievement*, as measured by *expected end-of-course grades*, for fully online asynchronous mathematics courses. Similarly, Table 4.7 below demonstrates the results of the Pearson Product-Moment Correlation between the student perception scores of the three subscales of *teaching presence* and *academic achievement*, as measured by students' expected end-of-course grades, for hybrid mathematics courses. The highest possible score for two of the subscales, *instructional design and organization* and *facilitation*, was 36, and for the third subscale, *direct instruction*, was 30. To demonstrate the mean scores in the same scale, they were converted to percentage and illustrated in Figure 4.4 below, for fully online asynchronous mathematics courses and in Figure 4.5 below, for hybrid mathematics courses. Figure 4.6 below displays a side-by-side comparison of mean scores (in percentage) of student perception of the three subscales of *teaching presence* for fully online asynchronous mathematics courses and hybrid mathematics courses.

Table 4. 6

Relationship Between Student Perceptions of Teaching Presence Subscales and Academic Achievement in Fully Online Mathematics Courses (N=77)

	Descriptive Statistics		Correlations	
	Mean	Standard Deviation	Pearson Correlation Coefficient	Significance
Instructional Design and Organization	29.03 (81.39%)	4.47	.591	.000
Facilitation	25.96 (72.11%)	6.14	.661	.000
Direct Instruction	22.60 (75.33%)	4.93	.421	.000

*Note: Correlation is significant at the .01 level (2-tailed).

Table 4. 7

Relationship Between Student Perceptions of Teaching Presence Subscales and Academic Achievement in Hybrid Mathematics Courses (N=77)

	Descriptive Statistics		Correlations	
	Mean	Standard Deviation	Pearson Correlation Coefficient	Significance
Instructional Design and Organization	31.14 (86.5%)	4.13	.404	.000
Facilitation	30.66 (85.17%)	4.52	.386	.001
Direct Instruction	25.58 (85.27%)	4.15	.325	.004

*Note: Correlation is significant at the .01 level (2-tailed).

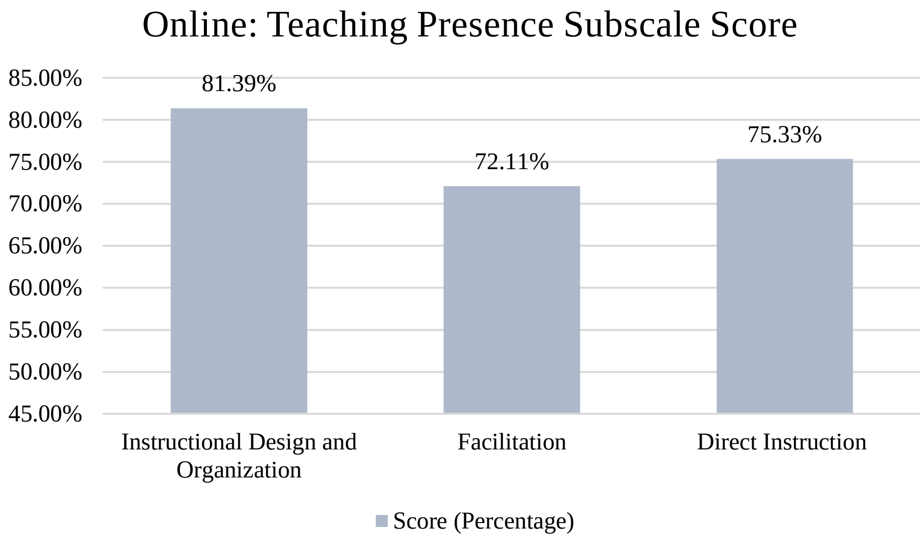

Figure 4. 4. The mean scores (in percentage) of student perceptions of the three subscales of teaching presence for fully online asynchronous mathematics courses.

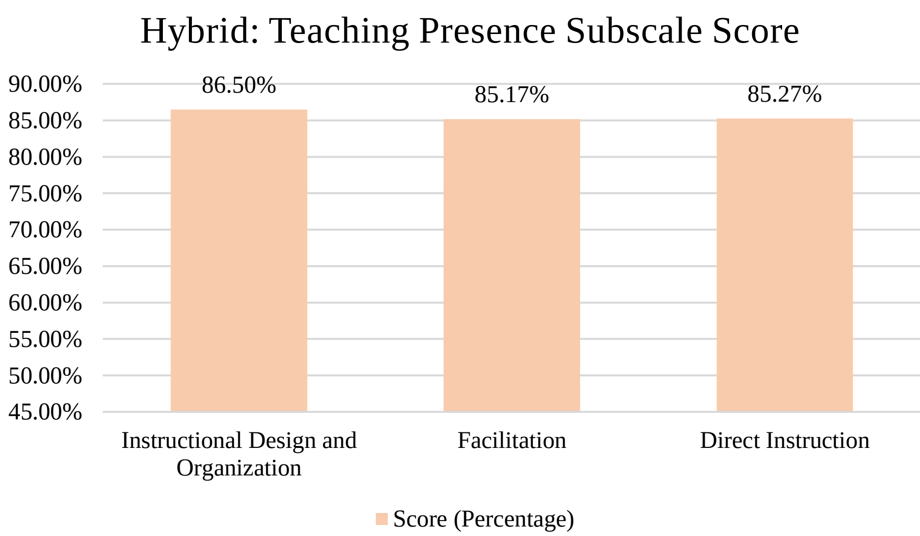

Figure 4. 5. The mean scores (in percentage) of student perceptions of the three subscales of teaching presence for hybrid mathematics courses.

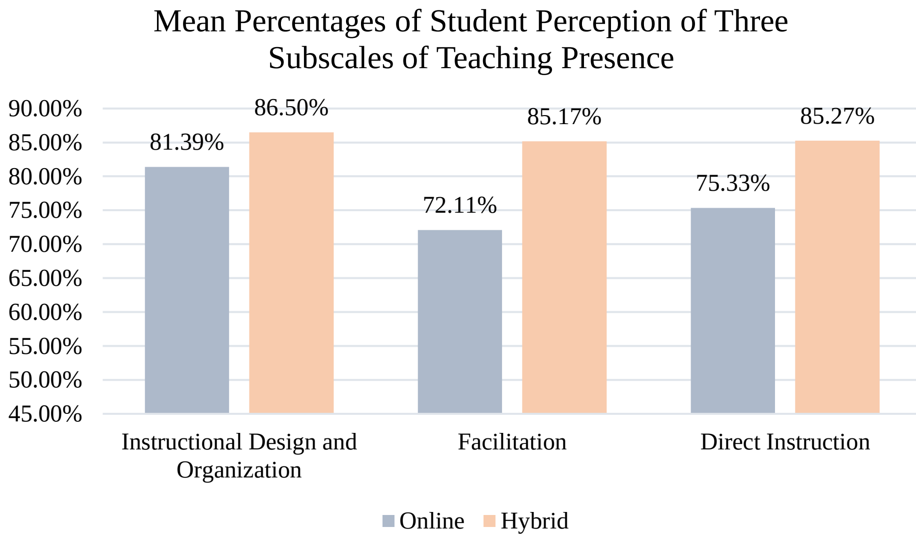

Figure 4. 6. Side-by-side demonstration of the mean scores (in percentage) of student perception of the three subscales of teaching presence for fully online asynchronous and hybrid mathematics courses.

The results of the mean scores of student perceptions of the three subscales of *teaching presence* show that students in fully online asynchronous mathematics courses scored *instructional design and organization* the highest ($M = 81.39\%, SD = 4.47$), followed by *direct instruction* ($M = 75.33\%, SD = 4.93$), and lowest for *facilitation* ($M = 72.11\%, SD = 6.14$). The results also indicate that there is a statistically significant positive relationship between students expected end-of-course grades and student perception of each subscale of teaching presence as: *instructional design and organization*, $r = .591, p < .01$, *facilitation*, $r = .661, p < .01$, and *direct instruction*, $r = .421, p < .01$.

Similarly, the results of the mean scores of student perceptions of the three subscales of *teaching presence* show that students in hybrid mathematics courses also scored *instructional design and organization* the highest ($M = 86.5\%, SD = 4.13$), followed by *direct instruction* ($M = 85.27\%, SD = 4.15$), and very closely followed by *facilitation* ($M = 85.17\%, SD =$

4.52). The results of the Pearson Product-Moment Correlation indicate that there is a statistically significant positive relationship between students' expected end-of-course grades and *instructional design and organization*, $r = .404, p < .01$, *facilitation*, $r = .386, p < .01$, and *direct instruction*, $r = .325, p < .01$.

In addition to the results of the statistical analyses described above, a multivariate analysis was employed to find the best predictor of *academic achievement*, measured by students' *expected end-of-course grades,* among the three subscales of *teaching presence*: *instructional design and organization*, *facilitation,* and *direct instruction*. Table 4.8 below presents the results of the data analyses using a multiple linear regression technique for fully online asynchronous mathematics courses, and Table 4.9 below illustrates the results of the analyses for hybrid mathematics courses.

Table 4. 8

Subscales of Teaching Presence as Predictors of Academic Achievement in Fully Online Asynchronous Mathematics Courses

Multiple R: .708	R^2: .501	Adjusted R^2: .481	Std. Error of Estimate: .501		
Variable	B	Std. Error B	Beta	t	Sig.
Constant	-.712	.656		-1.086	.281
Instructional Design and Organization	.085	.037	.321	2.299	.024
Facilitation	.138	.029	.718	4.699	.000
Direct Instruction	-.093	.035	-.387	-2.692	.009

Analysis of Variance

	Sum of Squares	df	Mean Square	F Ratio	Sig.
Regression	53.293	3	17.764	24.460	.000
Residual	53.018	73	.726		

As shown in Table 4.8, the analysis yielded a multiple correlation coefficient ($R = .708$) and a coefficient of determination ($R^2 = .501$), with an F ratio ($F = 24.460$), which is statistically significant ($p < .01$) for the predictor variables combined.

Table 4. 9

Subscales of Teaching Presence as Predictors of Academic Achievement in Hybrid Mathematics Courses

Multiple R: .420	R^2: .176	Adjusted R^2: .142	Std. Error of Estimate: .848		
Variable	**B**	**Std. Error B**	**Beta**	**t**	**Sig.**
Constant	.825	.747		1.104	.273
Instructional Design and Organization	.087	.059	.395	1.490	.141
Facilitation	.051	.056	.251	.904	.369
Direct Instruction	-.054	.056	-.246	.961	.340

Analysis of Variance

	Sum of Squares	df	Mean Square	F Ratio	Sig.
Regression	11.227	3	3.742	5.205	.003
Residual	52.487	73	.719		

As shown in Table 4.9, the analysis yielded a multiple correlation coefficient ($R = .420$) and a coefficient of determination ($R^2 = .176$), with an F ratio ($F = 5.205$), which is statistically significant ($p < .01$) for the predictor variables combined.

To further investigate the predictors and their correlation with *academic achievement*, as measured by *expected end-of-course grades*, a correlational analysis was applied to the items of each subscale to find out which one of the items are more significantly correlated to students' *academic achievement*, as measured by *expected end-of-course grades*. Table 4.10 presents the results of the Pearson Product-Moment technique applied to data from fully online asynchronous mathematics courses. All items are from *Teaching Presence Scale* (Shea et al., 2006).

Table 4. 10

Relationship between Each Item of Teaching Presence Subscales and Academic Achievement

Instructional Design and Organization				
Items	Fully Online Asynchronous		Hybrid	
	CC	Sig.	CC	Sig.
1. The instructor clearly communicated important course goals.	.391	.000	.414	.000
2. The instructor clearly communicated important course topics.	.431	.000	.316	.005
3. The instructor provided clear instruction on how to participate in course learning activities.	.571	.000	.268	.019
4. The instructor clearly communicated the important due dates/time frames to help me keep pace with the course.	.287	.011	.292	.010
5. The instructor helped me take advantage of learning environment to assist my learning.	.474	.000	.356	.002
6. The instructor helped students to understand and practice the kinds of behavior acceptable in online learning.	.444	.000	.380	.001
Overall	.591	.000	.404	.000

Facilitation				
Items	Fully Online Asynchronous		Hybrid	
	CC	Sig.	CC	Sig.
1. The instructor was helpful in identifying areas of agreement or disagreement that assisted me to learn.	.642	.000	.250	.028
2. The instructor was helpful in guiding the class towards understanding the topics.	.289	.011	.343	.002
3. The instructor acknowledged student participation in the course.	.674	.000	.446	.000
4. The instructor encouraged the students to explore new concepts.	.640	.000	.357	.001
5. The instructor helped to keep students engaged and participating.	.657	.000	.283	.013
6. The instructor helped keep the participants on task in a way that assisted me to learn.	.345	.002	.297	.009
Overall	.661	.000	.386	.001

Direct Instruction				
Items	Fully Online Asynchronous		Hybrid	
	CC	Sig.	CC	Sig.
1. The instructor presented content or questions that helped me learn.	.197	.085	.274	.016
2. The instructor helped to focus discussion on relevant issues in a way that assisted me to learn.	.233	.041	.389	.000
3. The instructor provided explanatory feedback that assisted me to learn.	.690	.000	.207	.071
4. The instructor helped me to revise my thinking in a way that assisted me to learn.	.354	.002	.304	.007
5. The instructor provided useful information in a variety of sources that assisted me to learn.	.204	.076	.275	.015
Overall	.421	.000	.325	.004

Note. CC=Correlation Coefficient, Sig.=Significant at the 0.01 level (2-tailed).

Summary

Using the *Teaching Presence Scale* (Shea et al., 2006), participants scored their instructors' teaching presence in three subscales of *instructional design and organization*, *facilitation*, and *direct instruction*. Participants reported their expected end-of-course grades which were used to measure academic achievement. The result of correlational and multiple regression analyses were reported in this chapter in tabular and graphic form. The next chapter presents the conclusions, interpretations, implications, and limitations of the study suggested by the results.

CHAPTER V

CONCLUSION

The purpose of this study was to investigate how mathematics student perceptions of teaching presence differ by course delivery mode and student achievement. The results of the data analyses were presented in the previous chapter. In this chapter, the conclusions, interpretations, and implications of those results, as well as future studies are discussed.

Conclusions and Interpretations for Research Question One

The first research question was designed to find the difference between student perceptions of *teaching presence* in two undergraduate mathematics course delivery modes: fully online asynchronous and hybrid. An independent t-test was applied to the dependent variable, that was the total score of student perceptions of teaching presence obtained from the *Teaching Presence Scale* (Shea et al., 2006) in two groups with respect to the course delivery mode and learning environment: fully online asynchronous and hybrid. The highest possible score was 102 and the results presented in Table 4.1 in Chapter 4, showed that student perceptions of teaching presence differ in the two course delivery environments, with the scores in fully online asynchronous $(M = 77.58, SD = 14.34)$ being lower mean than those in hybrid courses $(M = 87.39, SD = 12.33)$.

The difference in the mean scores of student perceptions of *teaching presence* shows that students in hybrid mathematics courses perceived stronger teaching presence than those in fully online asynchronous mathematics courses. According to Engelbrecht and Harding (2005), online math learning requires interaction and collaboration between students and with the instructor. In the hybrid mathematics courses, students are more in contact with the instructor, have the opportunity to see, talk, receive immediate feedback, and collaborate with their peers and the instructor, while receiving course content and completing course assignments in an online environment. The difference of approximately 10 points in the mean scores of student perception of *teaching presence* in the two learning environments could be due to the stronger collaboration and interaction available in hybrid mathematics courses than fully online asynchronous mathematics courses of this study.

Conclusions and Interpretations for Research Question Two

The second research question was intended to examine the relationship between *teaching presence* and *academic achievement*, as measured by students' expected end-of-course grades, in undergraduate fully online asynchronous mathematics courses and hybrid mathematics courses. In order to determine whether a relationship existed between the independent variable, *teaching presence*, and dependent variable, *academic achievement*, a correlational design using Pearson Product-Moment correlation technique was employed.

Table 4.4 in Chapter 4 presented the results of the descriptive statistics and Pearson correlation coefficient, r, for fully online asynchronous mathematics courses. Expected course end-of-course grades were reported in letter form and converted into 5 to 1 (A = 5; B = 4; C = 3; D = 2; and F = 1). The Pearson correlation yielded to a coefficient ($r = .61, p < .01$) that is statistically significant, positive and strong. That shows that student perceptions of their instructor's *teaching presence* in fully online asynchronous mathematics courses is strongly related to their expected end-of-course grades; the higher the learners scored the *teaching presence*, the higher their expected end-of-course grades were reported, hence a higher *academic* *achievement* was expected. Figure 4.2 depicted the result in a scatterplot form, and the equation of the trend line had a positive slope of $.05$, indicating a positive relationship between the variables.

Similarly, Table 4.5 in Chapter 4 presented the results of the correlational analysis, using the Pearson Product-Moment technique, for the hybrid mathematics courses. The Pearson correlation coefficient showed a statistically significant relationship between *teaching presence* and *academic achievement* in hybrid mathematics courses, however, the relationship is weak ($r = .39, p < .01$). That means that in hybrid courses, student perceptions of *teaching presence* is positively correlated to their academic achievement, as reported by their expected end-of-course grades, but the relationship is not strong. The slope of the trend line in Figure 4.3 was $.03$, indicating a positive relationship among the variables.

The mean value of expected end-of-course grades in fully online asynchronous mathematics courses ($M = 3.25, SD = 1.18$) was reported lower than the one for hybrid mathematics courses ($M = 3.71, SD = .92$). That shows that on average, *academic achievement* in a scale of 1-5 is higher in hybrid mathematics courses than in fully online asynchronous mathematics courses. Comparing the Pearson correlation coefficients confirms that although student perceptions of *teaching presence* in both learning environments were positively and significantly correlated to their *academic achievement*, the correlation is much stronger in fully online asynchronous mathematics courses than in hybrid ones. That corroborates the importance of effective *teaching presence* in both modes of delivery, but especially in online learning of mathematics courses. This yields suggestions for improving teaching presence in online and hybrid learning environments of mathematics courses.

Conclusions and Interpretations for Research Question Three

Teaching presence has three subscales: *instructional design and organization*, *facilitation*, and *direct instruction*. The purpose of the third research question was to identify which one of the three subscales of *teaching presence* is the best predictor of student *academic achievement*, as measured by *expected end-of-course grades*, in undergraduate fully online asynchronous and hybrid mathematics courses. Student perceptions of each of the subscales in *Teaching Presence Scale* (Shea et al., 2006) in each of the delivery modes were analyzed using a multiple linear regression technique.

Fully Online Asynchronous Learning Environment

The results obtained for fully online asynchronous courses as reported in Table 4.8 in Chapter 4 showed that F ratio $(F = 24.46)$ was statistically significant $(p = .000)$ for the predictors combined, and confirmed that using multiple regression was indeed a better method in predicting values of the outcome than using the means alone. The results also showed a multiple correlation coefficient $(R = .71)$ and a coefficient of determination $(R^2 = .50)$. That confirms that 50% of the variance of the student *academic achievement*, measured by students' *expected end-of-course grades*, was accounted for by the combination of the three subscales of *teaching presence*. The B-value of unstandardized coefficients for *instructional design and coefficient* $(B = .09)$, *facilitation* $(B = .14)$, and *direct instruction* $(B = -.09)$, indicated that *facilitation* is the best predictor of the *academic achievement* in fully online asynchronous mathematics courses; predicting that for one unit increase in student perceptions of *facilitation*, the students' *expected end-of-course grades* increase by .14, in a 1-5 scale. The more detailed conclusions and interpretations for fully online asynchronous mathematics courses are as follows:

Academic achievement and instructional design and organization. As reported in Table 4.10 in Chapter 4, the results obtained from the Pearson Product-Moment method showed a statistically significant relationship between *instructional design and organization* subscale of *teaching presence* and student *academic achievement*, measured by *expected end-of-course grades*, in fully online asynchronous mathematics courses $(r = .59, p = .000)$. Table 4.10 in Chapter 4, also presented the correlation coefficients for each of the six items in the subscale of *instructional design and organization*. The results showed that although correlation of each item to *academic achievement* was statistically significant, item three, the *instructor's clear instruction on how to participate in the learning activities* (Shea et al., 2006), had the strongest correlation with *academic achievement* in this subscale ($r = .57, p =$.000). This shows a moderate correlation, important to consider for implications.

Academic achievement and facilitation. The results of the correlational analysis using the Pearson Product-Moment technique shown in Table 4.10 in Chapter 4 indicated a statistically significant relationship between *facilitation* subscale of *teaching presence* and *academic achievement* in fully online asynchronous mathematics courses $(r = .66, p = .000)$. Not only is this a strong relationship, but it is also the strongest among the three subscales of *teaching presence* with *academic achievement* for this category. Furthermore, the third item of *facilitation, the instructor's acknowledgement of student participation in a positive and encouraging manner* (Shea et al., 2006), showed the strongest relationship with *academic achievement* $(r = .67, p = .000)$, followed by the fifth item, *the instructor's assistance to keep students engaged with the course and participate in activities* (Shea et al, 2006), $(r = .66, p = .000)$. In fact, four out of six items of *facilitation* were strongly correlated to *academic achievement*, as measured by expected end-of-course grades, which agrees with *facilitation* being the best predictor of the expected course grades in undergraduate fully online asynchronous mathematics courses.

Academic achievement and direct instruction. Table 4.10 in Chapter 4 presented the result of the Pearson correlation coefficient for *direct instruction* subscale of *teaching presence* and *academic achievement* in fully online asynchronous mathematics courses ($r = .42, p = .000$) indicating a statistically significant relationship between the two variables. Although this is a moderate correlation and the lowest among the three subscales of *teaching presence*, its third item, *the instructor's providing of explanatory feedback* (Shea et al., 2006), showed the strongest relationship in *direct instruction*, and also among all 17 items of the scale ($r = .69, p = .000$). This confirms the importance of providing explanatory feedback to the fully online students in mathematics courses. The students in this learning environment do not receive immediate feedback, as offered in a traditional class setting, but receiving feedback from the instructor is still important to them.

Hybrid Learning Environment

As illustrated in Table 4.9 in Chapter 4, the results of the multiple regression analysis for hybrid mathematics courses showed that F ratio ($F = 5.21$) was statistically significant ($p = .003$) for the predictors combined. That confirmed that using multiple regression was a better choice in predicting values of the outcome than using the means alone. The results presented a multiple correlation coefficient ($R = .42$) and a coefficient of determination ($R^2 = .18$). This shows that only 18% of the variance of the student academic achievement, measured by students' *expected end-of-course grades*, was accounted for by the combination of the three subscales of *teaching presence*. The B-value of unstandardized coefficients were reported for *instructional design and organization* ($B = .09$), *facilitation* ($B = .05$), and *direct instruction*

$(B = -.05)$. The results indicate that *instructional design and organization* is the best predictor of the *academic achievement* in hybrid mathematics courses; predicting that for one unit increase in student perceptions of *instructional design and organization*, the students' *expected end-of-course grades* increase by .09, in a 1-5 scale.

Academic achievement and instructional design and organization. The results presented in Table 4.10 in Chapter 4 of the Pearson Product-Moment showed a statistically significant and moderate relationship between *instructional design and organization* subscale of *teaching presence* and student *academic achievement*, measured by *expected end-of-course grades*, in hybrid mathematics courses $(r = .40, p = .000)$. From the correlation coefficients for each of the six items in the subscale of *instructional design and organization* presented in Table 4.10, it is determined that the correlation between each item and *academic achievement* was statistically significant, varying from weak to moderate correlations. The first item, *the instructor's clear communication of the course goals* (shea et al., 2006), had the greatest correlation with *academic achievement* in this subscale ($r = .41, p =$.000).

Academic achievement and facilitation. The results in Table 4.10 in Chapter 4 indicated a statistically significant relationship between *facilitation* subscale of *teaching presence* and *academic achievement* in hybrid mathematics courses $(r = .39, p = .001)$, which is a weak, close to moderate relationship. Examining the items of this subscale, the third item of *facilitation*, *instructor's acknowledgement of student participation in a positive and encouraging manner* (Shea et al., 2006), showed the strongest relationship with *academic achievement* $(r = .45, p = .000)$. Similar to the results from the fully online asynchronous mathematics students, hybrid mathematics students also found being acknowledged and encouraged as the most important item of *facilitation*.

Academic achievement and direct instruction. Using the Pearson Product-Moment method, Table 4.10 in Chapter 4 also showed the correlation coefficient for *direct instruction* subscale of *teaching presence* and *academic achievement* in hybrid mathematics courses ($r = .33, p = .004$). Although statistically significant, this is a weak correlation between the two variables. The second item of *direct instruction, the instructor's assistance to keep the focus of discussions on relevant issues* (Shea et al., 2006), showed the greatest correlation coefficient among all five items of *direct instruction* ($r = .39, p = .000$). The result of this correlation is aligned with the literature review. According to Park and Choi (2009), adult learners prefer the online course content and activities that they can relate to with their experiences.

Implications

The purpose of this study was to investigate how mathematics student perceptions of *teaching presence* differ by course delivery mode and student achievement. In order to achieve the purpose, research questions were developed, data were collected, and results were reported and interpreted. This study sought to closely examine student perception of *teaching presence* in fully online and hybrid learning environments, specifically for students enrolled in undergraduate mathematics courses. The results of this study indicate that student perceptions of *teaching presence* in fully online asynchronous mathematics courses is lower than in hybrid mathematics courses. Hybrid students perceived the three domains of *teaching presence*, namely, *instructional design and organization*, *facilitation*, and *direct instruction*, almost the same. The *instructional design and organization* of the course was slightly more correlated with *academic achievement* for hybrid mathematics students. Design of the course includes the clear communication of course goals, topics, instruction on how to complete the assignments and how to navigate the online environment, due dates, and etiquette in online courses. *Instructional design and* *organization* was also reported to be correlated with fully online student *academic achievement*. These results are supported by findings of Ralston-Berg et al. (2015), as presented in Chapter 2. Also, the two items of *instructional design and organization* that were found most correlated with *academic achievement* were instructor's clear instruction on how to participate in the course activities, for fully online asynchronous courses, and *clear communication of the course goals*, for hybrid courses, which could be included in the orientation to the course, as explained and supported by findings of Wojciechowski and Palmer (2005), presented in Chapter 2. Although the correlation is confirmed, not all online and hybrid instructors design their courses. Palloff and Pratt (2011) explained that many colleges assign a previously developed online or hybrid course to faculty to teach. In that situation, the opportunity to design and organize the course is not given to the instructor, but there are still components of design and organization that the instructor can establish, modify, and change to fit the needs of the learners of the particular course. Therefore, developing a new course, and redesigning or polishing an existing online or hybrid mathematics course where the course objectives and goals are communicated to the students, the ways to complete the assignments are described, a calendar with dates of completing the assignments is shared, and detailed expectations are explained are among the ways of improving the *instructional design and organization* for fully online or hybrid mathematics courses.

According to Dixon (2010), an effective online instructor has strong presence and utilizes methods that engage students in activities that require interaction and collaboration among students. Based on this and the results of this study, it is recommended that online and hybrid mathematics instructors employ an approach to present activities that target student engagement and provide opportunities of content exploration and collaboration with peers. The collaboration and engagement with the course and other students enhance learning math concepts and their applications (Kaser & Hauk, 2016). Furthermore, Kaser and Hauk (2016) suggested that online math instructors utilize a learner-centered approach, discover challenging points for students, and adjust instruction to alleviate such struggles. Hoyte (2010) also supported learner-centered teaching methods in online mathematics instruction that promote student interaction with the content and with other students as a part of the learning process. Creating activities that promote interaction and collaboration among students, and supporting students in learning process are recommended for a learner-centered approach, and are among the factors of teaching presence.

The results of this study, indicated that online students perceived *facilitation* as the weakest aspect of *teaching presence* in their courses, yet the study results demonstrated that for this population, *facilitation* has the strongest correlation to *academic achievement.* Therefore, strengthening all items that the *facilitation* subscale of the *Teaching Presence Scale* (Shea et al., 2006) improves student perceptions of *facilitation* of *teaching presence*, which as the results of this study showed, is positively correlated with *academic achievement. Facilitation* consists of items that agree with the learner-center pedagogy suggested for online and hybrid teaching (Hoyte, 2010; Kaser & Hauk, 2016; Weimer, 2002). Both groups of participants in this study perceived *being acknowledged by the instructor in an encouraging and positive manner* as the most correlated item of *facilitation* to their *academic achievement*. This finding provides suggestions for an online instructor as the facilitator. As suggested by Palloff and Pratt (2011, 2013), embracing the facilitator role of online teaching is to engage students in their learning, providing learning opportunities by relevant discussion to their experiences, as well as identifying students' struggles and assisting them to overcome them. Encouraging participation in the course activities and being engaged with relevant discussions that eventually assist students to gain deeper understanding of the course content are among the suggestions for improving *facilitation* of online learning environment (Boettcher & Conrad 2010; Dixon, 2010; Kaser & Hauk, 2016; Ko & Rossen, 2010; Hoyte, 2010). One way of achieving this, as described by Armellini and De Stefani (2016), is through the design and facilitation of discussion boards. Dixon (2010) and Shea et al. (2006) add that selecting and developing questions or prompts for the discussion boards that offer myriad of opportunities to the students, allowing the students to express their opinions, guiding the conversations when necessary, identifying points of agreement and disagreement, acknowledging students' participation, keeping the discussion on the course topics, and creating learning opportunities are a part of the facilitation of an online learning environment. These suggestions also apply to online and hybrid teaching. Based on the results of this study and other related studies, it is recommended that mathematics faculty, as facilitators of online learning environments, be more encouraging, acknowledge adult learners' efforts and participation, provide learning activities that learners can relate to, and be positive even in correcting mathematical mistakes. Hoyte (2010) observes that incorporating discussion boards in online and hybrid mathematics courses, with relatable and applicable to real world topics, are recommended to increase interaction among the students, with the instructor and with the content. It results in enhanced social presence which leads into higher level thinking, learning, and strong cognitive presence, that may improve academic achievement (Bliss & Lawrence, 2009; Kupczynski et al., 2013). Using the online tools for student-student and student-instructor interactions are recommended to simulate the face-to-face components of interaction (Hoyte, 2010).

The results of this study showed that receiving explanatory feedback from the online instructor was reported to have the strongest relationship with *academic achievement* for fully online asynchronous mathematics students. As suggested by Hoyte (2010), feedback should acknowledge what the student has attempted, as well as the aspects that were done well and a correction of parts that needed improvement. Based on the results of this study and recommendations in related studies, it is suggested that in online and hybrid mathematics learning environments, detailed and explanatory feedback be provided to the students. For example, acknowledging the correct steps to find mathematics solutions and making suggestions on how to correct the mistakes are among useful and explanatory feedback, which according to the results of the study is strongly correlated with *academic achievement*.

Considering the literature and results of this study, redesigning online mathematics courses and faculty training for mathematics online teaching are highly recommended. At the university where this study took place, a Quality Matter training has been recently implemented for all mathematics faculty teaching online courses, but not for hybrid teaching. In addition to formal training offered by the university, Kaser and Hauk (2016) suggest a seven-factor self-assessment for faculty who are assigned to teach online. The seven factors ask where the faculty has experience in online learning as a student, whether they are prepared for a major change in teaching, if their pedagogy is compatible with online teaching, if they possess the conditions required to take on a new and major teaching responsibility, whether they can guide online students how to learn in an online environment, if their college is prepared to offer support, and whether their content area adapts to the online learning environment using technology (Kaser & Hauk, 2016). These are the factors that are recommended for each faculty to think about and reflect on, to whether choose to teach online or if the online teaching is assigned to them, to make themselves and their course compatible and ready for the big change.

Limitations of the Study

A few factors are considered as limitations to this study:

1. Sample size. The complete data were collected from a small fully online participants $(N = 77)$ and over 200 hybrid students. To have the equal number of data from both groups, a random sample was taken from hybrid participants $(N = 77)$. The low number of participants in each group may suggest that results cannot be generalized to a larger population.
2. Expected End-of-Course Grades. To measure academic achievement, expected course grades were used instead of the actual grades of participants. This strategy was employed to help maintain participant anonymity; asking participants to provide any form of identifying information to find their course grade by the end of the semester would have prevented anonymity and also may have discouraged students from participating and/or providing honest answers. Although expected course grades were collected toward the end of the semester and after many assessments involved in end of course grades were completed, they were not the actual end-of-course grades.

Future Study

The research on online learning of undergraduate mathematics courses is very limited. Therefore, there are vast opportunities for further research and future study in this area. The findings of this study led to the development of the following ideas for the future studies:

1) An improvement to the present study by collecting data at the end of the semester to receive students' end-of-course grades.
2) A comparison of students' math anxiety in online, hybrid, and face-to-face mathematics courses.

3) The effect of teaching presence on students' levels of math anxiety, academic success, and completion of online and hybrid mathematics courses.

Summary

This study was designed to investigate how mathematics student perceptions of teaching presence differ by course delivery mode and student achievement. Online learning has had a steady growth in higher education, and mathematics courses are also offered in fully online and hybrid modes, but the research on online mathematics learning and academic achievement is limited. In order to contribute to the body of research in this field, the focus of this study was on teaching presence and academic achievement in two delivery modes: fully online asynchronous, where all the instruction and assignments are delivered and completed online, and hybrid, which is a blend of online and face-to-face teaching and learning activities.

The *Community of Inquiry* was the theoretical framework of this study, where the three elements, namely: social presence, cognitive presence, and teaching presence, are interrelated and learning is at the intersection of these main elements (Garrison et al., 2000). Using the *Teaching Presence Scale* (Shea et al., 2006), student perceptions of teaching presence in the two course delivery modes were compared. The results showed that mathematics students in hybrid courses perceived their instructors' teaching presence higher than fully online asynchronous mathematics students. A correlational research design was utilized and the results determined that there is a statistically significant positive relationship between student perceptions of teaching presence and academic achievement in both course delivery modes, stronger in fully online asynchronous than in hybrid mathematics courses. In addition, the relationship between student perceptions of each subscale of teaching presence (instructional design and organization, facilitation, and direct instruction) and academic achievement showed that facilitation was the best predictor of academic achievement in fully online asynchronous mathematics courses and instructional design and organization was the best predictor in hybrid mathematics courses.

Based on the results of this study, implications and recommendations to improve teaching presence in undergraduate fully online and hybrid mathematics courses were discussed. Although the findings of this study do not establish a cause and effect relationship among the variables, the study contributes to the body of research and leads to the ideas for future studies in the related field.

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APPENDIX A

APPENDIX A

THE TEACHING PRESENCE SCALE

The Teaching Presence Scale developed by Shea, Li, and Pickett (2006) is the instrument used in this study to measure student perceptions of teaching presence. The instrument has 17 questions covering the three subscales of teaching presence: instructional design and organization, facilitation, and direct instruction. The questions are as the following:

A.1. Instructional design and organization

Setting the curriculum

1. Overall, the instructor for this course clearly communicated important course goals (for example, provided documentation on course learning objectives).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

2. Overall, the instructor for this course clearly communicated important course topics (for example, provided a clear and accurate course overview).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

Designing methods

3. Overall, the instructor for this provided clear instructions on how to participate in course learning activities (e.g. provided clear instructions on how to complete course assignments successfully).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

Establishing time parameters

4. Overall, the instructor for this course clearly communicated important due dates/time frames for learning activities that helped me keep pace with this course (for example, provided a clear and accurate course schedule, due dates, etc.).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

5. Overall, the instructor for this course helped me take advantage of the online environment to assist my learning (for example, provided clear instructions on how to participate in online discussion forums).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

Establishing netiquette

6. Overall, the instructor for this course helped students to understand and practice the kinds of behaviors acceptable in online learning environments (for example, provided documentation on "netiquette" i.e. polite forms of online interaction).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

A.2. Facilitating discourse

Identifying areas of agreement/disagreement

1. Overall, the instructor for this course was helpful in identifying areas of agreement and disagreement on course topics that assisted me to learn.

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

Seeking to reach consensus

2. Overall, the instructor for this course was helpful in guiding the class towards understanding course topics in a way that assisted me to learn.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

Reinforce student contributions

3. Overall, the instructor in this course acknowledged student participation in the course (for example replied in a positive, encouraging manner to student submissions).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

Setting climate for learning

4. Overall, the instructor for this course encouraged students to explore new concepts in this course (for example, encouraged “thinking out loud” or the exploration of new ideas).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

5. Overall, the instructor for this course helped to keep students engaged and participating in productive dialog.

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

Assessing the efficacy of the process

6. Overall, the instructor for this course helped keep the participants on task in a way that assisted me to learn.

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

A.3. Direct instruction Present content/questions

1. Overall, the instructor for this course presented content or questions that helped me to learn.

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

2. Overall, the instructor for this course helped to focus discussion on relevant issues in a way that assisted me to learn.

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

Confirm understanding

3. Overall, the instructor for this course provided explanatory feedback that assisted me to learn (for example, responded helpfully to discussion comments or course assignments).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

Diagnose misconceptions

4. Overall, the instructor for this course helped me to revisemy thinking (for example, correct misunderstandings) in a way that helped me to learn.

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

5. Overall, the instructor for this course provided useful information from a variety of sources that assisted me to learn (for example, references to articles, textbooks, personal experiences or links to relevant external websites).

Strongly agree
Agree
Neutral
Disagree
Strongly disagree
I choose not to answer this question.

BIOGRAPHICAL SKETCH

Shaghayegh Azadi Setayesh is a full-time mathematics Lecturer of rank III at the University of Texas Rio Grande Valley. She obtained her Bachelor of Science in Mathematics from the University of Texas at Brownsville in 2006 and completed her master's degree in Mathematics from the same university in 2008. She earned her doctoral degree from the University of Texas Rio Grande Valley in December 2018. She has been teaching undergraduate mathematics courses for the past 10 years, first at the University of Texas at Brownsville, and for the past three years at the University of Texas Rio Grande Valley. Her passion for teaching mathematics led her to pursue a doctoral degree in Curriculum and Instruction with specialization in Educational Technology. She focused her research on online mathematics teaching and will continue research in this field. Her email address is shaghayegh.setayesh@utrgv.edu