The Impact of Text Messaging on Students’ Academic Achievement in an online Computing Course

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ABSTRACT

THE IMPACT OF TEXT MESSAGING ON STUDENTS’ ACADEMIC ACHIEVEMENT IN AN ONLINE COMPUTING COURSE

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Northern Illinois University, 2018
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The problem of low student completion rates in distance learning courses remains one of the major issues that institutions of higher learning face. Efforts by school administrators to reverse this trend have so far produced mixed results. The rapid expansion of distance learning has encouraged many institutions to move more courses online, including computer programming courses. Using a randomized posttest-only experimental design method, this study examines how the use of a mobile phone text messaging application (Remind) as a two-way communication tool may help foster a learning environment that enhances interaction between students and instructors and increases student achievement.

The study uses the dialogue construct of Moore’s transactional distance theory as a conceptual framework and was conducted at an urban community college. The study had 50 students who were randomly assigned to two groups of 25 after being enrolled in an online introductory computer programming course. Analysis of data collected indicates that there was no significant difference in the achievement scores between the treatment and the control groups. The two dependent variables used to analyze the students’ achievement scores were final proctored exam scores and their total scores on programming assignments. However, performance results on individual programming assignments at the beginning of the study
suggest that students in the treatment group did perform better on the first three programming assignments. Discussions about the use of text messaging as a communication tool in an online environment and the frequency and types of student-to-instructor interactions that affect student academic achievement are also highlighted.
THE IMPACT OF TEXT MESSAGING ON STUDENTS’ ACADEMIC ACHIEVEMENT IN
AN ONLINE COMPUTING COURSE

BY

SELOM ASSIGNON
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A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL
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DOCTOR OF PHILOSOPHY

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Doctoral Co-Directors:
Dr. Pi-Sui Hsu
Dr. Todd Reeves
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And finally, to my coworkers at Harold Washington College for their support and advice.
DEDICATION

To my parents, Genevieve and Adolphe, who taught me that life is a journey and education is the wealthiest gift they could ever give me. I miss you dearly, and you would have been very proud to see your son achieve this dream.
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CHAPTER 1

INTRODUCTION

Background of the Study

In distance learning, the lack of instructor-student interaction and immediate feedback from instructors is one of the main problems that students face (Ko & Rossen, 2001; Schutt, Allen, & Laumakis, 2009; Woods & Baker, 2004), and students believe that instant instructor-student interaction is as important as online instruction (Dzakiria, 2005; Kuo, Walker, Belland, Schroder & Kuo, 2014; Miliszewska, 2007; Waddick, 1994). Unlike in a traditional classroom where student interaction and instant feedback occurs, feedback is often not immediate in distance education, which is mostly done via email, discussion board forums, or announcements posted in the course management system (CMS).

The delay in responding to students’ questions and inquiries may have a negative impact on some students’ ability to learn and perform well in their courses (Blackman, 2012) and possibly decrease their motivation to learn (Allen, Witt & Wheeless, 2006). The integration of information communication technologies such as mobile phones into distance learning may be one of the ways to address the problem of interaction between students and instructors and thus improve student learning, performance, and completion in distance learning courses. Knowing that course interaction is central to effective learning (Thurmond & Wambach, 2004; Tuovinen, 2000), the integration of such technology into learning may create an environment where teaching and learning are not confined to the interactions that take place within the course.
learning management system, but also outside the virtual classroom setting, which promotes student-instructor interaction and affects learning and performance in online courses (Jaggars & Xu, 2016; Valk, Rashid & Elder, 2010).

Distance learning over the years has become a more collaborative, personalized, and interactive experience that promotes student-centered learning (Shockley, 2012). Enrollment in distance learning has steadily increased across the country and learning institutions are seeing the benefits of offering online courses. According to a survey by Babson Survey Research Group in partnership with e-Literate and the Western Cooperative for Educational Telecommunications (WCET), an education nonprofit organization, more than six million students enrolled in at least one online course in Fall 2015 (Friedman, 2017). This is an improvement in enrollment from Fall 2014, which was 5.8 million students. Although online student enrollment continues to increase, student completion rate in distance learning has generally remained lower in comparison to face-to-face instruction (Johnson & Mejia, 2014; Xu & Jaggars, 2011b, 2013). Some of the reasons described in the literature about lower completion rates include student unpreparedness and comfort level using technology to take online courses (Huss & Eastep, 2013; Kuo, Walker, Belland & Schroder, 2013; Liang & Wu, 2010), lack of adequate student support (Hixon, Ralston-Berg, Buckenmeyer & Barczyk, 2016; Patel & Rudd, 2012), low quality and design of some online courses created by instructors (Barshay, 2015), and inadequate faculty training to effectively teach online (Elliott & Oliver, 2015; Reilly, Vandenhouwen, Gallagher-Lepak & Ralston-Berg, 2012). Distance learning is here to stay and likely to expand since college administrators see it as an integral part of their institutional strategic plan (Allen & Seaman, 2015). To be able to fully harness the promise of distance learning, educational institutions need
to address this problem of low completion rates and develop strategies that will meet their institution-specific needs.

Statement of the Problem

The problem of low student completion rates in distance learning is a subject that institutions of higher learning continue to address. On average, student completion rates in online learning courses is 10% lower than students in traditional courses and this gap has remained relatively constant for the past years (Johnson & Mejia, 2014). Educational researchers have examined this problem from different perspectives. Some have focused on adequately preparing faculty to teach online to be the key factor in increasing student success (Travis & Rutherford, 2012; Willis, 1994); others have studied the issue from the institutional level (Newberry & DeLuca, 2013; Tung, 2012) or by focusing on learner characteristics such as age, gender and academic standing as predictors of success (Dupin-Bryant, 2004; Harrell & Bower, 2011; Morris, Finnegan & Wu, 2005; Muse, 2003). Other scholars have concluded that instructor-student interaction is the main factor that affects student success (Garrison, 1990; Ladyshewsky, 2013; Millbank, 1994; Vonderwell, 2003). Looking at these studies, one can conclude that there is no one specific reason why students fail to complete their courses. Therefore, colleges should develop strategies that reflect the realities within their institutions and put in place support structures that meet their specific needs.

The emergence of new information and communication technologies, especially mobile devices, provides a unique opportunity for educators to address the problem of low student completion rates. In particular, research studies suggest that communication and interaction are crucial to the success of any distance learning course (Huang, 2010; Ladyshewsky, 2013; Vonderwell, 2003). A survey conducted by Pearson Education (2015), showed that
approximately 86% of college students own smartphones, with 64% reporting that they regularly used them for school work two to three times a week. With this information, instructors can leverage the use of this tool to increase interaction, encourage students’ participation in course work and provide them with immediate feedback, which can enhance student learning. The integration of this tool to supplement the existing communication in distance learning may also mitigate the perception of isolation that students experience online, which can negatively affect their experience, participation, and academic performance in online courses (Jung, Choi, Lim & Leem, 2002; Ladyshewsky, 2013).

Previous studies have consistently shown that interaction is a positive predictor of student learning, retention, and perceived satisfaction in distance learning (Fulford & Zhang, 1993; Gray & DiLoreto, 2016; Lin & Lin, 2015; Picciano, 2002; Sherry, 1996). One strategy instructors can use to increase interactions is to integrate the use of mobile phones, which have become the dominant tool of communication among college students (Harley, Winn, Pemberton & Wilcox, 2007). Ownership and use of mobile phones among college students continue to increase because mobile phones are cheaper than computers and are easy to carry around. On college campuses, students are seen walking around with their phones, texting, chatting with friends on social media and playing games. Mobile phones are now an integral part of student life to the extent that some students prefer staying at home and being on their phones instead of socializing with friends (Cohan, 2016). Therefore, utilizing this tool to enhance communication in distance learning courses can create a learning environment where students feel connected and part of the learning community (Kuh & Hu, 2001). The use of mobile phones improves student-instructor relationships better than when emails and online forums are used as the main methods of communication (Longmate & Baber, 2002; Rau, Gao & Wu, 2008). This type of interaction has
been shown to enhance student-instructor relationships and stimulate learning and course content discussions, which have a direct impact on student success (Abdullah, Bakar & Mahbob, 2012).

Previous studies conducted about the use of mobile phones and two-way text messaging in education focused on understanding how students are using them to support and enhance learning (Gebb & Young, 2014; Nielsen & Webb, 2011; Vázquez-Cano, 2014). Others were focused on their pedagogical benefits (Adedoja, Adelore, Egbokhare & Oluleye, 2013; Makoe, 2012), social presence in online learning (DuVall, Powell, Hodge & Ellis, 2007; Kovalik & Hosler, 2010), and increased student interaction (Gikas & Grant, 2013; Wang, Shen, Novak & Pan, 2009). These studies suggest that students use mobile phones to access course materials and to communicate with peers; it is perceived that the use of mobile phones is beneficial to the learning experience. Despite this research, there are relatively few studies that focus on how the use of mobile phone text messaging directly impacts student academic achievement in online courses. The present study attempts to address this literature gap and to provide information to instructors and college administrators on the potential use of this tool to increase student academic achievement in distance learning courses.

Purpose of Study

The purpose of this study is to examine the impact of using text messaging as a complementary means of communication as it pertains to student academic achievement in an online computer programming course at a midwestern community college. The study uses Michael Moore’s transactional distance (TD) theory as the theoretical framework, which emphasizes the importance of purposeful and meaningful interactions between student and
instructor in order to bridge the pedagogical distance that occurs due to the physical distance between learners and instructors.

Research Question and Hypothesis

This study sought to answer the following question: Does the use of text messaging as a complementary method of communication have an effect on student academic achievement in an online course?

The hypothesis of the study was based on the transactional distance theory framework. It assumes that there would be a significant increase in academic achievement for students who used text messaging as a complementary method of communication with instructors in an online course.

Theoretical Framework

The study used Moore’s transactional distance learning theory as the framework and in particular the dialogue construct, which explains the importance of interactions between instructor and student, student and student, and student and content and using mobile phone text messaging as a communication tool to increase course interaction. Moore (1993) defined transactional distance as “a psychological and communication space to be crossed, a space of potential misunderstanding between the inputs of instructor and those of the learner” (p. 23). He further explained that transactional distance is pedagogical and not geographical and believed the “distance” between learners and the instructor may bring about feelings of disconnect and isolation, which will negatively affect learners’ performance and lead to lower retention and success rates in online courses. The premise of the transactional distance (TD) theory is that
students can succeed academically if the distance learning environment promotes active learning, student engagement, and interaction with one another, with instructors, and with the course content. Text messaging as a communication tool may be one of the methods to enhance interaction in distance learning and create a more collaborative learning environment and online community, which the theory sees as critical. The familiarity and popular use of mobile phone text messaging has made it a powerful tool that both students and instructors can utilize to improve communication outside the course management system and for instructors to provide instant feedback. This immediacy may have a positive effect on student-instructor relationships and contribute to student learning and academic achievement in online learning (Hayes & Weibelzahl, 2009, 2016).

Significance of the Study

The significance of this study to the field of instructional technology covers three areas. First, it adds to the body of literature on how to address the problem of low success rates among distance learning students using mobile phone text messaging as a complementary method of communication. Second, it provides instructors with practical ideas on how to leverage the use of mobile phone text messaging to engage students, increase interaction, provide timely feedback, and personalize teaching and learning to increase student success in their distance learning courses. Finally, it serves as a platform for school administrators to re-evaluate technology integration policies and usage, especially mobile phone usage in classrooms and in distance learning courses.
Definition of Terms

1. Academic achievement: In this study, it refers to the successful completion of coursework by students. Academic achievement is measured in relationship to the two-way text messaging between instructor and student.

2. Text messaging: Digital messages sent to another person regardless of location. It may take the form of digital text, audio, video, pictures or a combination of all forms of media. The transfer of the digital messages is instant and may only have delay with signal problems. In this study, text messaging is a two-way communication that includes standard short message service (SMS) sent from smartphone to smartphone and from a computer to a smartphone.

3. Remind: It is a communication application that was used in the study to interact with students. It can be downloaded from Google Play or the Apple Store into a smartphone for use or can be utilized by logging into the app website. Participants in the study are allowed to use any medium to send and receive text messages.

4. Distance learning/distance education: The two terms are used interchangeably and are defined by the U.S. Department of Education’s Office of Educational Research and Improvement as “the application of telecommunications and electronic devices which enable students and learners to receive instructions that originate from some distance location” (Bruder, 1989, p. 30, that is a virtual environment where teaching and learning take place via computers, mobile devices, and digital devices. Instructors and learners are physically separated but can still communicate electronically both asynchronously and synchronously.
5. Transactional distance theory: This theory refers to the pedagogical and communication space that exists between teacher and student in a virtual learning environment. When this space is bridged through communication, any potential misunderstanding between teacher and student is reduced, which impacts student learning outcomes (Moore, 1997). This study used the dialogue construct of the theory as its framework, particularly the student-instructor interaction element.

Assumptions

The study assumed that each participant owned a mobile phone that had a texting feature in order to participate in the study. This information was self-reported and the researcher assumed that participants honestly owned a mobile phone, especially after participants responded to a text message from the instructor. It is also assumed that the course was taught and delivered the same way by the instructor irrespective of the groups in which the participants were assigned. Students in both groups had access to the same course content, resources and activities. The final assumption was that participants in both groups received the same number of announcements and email communications from the instructor.
CHAPTER 2

LITERATURE REVIEW

Introduction

Communication among students has seen a clear shift from face-to-face encounters and discussions to electronic interactions via mobile phones and text messaging. However, the integration of such a device in education is still at an early stage because some instructors are reluctant to learn how to use it (Bawa, 2016; Ng, 2012), see it as a disruptive tool (Richtel, 2012; Shelton, Elliott, Lynn, & Exner, 2011), or have fears of student cheating (Tindell & Bohlander 2012; Tolson, 2008). Current literature on the direct impact of text messaging as an interactive tool on student academic achievement in distance learning is limited. This study has attempted to address the literature gap on this subject. The purpose of this literature review is to discuss past studies about the use of mobile phone text messaging in education and how the student-instructor element of the dialogue construct of the transactional distance theory helps to explain the importance of interactions in distance learning courses.

The literature review is organized into four sections. The first section provides a brief history of distance learning. The second section covers the trend of distance learning in higher education. The third section discusses the theoretical framework of the study, which is the transactional distance learning theory with specific attention to the dialogue construct of the theory. The fourth and final section examines the functional use of mobile phone text messaging,
which includes the general use of text messaging in different fields, text messaging in higher education, and text messaging in distance learning.

Brief History of Distance Learning

Distance learning has been around for decades and its definition has evolved with the changes in technologies. Schlosser and Simonson (2009) define distance education as an “institution-based, formal education where the learning group is separated, and where interactive telecommunication systems are used to connect learners, resources, and instructors” (p. 1). The concept of learning at a distance has its origin in independent study, self-directed learning, and non-traditional learning (Wedemeyer, 1981). It started with individuals and institutions offering correspondence courses where course materials, lessons, and exercises were sent to people through the postal service and upon completion were returned back to the educator for corrections and grading. The primary objective of distance education was to meet the educational needs of under-served people and those who did not have access to traditional educational institutions, which at the time was mainly for the privileged classes (Saba, 2011). The concept of correspondence courses continues to be popular, and in 1883, William Rainey Harper developed the first correspondence program that was offered at the University of Chicago (Casey, 2008; Scott, 1999).

In 1894, Guglielmo Marconi invented the radio (Buckland & Dye, 1991); it did not take long before distance educators started using it as a course delivery method to reach learners. The evolution of television broadcasting in the late 1920 brought forth the importance of visual media as a means of communication and Iowa State University became the first institution to start televising educational programs in 1950 (Saba, 2011). As the use of radio and television in
education continued to grow, it eventually became part of distance education where programs were broadcasted at scheduled times to allow learners to watch and complete their assignments (Verduin & Clark, 1991).

In 1989, the University of Phoenix, a for-profit institution, offered the first online educational program using CompuServe. Not long after, Tim Berners-Lee developed the World Wide Web in 1991 (Connoly, 2000). The invention of the World Wide Web (WWW) provided the ability for computers to network with other computers worldwide and made information accessible to anyone who had personal computers (Casey, 2008). The use of the internet connected to computers enabled new modes of instructional delivery that institutions were able to take advantage of to increase online course offerings and to create universally accessible educational opportunities for learners. Due to the expansion of distance learning, this mode of delivery is no longer considered a trend but the mainstream used by many learners who are able to carry on their day-to-day responsibilities while pursuing their academic goals (O’Lawrence, 2007). Distance education continues to grow and the number of students enrolled in online courses and programs has seen a constant increase for the past 10 years (Allen, Seaman, Poulin & Straut, 2016).

Distance Learning in Higher Education

Distance learning in higher education has steadily grown, with enrollment increasing for the past 14 years (Friedman, 2017). The Babson report, which was sponsored by Pearson, Online Learning Consortium, and Tyton Partners, showed that the number of distance learners grew by 5.6% from Fall 2015 to Fall 2016, making the total number of students taking at least one online course 6.3 million. While distance learning has enjoyed a sustained increase in its enrollment, the
same report indicated that on-campus enrollment between 2012 and 2016 has dropped by more than one million students, with the largest decline coming from for-profit institutions (Seaman, Allen, & Seaman, 2018). This continuous increase in distance education enrollments may indicate that this mode of delivery is popular, convenient, and offers flexibility that meets student needs more than classroom instruction. Online learning has yet to reach its full capacity. That is, distance learning is here to stay and, therefore, educators through a coordinated effort with all stakeholders must put in place an infrastructure that supports, enhances, and provides students with the best learning experience and outcomes. This is especially true at community colleges where the demand for online education outpaces its supply (Fox, 2017).

**Distance Education in Community Colleges**

Community colleges play a critical role in offering higher education to people from diverse backgrounds. Historically, community colleges were established to serve students with local needs and provide them with the opportunity to seek postsecondary education. In an effort to respond to the growing demand of students interested in pursuing academic careers, community colleges have responded by expanding online course offerings, programs, and making their academic schedule more flexible (Allen et al., 2016; Hachey et al., 2013). In fact, in 2014 more than 63% of chief academic leaders in higher education in the United States considered online education critical to their long-term strategic plans (Allen & Seaman, 2015). However, the problem of low student completion rates among online learners in comparison to traditional learners is still a problem that retains the attention of academic researchers.

A significant number of students who are enrolled in online courses at community colleges are adults who are more likely to be 25 years and older, employed, and have family
responsibilities, which can make it impossible for them to take face-to-face classes (Lindermann, 2015; Pontes & Pontes, 2012). These characteristics separate them from traditional face-to-face students who see their student role as their primary responsibility. However, community college students who enroll in distance learning courses are at risk for non-completion due to their many responsibilities (Hachey et al., 2013). This is because these students have to juggle multiple jobs, family, parental responsibilities and academic work, which make it difficult to successfully complete course work. Several studies conducted in the past have consistently shown that students enrolled in distance learning courses are less likely to successfully complete their online courses compared to face-to-face students (Jaggars & Xu, 2010; Jaggars, Edgecombe & Stacey, 2013). Johnson and Mejia, in a study conducted in 2014, compared students’ success in online and traditional courses in California community colleges. The authors defined student success as students who completed a course with a passing grade. The results of the study suggested that, “on average, students in online courses are at least 11 percentage points and as much as 14 percentage points less likely to successfully complete an online course than otherwise similar students in traditional format classes” (p. 9). This trend of lower success rates in online students vis-a-vis traditional students is a continuous challenge for academic leaders. Luckily, higher education institutions are taking steps to address some of the issues that affect student completion rates.

The State Board for Community and Technical Colleges (SBCTC) in Washington, for instance, have taken concrete steps to address the success rate problem by adopting Canvas, a new learning management system, which according to the board will help improve course delivery and increase student-faculty interaction (Long, 2015). Instructors were also trained throughout the system to improve the quality of online courses. Other colleges such as Seattle
Central College created a Center for Extended Learning to ensure that students who are enrolled in online courses are oriented and well informed on the expectations of being online students (Long, 2015). Efforts by college administrators to address the problem of low student success rates have generally focused on making sure student support services are available and accessible to students (Chen, 2017). However, one of the strategies that has not been proposed to tackle the problem of low success rates at the institutional level is a careful planning and integration of mobile technologies, such as mobile text messaging, which may help improve student academic performance in online courses (Kuyath, Mickelson, Saydam, & Winter, 2013; Kuznekoff & Titsworth, 2013). This study aims to address that literature gap using an online computing course offered by a college in the midwestern part of the United States.

Theory of Transactional Distance

The theoretical framework that guided this research was the theory of transactional distance (TD), especially the dialogue construct of the theory. The transactional distance theory was part of the theory of independent learning developed in 1972 (Moore, 1993). The idea of distance learning as an instructional mode was based on John Dewey’s thought that learning occurs through an interaction with one’s environment (Dewey & Bentley, 1949). It was not until 1993 that the term “transactional distance” became one of the primary theoretical frameworks for distance education/learning. Moore (1993) defined transactional distance as “a psychological and communication space to be crossed, a space of potential misunderstanding between the inputs of instructor and those of the learner” (p. 23). Moore went on to explain that transactional distance is pedagogical and not geographic. He believed that the “distance” between learners and the instructor may bring about feelings of disconnect and isolation (Moore, 1993), which will
negatively affect learners’ performance and lead to lower course retention and success rates. This concept of TD is a relative rather than an absolute term (Moore, 1993) because it occurs under any instructional setting. Rumble (1986) also pointed out that transactional distance exists in any educational program because the psychological and communication spaces between a student and an instructor are never the same. To address this problem, constant dialogue between the student and the instructor needs to be present. With the advent of technology, the use of mobile devices and especially mobile phone text messaging features can help bridge that transactional distance between students and instructors.

Transactional distance theory describes the relationship between three constructs: dialogue, structure, and learner’s autonomy. Moore (1993) states that there is an inverse relationship that exists between these three constructs, in that an increase in one can lead to corresponding decreases in others. That is, how these constructs interact either increases or decreases the pedagogical gap and the miscommunication between the instructor and the learner. For instance, a course which is well structured will lead to a decrease in the quality of dialogue that occurs in the course (Ekwunife-Orakwue & Teng, 2014); the more autonomy the learner experiences (Goel, Zhange & Templeton, 2012), the less dialogue exists in the course, which increases learners’ perception of transactional distance.

Dialogue

Dialogue, according to Moore (1993), is a purposeful and constructive communication that happens between parties. In an instructional setting, dialogue occurs when an instructor presents course materials or gives instructions and the learners react. Dialogue is more than a two-way communication and includes all forms of interaction “within the context of clearly
defined educational targets, cooperation and understanding on the part of the teacher, and, ultimately, it culminates in solving the learners’ problems” (Giossos, Koutsouba, Lionarakis & Skavantzos, 2009, p. 2). Therefore, the importance of dialogue is not based on its frequency but its quality and how effectively it enables the transfer of knowledge to the learner in a distance learning environment. Despite that, interaction and dialogue are used interchangeably to mean the same thing. In TD theory, dialogue is referred to as a positive interaction between parties, where value is placed on improved understanding of the student (Moore, 1983). The absence of dialogue increases the distance between the instructor and the learner.

According to Moore (1993), there are three forms of dialogue/interaction: 1) student-student (S-S), 2) student-course content (S-C), and 3) student-instructor (S-I), which this study will focus on investigating its effect via text messaging on student academic achievement.

Student-student interaction (S-S) plays an essential role in fostering student learning. When students are given the opportunity to interact, discuss, and collaborate on projects and share the meaning of the course content, this reinforces student understanding of the materials. It also motivates and increases their satisfaction and performance in the course (Berge, 1999). Furthermore, several studies showed that students had positive learning experiences in their online courses when they were actively engaged and interacted with peers (Kolloff, 2011; Sher, 2009). In a survey study conducted by Sher (2009) at East Coast University in the United States, data were collected from 208 students enrolled in the Tourism Administration, Project Management, and Health Sciences online courses. Using regression statistical analyses, results showed that instructor-student and student-student interactions had significant impacts on student learning and satisfaction.
Student-content interaction (S-C) is also important since learning only occurs when the instructional content is meaningful and relevant. In distance learning, effective instruction helps students understand the course content and enables them to relate their experiences to what they are being taught (Driscoll, 2000). Thus, learner-content interaction is an important element of an educational process and its presence is essential to student performance and success in an online course. In 2014, Ekwunife-Orakwue and Teng conducted a survey study to measure the impact of student interactions in online and blended courses on student learning outcomes using the dialogue construct of transactional distance theory as the framework. Analysis of the data collected from 342 students between 2010 and 2013 indicated that student-content interaction has a more significant effect on student learning outcomes than other forms of dialogue.

Among the three types of dialogues/interactions, student-instructor (S-I) interaction is the one form of interaction that distinguishes distance learning from independent studies. Student-instructor interaction refers to all interactions that occur between the learner and the instructor towards increasing student understanding throughout the duration of a course. Instructors’ teaching philosophies and instructional delivery strategies have a direct impact on students’ understanding, especially in distance learning where students need feedback. Irrespective of the instructional delivery formats, interactions remain a key factor in students’ learning. In a case study conducted by Ladyshepsky in 2013 to explore the role of online instructors and how they influence student satisfaction, the author recruited two online instructors to facilitate six postgraduate Principles of Management and Leadership courses for a trimester. Using the university’s standardized evaluation survey, the author collected data from students, which were analyzed to determine the effects of interaction on student satisfaction. The results showed that instructors’ presence through course interaction, teaching, and constant feedback to students are
important factors that drive the quality of learning and student perceived satisfaction with online experiences. This finding confirms outcomes from past studies that showed strong correlation to instructor-learning interaction on student learning and achievements (Arbaugh, J., Godfrey, M., Johnson, Pollack, Niendorf, & Wresch, 2009; Darling-Hammond, 1999).

Several past studies have shown that the presence of the dialogue elements (S-I; S-S; S-C) in distance learning courses had positive impacts on student learning and satisfaction (Chen, 2001; Ekwunife-Orakwue & Teng, 2014; Swan, 2001). Mbwesa (2014) conducted a quantitative research study at University of Nairobi in East Africa to examine student’s perceived satisfaction of the three constructs of Moore’s transactional distance (TD) theory. One hundred and sixty-eight students in a Bachelor of Arts program participated in the study. The author used a survey questionnaire to measure the predictive ability of the TD constructs on students’ perceived satisfaction. Using descriptive and correlational statistics to analyze the data collected from the questionnaires, the author found that the three elements were key predictors of students’ satisfaction with distance education courses, which confirms results from past studies about the theory. This study added additional perspectives and information to the literature on TD by touching on an instructional format (print-based distance education), which is rarely used in the developed countries but still prevalent in developing countries in Africa, where the emergence of the internet and technology is still at the earliest stage regarding distance education.

The application of the theory of transactional distance to improve course interaction and performance is also applied to flipped classroom instruction. Flipped classroom is an instructional strategy that reverses the traditional classroom teaching. That is, students are introduced to course topics and content at home by reading and watching videos and complete all their course assignments in class. The philosophy behind this concept is to support students when
they most need it, which is to complete their work. Swart and Wuensch (2016) conducted a quantitative study to investigate students’ perception of transactional distance in a flipped versus a traditional classroom and to determine if any change in the transactional distance between the two instructional modes was a predictor of student satisfaction. Ninety-six students enrolled in a university business course participated in the study. The authors administered a survey questionnaire to collect data from students and used multiple regression analysis to quantify the extent to which each of the transactional distance constructs were predictors of student satisfaction. Findings of the study showed that student satisfaction improved in flipped classrooms due to the improvement in the transactional distances between students, students and instructor, and students and technology. The conclusion was that using the flipped classroom as a pedagogical strategy provided a learning environment that increases student engagement and interaction with peers, instructor, and technology, which in turn leads to student success and retention.

Transactional distance theory continues to be one of the main conceptual frameworks used for distance education study, and the dialogue construct is seen as a critical element that affects student learning and outcomes. Every learning activity should encourage greater interaction where students can easily get access to not only the learning content but also be able to frequently communicate among themselves and with the instructor in order to prevent miscommunication and reduce the transactional distance. In an online environment, text messaging may bridge this transactional isolation through constant and instant communication and promote a sense of belonging and community between students and the instructor, which is one of the benefits of face-to-face instruction. See Figure 1 below.
Functional Use of Text Messaging

Mobile phone text messaging has been embraced as one of the main communication methods among people of all ages. As a communication tool, it allows people to send messages to anyone, which makes it a convenient device to carry along. Almost every field that involves human interactions and activities, be it education, medical, business and even politics, uses text messages in some form to communicate with staff, patients, employees and supporters respectively. This section discusses some of the functions of text messaging and its impact on people’s day-to-day communication and activities.
Practitioners in the medical field have embraced the use of text messaging as a tool to communicate and send health-related information to patients. Due to the challenges of promoting positive health behavior among patients such as encouraging them to participate in programs that improve and sustain patients’ recovery progress as well as maintaining an on-going connection, researchers in the medical field had taken steps to integrate the use of text messaging to increase access to health care. Thus, medical staff are able to develop personal connections with patients by sending them reminders, health tips, encouraging words, and making themselves accessible to them. According to Head, Noar, Iannarino, and Harrington (2013), the first published study about the use of text messaging as part of a larger strategy of mobile health (mhealth) was published in 2002.

An example of how text messaging is used in the medical field is discussed in a study conducted by Lounsbury, Eloka, Gylten, Arena, Clarke and Gordon (2015), which explored the use of text messaging as a communication tool in the health industry domain. Fifty-two out of 237 patients voluntarily enrolled into the text messaging program and received about three to five text messages every week from the Outpatient Cardiac Rehabilitation (OP-CR) Department about heart-healthy tips, medication adherence, and other important communication. Analysis of data collected showed that a significant number of patients in the text message group completed the OP-CR program. This study shows that an effective integration and use of text messaging as an interactive tool can produce positive outcomes irrespective of the setting within which it is utilized. These findings supported past studies that employed mobile technology to promote positive behavior (Beatty, Fukuoka & Whooley, 2013; Blasco et al., 2012). Another study by Bock, Barnett, Thind, Rosen, Walaska, Traficante, and Scott-Sheldon (2016) examined the
acceptability and efficacy of text messaging as a communication tool to reduce community college students’ risk of consuming lots of alcohol. The findings showed that those who enrolled in the text messaging program were less likely to report heavy drinking and negative alcohol consequences. It is evident from the above studies that the use of mobile phone text messaging can lead to healthier lifestyles and ultimately bring about positive behavior in patients.

**Text Messaging Use in Business Organizations**

Information dissemination and communication in organizations is considered one of the pillars of successful business operations (Husain, 2013; Zhang & Agarwal, 2009). As such, firms and organizations are among entities that are using text messaging to communicate with their clients and customers. In the field of marketing, for instance, although past studies about advertising communication showed that consumers saw these text messages to be irritating, intrusive (Monk, Carroll, Parker, & Blythe, 2004), and an invasion of privacy (Windham & Orton, 2002), businesses continue to push information to consumers’ phones as a way to promote new products and send coupons, deals and reminders. A study conducted by Watson, McCarthy and Rowley (2013) about consumers’ attitude toward mobile marketing found that consumers remained resistant to mobile marketing because they see it as intrusive. The authors, however, suggested that consumers might be more receptive to permission marketing, where consumers feel that they are in control of the type of marketing message they receive. To address this issue, companies have taken a more integrated approach by making mobile marketing a more personalized experience, where consumers are able to opt in and out of these messages (Ström, Vendel & Bredican, 2014). Customers can now subscribe to the type of text messages and marketing information they desire.
Human resource departments have also accepted the use of text messaging as a complementary method of communication with their staff by sending out different types of messages such as trainings, professional development, meeting reminders, surveys to employees, and payroll information (Rhie, 2017). The use of this tool has made information sharing easy and available to staff who in the past depended more on emails or phone calls. Additionally, emergency communication protocols adopted by many businesses involve the use of text messages and phone calls as a means of sending out mass communication to their staff and students in case of emergencies (National Research Council, 2011). Knowing that over 350 million employees were estimated to own smartphones by 2016 (Chen, 2012), it is natural to make use of this tool as an effective means of communication during these urgent times.

**Text Messaging Use in Politics**

Information communication technology has also found its way into politics for years where candidates used it for campaigning and as a means to directly reach out to donors to raise funds. According to Thurlow and Poff (2011), the greatest impact of text messaging in presidential history was when candidate Barack Obama used text messages to announce his choice of vice president directly to his supporters. President Obama’s campaign went on to leverage the use of this technology to send out vote reminders in a manner that had never been seen before (Strauss, 2009). The current U.S. president, Donald Trump, has taken this cue from his predecessor and is continuing the tradition by communicating directly with his supporters using Twitter almost daily.
Text Messaging in Higher Education

Mobile phone use among college students is on the rise as it is normal to see students on campus holding their mobile devices everywhere they go; its ownership among college students is approximately 86% (Person Education, 2015). The use of this tool is also not new to the current generation of students who are commonly referred to as digital natives (Ng, 2012; Pedró, 2006; Prensky, 2004). Students have adopted text messaging as their preferred mode of communication among themselves (Porath, 2011; Turkle, 2011) because of the ease of use, its ubiquitous nature, low cost of ownership and its ability to instantly transfer message to recipients without all the greetings and niceties of phone calls. However, its adoption as a learning tool among educators is still at the infant stage due to instructors’ fear of classroom disruption (Richtel, 2012) and cheating (Tolson, 2008). Below is a review of how mobile phones are used as an interactive tool in classrooms and across the world.

Mobile Phones as a Classroom Collaborative Tool

Studies about mobile phone use in the classroom for the most part have showed it negatively affects student learning and performance because of the distraction and the lack of attention by students engaging in texting, using Facebook and other non-academic activities in the classroom while lecturing is taking place (Burns & Loheny, 2010; Hong, Chiu & Hong, 2012; Rosen, Carrier, & Cheever, 2013). Tindell and Bohlander (2012) conducted a study to gain a better understanding of the frequency and ways in which mobile phones are used in college classrooms. Two hundred and sixty-nine college students from a small northeastern university participated in the study. These students represented each of the 21 different academic majors in the college and were given an online survey made up of 26 questions about the use of cell phones
in the classroom to complete. The results of the study showed that 95% of students brought their phones to class every day and 92% used their phones to text others during class time. However, the one important finding that captured this writer’s attention is that students believed instructors were unaware of the extent to which texting and other phone activities engaged students in the classroom. Additionally, students stated that they would continue to use their phones even if classroom policies banned their possession or use. This is an indication that although instructors are aware of the use of mobile phones among students and that their fear of abuse in the classroom is justified, prohibiting its use during class may not be the solution. Instructors need to work with students to set up a policy on mobile phone use in class and at the same time look for effective ways to include it in their instruction.

Kuznekoff and Titsworth (2013) also investigated the impact of cell phone use during classroom lectures on students’ learning and assessments. The authors used an experimental research design and randomly assigned 47 students enrolled in communication courses at a large midwestern university and divided participants into three groups. Nineteen students were placed in the control group, 14 in the low distraction group, and 14 in the high distraction group. After a 12-minute lecture video was played to all the groups during which students were allowed to take notes, the control group, which did not use cell phones during lectures, scored highest on recall and multiple-choice tests. This finding showed that if cell phones are not effectively integrated as a learning tool in classroom, this will negatively affect student learning. This is in line with past studies on classroom texting which have also found that it negatively affects student learning and academic performance (Wei, Wang & Klausner, 2012; Wood, Zivcakova, Gentile, Archer, De Pasquale & Nosko, 2012).
Mobile phone integration in classrooms, if well planned and executed, can enhance teaching and learning. Although instructors are reluctant because of its disruptive nature, students can benefit from using mobile phones as a learning tool by receiving learning tips, course links and triggering questions from their instructors. The text messaging feature of a mobile phone provides an assured way of reaching out to students who spend more time with their devices than checking their emails or logging into their course management systems.

Gasaymeh and Aldalalah (2013) conducted a nonrandomized pre-posttest quasi-experimental design study to investigate the impact of using short message service (SMS) - a text messaging application - as a learning tool on student learning in order to examine students’ perception of the benefits and drawbacks of using SMS. The study had 52 undergraduate students enrolled in a visual basic course with 23 randomly assigned to the control group and 29 to the experimental group. Students in the latter group received 36 messages during the course of the semester. Analysis of the data collected suggested that the use of SMS contributed significantly to improving student learning in the experimental group compared to the control group. Students believed that the use of SMS as a learning tool has more advantages than disadvantages. The conclusion of this study shows the positive correlation between text messaging and student learning and satisfaction, which are critical elements of student success.

Lauricella and Kay (2013) also conducted a study to examine how students used text messaging and instant messaging for academic purposes in higher education. The study was specifically interested in the usefulness, student comfort levels and the reasons behind their use. The authors selected 75 students enrolled in three different disciplines at a small university and were provided with the instructor’s mobile phone and SMS address for instant messaging. They were encouraged to text message their instructor via their laptops to ask questions or to request
information about the course. Students have the option to either text message or send an SMS to their instructor and their peers if they so wished. At the end of the class, students completed an online survey about the use of text messaging devices. Analysis of the data collected shows that students were very comfortable using both mobile phones and instant messaging as communication technologies. However, students used text messaging more frequently to communicate with their peers than with their instructors for academic purposes and indicated that it is their preferred means of communication to get instant responses to their requests. The findings of this study show that the use of text messaging among students as a communication method is prevalent and instructors can take advantage of this tool to improve student engagement and interaction with students outside the classroom. The conclusion of this study supports the current trend of text messaging among students and how its effective use and adoption can enhance student interaction and collaboration. My study, on the other hand, investigated how the use of text messaging between student and instructor directly impacts student academic achievement in distance education.

Text Messaging as an Educational Tool Used Across the World

Text messaging as a means of communication among college-aged adults is not restricted to students in North America, Europe, or in other developed countries. A study published by Pew Research Center showed that in the last couple of years, mobile phone ownership has increased among people across the globe. In the United States, 91% of the population owned mobile phones compared to 94% in Europe, 93% in the Middle East, and 84% in Asia/Pacific (Poushter, 2016). Irrespective of where college students are located, there is a fundamental shift in how students are using mobile phones to communicate among themselves and with family members.
For instance, in Africa, mobile phone ownership has grown exponentially, with 80% of adults stating that they mainly used it to send text messages (Poushter & Oates, 2015). Its integration in education as a teaching and learning tool has also caught the attention of researchers who are interested in investigating how mobile phones can be used to increase access to students in remote areas and to improve the educational system in those countries (Mtega, Bernard, Msungu & Sanare, 2012). Some countries such as South Africa, Nigeria, and Kenya have already taken the step to leverage the use of mobile phones in their educational system. An example is the study conducted by Koross and Kipkenda (2016), who examined the impact of SMS text messaging on written skills among Kenyan university students. Using a descriptive survey to collect both quantitative and qualitative data from 180 students and 20 instructors, the study concluded that students sent on average around 100 texts daily but used “special jargons” to communicate with one another, which influenced their writing skills. Thus, the prevalence and adoption of mobile phone text messaging is real and has become the main method of communication among students.

In Hong Kong, So (2016) did a study to evaluate the use of instant messaging as a supportive tool for teaching and learning in higher education. Sixty-one undergraduate students who had smartphones with WhatsApp installed were randomly assigned to experimental and control groups. Apart from the traditional teaching and learning for both groups, the experimental group also received supporting materials and interacted with the instructor outside school hours. The posttest scores showed that participants in the experimental group performed better than those in the control group. Additionally, data collected from the survey questionnaire also indicated that the use of text messaging through WhatsApp improved learning for these participants, who also presented a positive attitude and acceptance of the use of WhatsApp for
teaching and learning. This is inline with the generational shift in the method of communication that current students have embraced and educators need to get on board and aim to explore the many benefits of, including mobile phones in their teaching.

Text Messaging in Distance Learning

Literature about the use of text messaging in distance learning can generally be divided in three broad categories: 1) to enhance teacher presence, 2) to use as a learning tool, and 3) to use as a communication tool.

Teacher Social Presence

Social presence is defined as the “degree to which a person is perceived as ‘real’ in mediated communication” (Gunawardena, 1995, p.151). Social presence in a distance learning environment is connected to an instructor’s ability to create a sense of community among online learners (Palloff & Pratt, 2011). Several studies have shown that teacher social presence in an online course is a predictor of student overall perceived learning (Akyol & Garrison, 2008; Shea, Li & Pickett, 2006) and satisfaction (Richardson & Swan, 2003; Tu, 2000). DuVall, Powell, Hodge, and Ellis (2007) did a pilot study at East Carolina University to evaluate the effectiveness of incorporating text messaging as a means of conveying information to students in online learning courses, to improve social presence, and to evaluate student perceptions of the tool. Participants in the study were selected from the business, career, and technical education departments. During the pilot, they received a specific type of text messages that were centered on course updates, grade information, due dates and weekly hot topics. Data collected from the survey showed that students who participated in the study liked to use text messaging and felt
that it was useful for enhancing communication in their online class. The collaboration and communication created through text messaging also supported the creation of a social context that fostered a sense of community and provided the opportunity for students to learn through interaction with other students in the online environment. Additionally, the text messaging between students and the instructor also enhanced dialogue in the course, which many online learners preferred. The conclusion of this study exemplifies how text messaging can help improve social presence and learning in online courses.

Social presence in distance learning using text messaging also helps to create a learning environment that fosters collaboration and a sense of community among students. Kovalik and Hosler (2010), in their experimental study, attempted to determine the ability of text messages to communicate course-related information to graduate students enrolled in online courses. The Community of Inquiry (CoI) survey was used to measure students’ reactions to receiving the messages. Using a convenience sampling method, they selected 52 students who owned cellphones and had text message capability in their telephone plans. Participants were put in two groups: the experimental and the control. Students in the experimental group received text message communications on due dates, grade postings, and other course-related messages; the control group did not receive any text message communications. Findings from the study revealed that students had a positive reaction to the use of text messages as a communication tool. The instructor also saw text messaging as a means of maintaining a stronger connection with the class, which positively affects student learning and academic achievement in distance learning courses.
Acceptability of Text Messaging as a Mobile Learning Tool

The adoption of mobile phones as a communication tool in distance learning has also encouraged educators to look for creative ways it can be used to support student learning in a virtual environment. Ismail, Johari and Idrus (2010) conducted a quantitative study at Universiti Sains Malaysian (USM) to explore the impact of perceived usefulness, ease of use and students’ acceptability of mobile learning via SMS. One hundred and five students participated in the study by completing a 23-item survey, which was analyzed using Rasch unidimensional measurement. The result of the study indicates that students agreed that SMS learning using mobile phones was effective, easy and useful in assisting them to study. This shows that students endorsed this mode of communication as an effective method that contributed to their learning.

The ubiquitous nature of this device and its wide acceptance use among college students has also encouraged educators to closely look at ways mobile phones can be used to improve teaching and support student learning in distance education. Adedoja, Adelore, Egbokhare, and Oluleye (2013) conducted a case study at University of Ibadan to examine students’ acceptance of mobile phones as a learning tool in distance learning courses. The study was framed using Davis’s technology acceptance model (TAM) as the theoretical framework; a purposive sampling method involved 201 students who required to have cellphones. Using a mixed-method approach, the authors collected the quantitative data via surveys and the qualitative data through focus group discussions. Analysis of the data collected showed that students perceived the use of mobile phones to have enhanced their learning and to be beneficial. Additionally, the results show a significant positive correlation between perceived usefulness and perceived ease of use.
Text Messaging as a Communication Tool

The integration of text messaging as a method of communication can play a critical role in enhancing student-instructor interaction in online learning courses and in bridging the transactional gap that exists in distance education. Kuyath, Mickelson, Saydam, and Winter (2013) conducted a quasi-experimental research study about the impact of instant messaging (IM), a text message tool, on student-teacher interaction in distance education and also to evaluate how students perceived its use as enhancing their quality of learning and social presence in their online courses. Fifty-nine students enrolled in an engineering program participated in the study. The authors grouped the participants into two groups, where the treatment group was required to use IM to communicate with the instructor when working on their assignments and the control group was expected to only communicate via email with the instructor. The experiment started during the seventh and eighth weeks of a sixteen-week semester. After the first treatment, the authors then switched the groups by reversing their roles. At the end of each treatment, participants were expected to complete a survey, which was later downloaded and analyzed using analyses of covariance (ANCOVA) in SPSS. The study concluded that distance education students who communicated with their instructor via IM performed better than those who only used email and saw this mode of communication to have a positive effect on student learning and an increased social presence. Past studies have also supported this notion (Richardson & Swan, 2003; Swan & Shih, 2005). Therefore, teacher-student interaction through the use of text messaging goes beyond communication and social presence but also adds to the student learning experience, which can positively contribute to student achievement.

A review of these previous studies showed the critical role of interaction in supporting student learning and a learner-centered instructional environment, which are mostly experienced
in the classroom but which text messaging can replicate in online courses. However, there is still the need to investigate the direct impact of the use of text messaging on student academic performance in online courses, which this study attempted to address.

The use of messaging undoubtedly has many benefits that instructors can leverage in order to increase interaction, instant communication, and feedback and make learning possible irrespective of geographical constraints. Knowing that text messages are the preferred way college students communicate with one another, instructors should be encouraged to integrate it into their classroom instruction to build a bonded relationship with their students and to guide them on their path to achieve academic excellence in their courses.

Chapter Summary

From the above studies, it is apparent that the use of text messaging has been adopted in several fields as one of the preferred means of communication. Its impact in improving interaction and connectedness among interested parties is an indication that there is a clear shift in how people are currently communicating with one another. Based on the literature, much is known about the use of mobile phone text messaging as a tool that enhances teacher social presence, student learning, and teacher-student interaction in online learning. There are, however, limited studies that focus on the use of text messaging as a complementary method of communication in online courses and its direct impact on student academic achievement. This study sought to fill the gap in the literature using the dialogue construct of the transactional distance theory as the theoretical framework of the study.
CHAPTER 3

METHODOLOGY

Introduction

This chapter describes the research methods and design that were implemented to examine the impact of the use of text messaging as a communication tool on student academic achievement in an online course at an urban community college. Also, a summary of a pilot study that was conducted about the impact of text messaging in distance learning as well as procedures used to conduct the study, instrumentation, data collection and analysis are all discussed in this chapter.

The purpose of this study was to examine the impact of mobile phone text messaging as an interactive tool on student academic achievement in an online course. Particularly, the study looked at how a two-way communication between an instructor and students via Remind, a text messaging application, affects student academic achievement in an online course. The study used a quantitative research approach, and specifically an experimental design. An experimental design is a method where the researcher manipulates the independent variable and measures differences in a dependent variable(s) after the subjects have been randomly assigned to groups. Experimental research methods are used to evaluate causal-type research questions. For this study, the posttest-only control group experimental research method was specifically used to examine the effect of text messaging on student academic achievement.
The research question that this study investigated was: Does the use of text messaging as a complementary method of communication have a significant effect on student academic achievement in the online course?

The hypotheses were:

\( H_0 \): The use of text messaging as a complementary method of communication has no significant effect on student academic achievement in an online course.

\( H_1 \): The use of text messaging as a complementary method of communication has a significant effect on student academic achievement in an online course.

Prior to the start of the study, a pilot study was conducted using the same treatment and research method.

Summary of the Pilot Study

In the spring of 2016, I conducted a pilot study about the impact of text messaging on student success in an online course. I was also the instructor of a section of a Microsoft Office Application course named the Introduction to Computer Information Systems online, which lasted 16 weeks. Twenty-eight students enrolled in the course and were randomly assigned to two groups of 14 students. Students completed the same course activities and assignments and communicated via email and through the course management system Blackboard. The only difference was that students in the treatment group were able to send and receive text messages from the instructor via Remind, which is a text messaging application.

The Introduction to Microsoft Applications covers four applications: Microsoft Word, Excel, PowerPoint and Access. Students were required to complete four exams, each covering
the four main Office applications and 12 production assignments. The 12 assignments required students to produce documents based on the instruction provided to the students. These assignments were 25 points each.

In order to engage students and enhance communication, I sent out on average five general text messages to students in the treatment group only that contained, among others, reminders about due dates, posting of grades, and check-in messages to find out if they were having any problem with the course content or assignments. Specifically, I was very engaged and willing to reach out to students and encouraged them to ask questions via text messages. Apart from the welcome messages and reminders that were sent out to all students in both groups in Blackboard, other communications about check-ins were tailored to students in the treatment group. About 10 students actively engaged with me and continuously asked questions about course contents and assignments via text messaging. Analysis of data collected at the end of the pilot study indicated that students in the treatment group performed significantly better than students in the control group using the course final grade system as a measure of success. Ninety percent of students passed the course with a grade of C and above compared to 60% of students in the control group. The results of the pilot study showed that text messaging as a communication tool had a significant effect on student performance in the online course. Using the pilot study as a framework, I designed the current study using the same research method but altered the design procedure.

Study Treatment Design

This study was designed to examine the impact of using text messaging as a communication tool on student academic achievement in an online computing course. The study
employed an experimental design which involved 50 students enrolled in an online computer programming course in an urban community college. It covered eight weeks and students were randomly assigned into two groups, control and experimental groups. Both groups were taught by the same instructor and received the same instructions and course materials. While students in the experimental group were able to exchange text messages with their instructor via Remind, a text messaging application, in addition to email and through Blackboard, those in the control group only communicated with the instructor via email and the course management system.

The decision to select a treatment design for this study was based on the pilot study, but specifically on a text messaging study conducted by Kovalik and Hosler (2010). Their study investigated the impact of text messaging as a communication tool to convey course information to students in online courses taught by one instructor as in the case of the current study. Despite these similarities, there were also notable differences in the way texting was used in the two research studies. In the current research, communication was a two-way process and the researcher used a texting application to communicate with students, unlike in Kovalik and Hosler’s study, which was a one-way direct communication through cellphones. Also this study theorized transactional distance as the mechanism to evaluate the impact of text messaging on student academic achievement, unlike in Kovalik’s and Hosler’s study which relied on the community of inquiry theory. Therefore, some of the lessons learned from that study were taken into consideration when designing this study.

Participants

Study participants were first-year students enrolled in an online Introduction to Programming course at a community college in the state of Illinois. The selection of this college
and participants was based on convenience and access by the researcher. The target population from the convenience sample were students who enrolled in the introductory Computer Programming Language course sections offered in the Spring 2018 semester. In this study, only two course sections were offered by the college and facilitated by the same instructor. To be part of the study, students were required to own a mobile phone with text messaging capability. To ensure that students had working mobile phones, the researcher verified student profile information using the college student information system (PeopleSoft Campus Solution) where all students were expected to list their home, mobile, and emergency phone numbers.

Students could self-enroll into the programming course via their student portal or could be added to the course by their college advisors. The only requirement to take this course was that students had to be eligible for English Composition. Fifty-eight students enrolled into the online programming course by the first day of the Spring 2018 semester. However, by the time the study started, eight students withdrew from the course for various reasons. The final count of students who participated in the study was fifty (N=50).

Students (N=50) enrolled in the course were randomly assigned to a treatment or a control group using a pseudo-random number generator program called Research Randomizer, which uses a complex algorithm to come up with random numbers (Urbaniak & Plous, 2015). I performed the randomization procedure and attached a number to the name of each student in order to protect their privacy. I then input information into the randomization system, which generated two random groups that were subsequently named the treatment and control groups. Twenty-five students were assigned to the treatment group and 25 to the control group.

Students in the treatment group had an average age of 26 with 52% (13) in the 15-24 age group. Out of a total of 25 students in the group, 13 of them (representing 52%) identified
themselves as Hispanics. Also 20 out of the 25 students were male students, representing 80%

The grade point average (GPA) of the majority of the students (11) was in the 2.0 - 2.9 category.

The composition of participants in the control group also had an average age of 27; 76% of the students were male. Sixteen students (64%) were in the 25-44 age group. Hispanic and White students each constituted 32% of the total students and 28% of all students had a GPA that were in 4.0-3.5 and 2.9-2.0 categories. Table 1 below shows a detailed breakdown of the characteristics of both treatment and control groups.

In comparing both groups, it could be concluded that they were fairly similar in regards to their average age and gender. In both groups, the average was 26 in the treatment and 27 in the control group. Also, both groups had more male students. The main differences were the ethnicity composition that had 52% Hispanic in the treatment group compared to 32% in the control group. Also, 44% of students in the treatment group had GPAs in 2.0-2.9 category compared to 28% of students in the control group. Reported in the next chapter are the study group composition results which showed that there was no significant difference between the treatment and control groups in regard to gender and ethnicity, with an alpha value of 0.05, as well as the reliability results of the dependent variables.
Table 1

Age, Gender, Major and Ethnicity Distribution of the Students Who Participated in the Study

<table>
<thead>
<tr>
<th></th>
<th>Treatment Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Percentage</td>
<td>Percentage</td>
</tr>
<tr>
<td>15-24</td>
<td>52%</td>
<td>36%</td>
</tr>
<tr>
<td>25-44</td>
<td>48%</td>
<td>64%</td>
</tr>
<tr>
<td>45-64</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td>Percentage</td>
<td>Percentage</td>
</tr>
<tr>
<td>Asian</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Black</td>
<td>20%</td>
<td>28%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>52%</td>
<td>32%</td>
</tr>
<tr>
<td>White</td>
<td>20%</td>
<td>32%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Percentage</td>
<td>Percentage</td>
</tr>
<tr>
<td>Female</td>
<td>20%</td>
<td>24%</td>
</tr>
<tr>
<td>Male</td>
<td>80%</td>
<td>76%</td>
</tr>
<tr>
<td><strong>Major</strong></td>
<td>Percentage</td>
<td>Percentage</td>
</tr>
<tr>
<td>Computer Sci.</td>
<td>76%</td>
<td>68%</td>
</tr>
<tr>
<td>Visiting stud.</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Web Dev.</td>
<td>8%</td>
<td>4%</td>
</tr>
<tr>
<td>Undeclared</td>
<td>4%</td>
<td>-</td>
</tr>
<tr>
<td>Bus/Economics</td>
<td>4%</td>
<td>-</td>
</tr>
<tr>
<td>Human Sci /</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undecided</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Networking</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Pre-nursing</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Natural Science</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td><strong>GPA</strong></td>
<td>Percentage</td>
<td>Percentage</td>
</tr>
<tr>
<td>4.0 – 3.5</td>
<td>24%</td>
<td>28%</td>
</tr>
<tr>
<td>3.4 – 3.0</td>
<td>16%</td>
<td>24%</td>
</tr>
<tr>
<td>2.9 – 2.0</td>
<td>44%</td>
<td>28%</td>
</tr>
<tr>
<td>1.9 – below</td>
<td>4%</td>
<td>8%</td>
</tr>
<tr>
<td>No GPA</td>
<td>12%</td>
<td>12%</td>
</tr>
</tbody>
</table>
Research Procedures

This study used an introductory programming course that was fully taught online by one instructor and used text messaging (independent variable) as a complementary method of communication with students only in the experimental group. The study covered eight weeks. The course facilitator was an experienced and certified online instructor who had been teaching this course for several years. She was also involved in redesigning the course years ago and is comfortable with the course content and assessments. As an experienced online instructor, she is aware of some of the challenges that students usually encounter when taking this course and has put in place several strategies to support students whenever she teaches this course. All complementary text message communications were done using the Remind application.

Remind, formally known as Remind 101, is an application that enables instructors to communicate with individuals or groups of students in real time through text messages directly to their cellular phones. To get started, the instructor created an account on the Remind site using her computer. She later downloaded the application from iTunes onto her phone. From her computer, the instructor created an online class community and posted a short code with instructions on how students could register and self-enroll into the online community. All text message communications went through Remind directly into the students’ phones. Students had the option to text their instructor back from their mobile phones or online via their Remind online account. Remind stored all text messages both from the instructor and the students throughout the study.

Remind application has many benefits. Among them, students’ phone numbers are never revealed to the instructors and vice versa. Every text message that goes to students comes with a number that Remind randomly generates in order to mask students’ real telephone numbers. This
addresses any issue about student privacy in regards to their personal numbers. Instructors can schedule future messages throughout the semester well in advance. It also allows instructors to send attachments and to interact with students in real time. Additionally, instructors can post their availability schedule in Remind to indicate when they are available to chat. Finally, despite that Remind has a 140-letter limit feature, it is only applicable when using the web version unlike when texting from a smartphone.

The online introductory programming course used for the study is offered every semester for first-year students who are interested in pursuing a degree in computer science. However, other students interested in learning programming languages can also enroll in the course. The course is structured in eight modules and has a series of assignments which are made up of programming exercises and a proctored exam. All assignments were due on Sunday by midnight and the course was hosted on the course management system Blackboard. Students in the treatment and control groups had access to the same course content, materials and assignments. They all received email communications and weekly announcements that the instructor posted in the course. At the beginning of each week, a detailed announcement about readings and activities were posted in Blackboard with a copy sent directly to all students’ email accounts. These announcements were posted every Monday morning when a new module started (see Appendix G). The only difference in the communications between the two groups was that students in the treatment group could directly initiate a two-way text messaging communication with the instructor and ask questions about course content. Students in the control group, on the other hand, could not text their instructor. That is, their interaction with the instructor was limited to email and communication via Blackboard.
Students in the treatment group received on average three text messages a week from the instructor. The first one was sent out around 10:00 a.m. on Mondays and introduced students to the new module and the tasks they were required to complete by the end of the week. On Fridays around noon, the instructor sent a second message which served as a reminder to students in the treatment group about the module activities and encouraged them to start working on them immediately to avoid submitting their assignments late. A final message was sent out on Sundays around 10:00 a.m. reminding students in the treatment group again that the weekly assignments were due by midnight. A script of the three text messages the instructor sent out are below in Figures 2, 3 and 4.

Figure 2: An example of Monday’s text messages that the instructor sent out to students in the experimental group.

Figure 3: An example of Friday’s text messages that the instructor sent out to students in the experimental group.
Information included in these text messages are an extension of the weekly announcements and the email messages that the instructor also sent out during the week. The main advantage of sending text messaging to students in the treatment groups was the ease and instant access to the information on the phone, unlike in Blackboard or via email.

In order to increase student-instructor interaction and provide instant replies to students, the instructor made every effort to reply to students’ questions and inquiries within minutes of receiving them. Even when the instructor did not have answers to students’ questions, at the very minimum she acknowledged receipt of the messages and got back to the students by the end of the day. Additionally, students in the treatment group were encouraged to initiate contact with the instructor via text messages and ask questions if they had any. This was a two-way communication interaction between the instructor and students in the treatment group. Finally, in order for the instructor not to be overwhelmed with text messages, she created a schedule in Remind that indicated the time she was available to interact with students and answer questions about course content and assignments.

Figure 5 presents a graphical design of the study. The independent variable is the text message and the dependent variable are the final scores of the proctored exam and the programming exercises.
The study used the programming exercise scores and the proctored exam (dependent variable) as the measurement to answer the research question, which was to examine the impact of the use of text messaging on student academic achievement. Table 2 below shows a breakdown of the assignments used in the study.

Table 2
Introduction to Computer Programming Course Learning Activities Outline

<table>
<thead>
<tr>
<th>Learning Activities</th>
<th>Number of Activities</th>
<th>Points for each activity</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Exercises</td>
<td>6</td>
<td>20</td>
<td>120</td>
</tr>
<tr>
<td>Proctored Exam</td>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>220</strong></td>
</tr>
</tbody>
</table>

Instrument Descriptions
The programming exercises were divided into two parts: part 1 required students to write a pseudocode; part 2 required students to draw a flowchart that depicted the programming logic.
of the codes. There were six programming exercises and each of them carried 20 points. To complete the program assignments, students used MS Word to write the codes and Raptor to draw the flowchart. Raptor is a free flowchart-based application that helps users to visualize their coding logic and algorithms and has many pre-defined shapes that students can use to create the flowchart. In grading these assignments, the instructor used rubrics she developed and tested with two of her colleagues who also teach computer science courses in the college. See Appendix A for an example of the assignment rubric. Each assignment had its rubric and was based on the learning objectives covered in the particular module. Also available to students when working on their assignments were tutorial videos that explained the programming concepts covered in the assignments.

The proctored exam was made up of 50 multiple-choice and true/false questions covering all the topics in the course. Students were required to take the exam in a proctored environment under the supervision of a testing staff. To take the exam, students were required to schedule their appointments during the first week of the semester. The duration of the exam was 60 minutes and had a total score of 100 points, which was also computer scored after it was submitted. Students were allowed to take it only once.

**Instrument Validity**

To ensure the validity of the instruments (i.e., proctored exam and programming exercises), I had them validated by other programming instructors with years of teaching experience in programming language courses. Specifically, these instructors helped ensure content validity by referencing the four elements of test content validity: domain definition,
domain representation, domain relevance and appropriateness (i.e., the content adheres to the course syllabus; Sireci, 1998).

The course assignments were reviewed by subject matter experts (SMEs) for validation purposes prior to the start of the study. Two computer programming instructors were recruited as subject matter experts (SMEs) to validate the assignments (programming exercises and proctored exam). After their selection, SMEs met with me in a computer lab for a few hours where they were oriented about the tasks they would complete. Since they were familiar with the course content, discussions on how to validate the assignments in the course were straightforward and took a few hours. They were subsequently given three weeks to complete the test validation process.

To validate each test item on the proctored exam and the programming exercises, the two SMEs examined the questions by reviewing the “construct” on the test items to determine if the content domain adequately represented and measured the skills, tasks and concepts in the course. Also, the SMEs reviewed the relevance of the test items with regards to the targeted domain and their appropriateness. This was to ensure that all course instruments measured the desired “content domain” they were intended to assess with respect to the learning objectives of the course. Evidence from these reviews suggested that items on these assignments were relevant and measured the construct intended.

**Instrument Reliability**

Reliability is the degree of consistency of a measurement tool or process (Beaumont, 2009). In other words, reliability is how consistent an instrument is in measuring what it is intended to measure. To measure the reliability of the exam, which includes questions from all
topics covered in the course, test scores of a sample of students were analyzed using SPSS. Cronbach’s alpha was used to measure the internal consistency of the exam. The theoretical value of alpha varies from 0 to 1, since it is the ratio of two variances. Higher alpha value means that the items on the instrument are measuring the same construct. According to Hinton, McMurray and Brownlow (2004), an alpha score of 0.70 and above is considered to be a scale of high reliability and a 0.5 to 0.70 score is generally accepted as a moderately reliable scale. So, an alpha score below 0.5 means the instrument is unreliable and should be checked and deleted. Therefore, any value less than 0.5 indicates either poor score reliability or multidimensionality.

The programming exercises were further tested for reliability using the inter-rater reliability estimates. To test the inter-rater reliability of the programming assignments, two instructors (SMEs) were asked to double score the work submitted by a sample of students, comprised of 10 students, five from the treatment group and five from the control group. SMEs independently graded each of the programming assignments submitted by these students in order to determine the degree of homogeneity or consensus among the SMEs. After double scoring the items, data collected were tested in SPSS. Assignments with an alpha value of 0.05 and above only were retained since any reliability coefficient of 0.5 or higher is considered as moderately reliable. The use of inter-rater reliability in testing performance-related assignments such as the programming exercises was beneficial since instructors might possibly interpret and score differently than the programming activities. The results of these tests are presented in the next chapter.

Data Collection

Prior to starting the study, I received permission from the Northern Illinois University Institutional Review Board (IRB) and the site where the research took place, as well as from the
participants. Obtaining IRB approval from the university was the first step in the permission process. I completed an application and provided detailed information about the research procedures (e.g., research site, target population, copies of informed consent, information about how participants’ rights and privacy would be protected).

Detailed information about the study was also provided to the administration of the college where the study took place. In regards to the study site, information about how the college would benefit from the study and confidentiality were among some of the pertinent questions that I needed to answer before being granted access to the site and the students. On the student consent form, I provided information about the purpose of the study in general but did not specify that it was mainly about text messaging, in order to control the experimental group and the validity of the study. Also on the form were statements about students owning cellphones with texting capabilities and their consent to receive and send text messaging during the study. Furthermore, the form explained that there was no discrimination in the selection of the participants and that no student would be penalized for not participating in the study. Once all the permissions were granted and the instructor was selected, a week before the start of the semester, students received an introductory message from the instructor about the study and a copy of the consent form electronically via their student email addresses; see Appendix B for a copy of the consent form. Once all the permissions were granted, I started the study beginning the first day of the Spring 2018 semester. Student achievement data, which included test scores, the proctored exam, and the programming exercises, were gathered at the end of the study.

During the data collection stage, I checked for any missing data, which was very unlikely to occur in the first place since all data are available in Blackboard and the Remind application
platforms. The reason for checking was to ensure that all the students’ exercise and exam scores were correctly recorded in the gradebook.

Data Analysis

After students’ final scores of the proctored exam and the programming exercises were collected from the instructor, I tabulated and organized them per groups (control and treatment) to have an idea of the results. I compared the mean and standard deviation of the two groups to get descriptive statistics.

The first step in the inferential data analysis process involved a review of the composition of treatment and the control groups to ensure that they were evenly distributed using factors such as gender, ethnicity, and age. To assess the gender and the ethnicity composition of the two groups and account for any sampling error that might exist, a series of statistical tests were conducted. If the difference between the two groups was clearly evidenced based on the gender composition, a chi-square statistical test would be performed to test the relationships between the two categorical variables (male and female). Additionally, a difference in the two groups based on age, which is a continuous variable, would require an independent samples t test to compare mean values of both groups.

These preliminary tests were necessary to ensure that there were no significant differences in the treatment and the control groups in regards to those variables prior to the treatment implementation. Therefore, results indicated that it was not necessary to statistically adjust for any initial differences in the treatment and control groups.

Next, data collected were assessed for normality and homogeneity of variances. Normality assumes that the scores are normally distributed; this can be tested using the Shapiro-
Wilk test. Homogeneity of variances assumes that both groups (treatment and the control groups) have equal variances, which can be assessed using Levene’s test. If the assumption of normality was violated because of the presence of an outlier, data would be re-checked to ensure that the occurrence was not due to data entry mistakes. Otherwise, a logarithmic transformation of the data would be conducted using SPSS so that data become normally distributed.

To answer the research question, two independent samples $t$ tests were used to determine if there was a significance difference in the academic achievement between the two groups (treatment versus control). An independent samples $t$ test is used to assess the mean difference of two independent groups (treatment and control groups) on the same continuous (interval/ratio) dependent variable (scores of programming exercises and the proctored exam). If the treatment and control groups were non-equivalent, an alternative procedure such as analysis of variance or analysis of covariance would have been used with any variable on which the groups were different included as a covariate. The test would help determine if there was a significant impact of using text messaging as a communication tool. The SPSS output included mean differences, standard deviation, standard errors, and confidence interval. The effect size of the treatment was also computed using Cohen’s $d$ test.

Chapter Summary

Distance learning continues to be one of the favored delivery modes for youth and working adults who want to pursue higher education while still working and taking care of their families. Enrollment data continues to support this trend, which may indicate that distance learning is here to stay and has yet to reach its full capacity (Seaman et al., 2018). Yet, despite the popularity of online courses, institutions are still facing the problem of low success rates,
which can be tackled using various instructional strategies and technology. One such strategy might be the integration of a mobile phone text messaging tool, which could create and enhance student interaction and engagement in online courses. The adoption of this tool in an online environment may come in handy considering that the majority of college students own and practically spend all their time on these devices.

This study examined how the use of text messaging as a two-way communication between students and instructor affected student academic achievement in an online computer programming course. Fifty students participated in the study and their programming exercise and proctored exam scores in the course were used to determine the impact of texting on their academic achievement using the independent samples $t$ tests.
CHAPTER 4
FINDINGS
Introduction

This chapter discusses the data collected from students, Blackboard and the subsequent statistical analysis of the data to determine the effect of text messaging on student academic achievement in the course. The chapter is organized into the following sections: study group composition, description of reliability test results, the inferential statistical results using independent samples t tests, and evaluation of findings.

The focus of this research study was to examine the impact of text messaging on student academic achievement in an online introductory computer programming course. The research question was: Does the use of text messaging as a complementary method of communication have an effect on student academic achievement in an online course? The null hypothesis (H₀) of the research question was that the use of text messaging as a complementary method of communication has no effect on student academic achievement in an online course. At the end of the study, data were collected for analysis. Included in the data were the programming assignments and the proctored exam scores earned by students in the control and treatment groups.

Study Group Composition Results

Fifty students participated in the study. Twenty-five students were randomly assigned to the treatment group and 25 to the control group. To verify the statistical equivalence of both
groups and ensure that there was no significant difference in their composition in regards to their gender and ethnicity, a chi-square test was performed with an alpha value of 0.05 for the gender and ethnicity compositions separately. The results of the tests showed the probability ($P$) values for gender and ethnicity were 0.733 and 0.529 and their Pearson chi-square values were 0.117 and 2.22 respectively. Since these results were more than the 0.05 alpha value, it meant there was no significant difference in the composition of the groups in regards to their gender and ethnicity, which suggested that the outcome of the study might not be necessarily due to the composition of the groups. Detailed results are shown in Table 3 below.

Table 3

Results of Chi-Square Test on Gender and Ethnicity Composition of Participants

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of students</th>
<th>$P$ value</th>
<th>Pearson Chi-Square</th>
<th>Degree of Freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Treatment</td>
<td>25</td>
<td>.733</td>
<td>.117</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>25</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Treatment</td>
<td>25</td>
<td>.529</td>
<td>2.22</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>25</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Also to determine the initial difference in the two groups based on student age and their grade point average (GPA) prior to enrolling into the course, separate independent samples $t$ tests were performed to compare mean values of both groups. The results of the test showed a $p$ value of 0.612 for the age and 0.373 for GPA. These results suggested that the mean values between the two groups were not significantly different. See Table 4 below for detailed information.
Table 4

Independent T-Test Results of Study Participants’ GPA and Age

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of students</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>P value</th>
<th>t-value</th>
<th>Df</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
<td>Treatment</td>
<td>25</td>
<td>3.096</td>
<td>.55772</td>
<td>.612</td>
<td>.511</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>25</td>
<td>2.988</td>
<td>.8209</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Treatment</td>
<td>25</td>
<td>26.24</td>
<td>6.635</td>
<td>.373</td>
<td>-.899</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>25</td>
<td>27.800</td>
<td>5.597</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reliability Results of Dependent Variables

The dependent variables in the study were the total scores students received on the programming exercises and the proctored exam at the end of the study. Reliability tests for the programming exercises were first conducted and then the proctored exam.

To determine the reliability of individual items on these programming assignments, two subject matter experts (SMEs) double graded a sample of programming exercises submitted by ten students, five from the control group and five from the treatment group. Each programming exercise had two parts, namely the coding (part 1) and the flowchart section (part 2). Scores collected from the SMEs were analyzed using Cohen’s kappa and Cronbach’s alpha tests. Cohen’s kappa test examined the degree of agreement between the two SMEs on the programming exercises. Cronbach’s alpha test, on the other hand, measured the internal consistency of the exercises, which is how well these assignments measure what they should. Generally, the values of both tests range from 0 to 1, where high values mean better reliability.
and values close to or less than zero suggest that the agreement is due to guessing. Analysis of the programming scores using Cohen’s kappa and Cronbach alpha are shown below in Table 5.

**Table 5**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Inter-rater reliability</th>
<th>Internal consistency (rater A)</th>
<th>Internal consistency (rater B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming exercise 1</td>
<td>Part 1 .66</td>
<td>.75</td>
<td>.57</td>
</tr>
<tr>
<td>Programming exercise 1</td>
<td>Part 2 .79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programming exercise 2</td>
<td>Part 1 .48</td>
<td>.59</td>
<td>.85</td>
</tr>
<tr>
<td>Programming exercise 2</td>
<td>Part 2 .61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programming exercise 3</td>
<td>Part 1 .72</td>
<td>.31</td>
<td>.48</td>
</tr>
<tr>
<td>Programming exercise 3</td>
<td>Part 2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Programming exercise 4</td>
<td>Part 1 .60</td>
<td>.69</td>
<td>.79</td>
</tr>
<tr>
<td>Programming exercise 4</td>
<td>Part 2 .87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programming exercise 5</td>
<td>Part 1 .86</td>
<td>.89</td>
<td>.92</td>
</tr>
<tr>
<td>Programming exercise 5</td>
<td>Part 2 .86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programming exercise 6</td>
<td>Part 1 .71</td>
<td>.80</td>
<td>.88</td>
</tr>
<tr>
<td>Programming exercise 6</td>
<td>Part 2 .83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scores in Table 5 show that, with one exception (Exercise 2, part 1 = 0.48), the inter-rater reliability values were acceptable (0.6 and higher), indicating the reliability of individual item scores on the programming exercises. Likewise, alpha coefficient values were generally high, except for exercise 3 (0.31 and 0.48), suggesting that items on the exercises had relatively high internal consistency. Based on these values, one could suggest that the reliability of the programming exercises is adequate to be treated as an instrument to answer the research question.

A reliability test of the proctored exam, which was the second dependent variable was conducted. The exam questions were made up of all the modules that the students covered in the course and the results showed that the alpha score was 0.73. The results indicated that items on
the proctored exam had high internal consistency since it was well above the minimum acceptable reliability threshold. Based on these values, one could suggest that the reliability of the proctored exam was adequate to be treated as an instrument to answer the research question.

Individual Programming Assignments Analysis and Results

The study covered a period of eight weeks, during which students were required to complete one programming assignment per week starting week 2 through week 7 and a proctored exam the final week of the study. Analysis of the six programming assignments that students completed weekly were conducted to examine the impact of the treatment on student performance on each of these assignments at different times. Table 6 below shows an outline of activities students in both groups completed weekly.

Table 6
Programming Exercises Weekly Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Activity and Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Course orientation and introduction</td>
</tr>
<tr>
<td>2</td>
<td>Module 1 programming assignment</td>
</tr>
<tr>
<td>3</td>
<td>Module 2 programming assignment</td>
</tr>
<tr>
<td>4</td>
<td>Module 3 programming assignment</td>
</tr>
<tr>
<td>5</td>
<td>Module 4 programming assignment</td>
</tr>
<tr>
<td>6</td>
<td>Module 5 programming assignment</td>
</tr>
<tr>
<td>7</td>
<td>Module 6 programming assignment</td>
</tr>
<tr>
<td>8</td>
<td>Proctored exam</td>
</tr>
</tbody>
</table>

In week 2, students in both groups completed Module 1 programming assignment. The t-test result showed there was a significant difference in the scores between the two groups,
$t(26.447)=2.02$, $p=0.04$. These results suggest that students in the treatment group ($M=16.80; SD = 3.27$) who used text messaging to communicate with their instructor performed better than students in the control group ($M =12.91; SD = 8.48$). The size of this effect (0.61) is referred to as medium based on Cohen’s (1988) coefficient $d$ effect size chart, which categorizes an effect size to be small when $d=0.20$, medium at $d =0.50$, and large when $d =0.80$. See Table 7 below for detailed results of the $t$ test.
Table 7

Independent Samples Test for Programming Assignment 1

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Programming 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>27.279</td>
<td>000</td>
<td>2.125</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>2.024</td>
<td>26.447</td>
<td>.043</td>
</tr>
</tbody>
</table>
T-test results for programming assignment 2, which took place in week 3, showed there was a significant difference in the scores between the two groups, $t(27.154)=2.48, p=0.02$. These results also suggest that students in the treatment group ($M=15.20; SD = 3.54$) did perform better than students in the control group ($M =10.71; SD = 7.62$). The effect size ($d=0.8$) between the means of the two groups was large. Table 8 below shows detailed results.
Table 8

Independent Samples Test for Programming Assignment 2

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Programming 2</td>
<td>Equal variances assumed</td>
<td>30.480</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td>2.483</td>
<td>27.154</td>
</tr>
</tbody>
</table>

In week 4, students in both groups completed programming assignment 3 and the \( t \)-test results suggested there was a significant difference in the scores between the two groups, \( t(17.011) = 2.22, p = 0.04 \). These results indicate that students’ scores in the treatment group (\( M = 16.86; SD = 1.56 \)) were higher than students in the control group (\( M = 12.53; SD = 7.90 \)). The effect size (0.8) between the means of the two groups was also large. See Table 9 below for detailed results.
Table 9

Independent Samples Test for Programming Assignment 3

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Programming 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>48.862</td>
<td>.000</td>
<td>2.460</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>2.224</td>
<td>17.011</td>
<td>.040</td>
</tr>
</tbody>
</table>
The independent $t$-test results for programming assignments 4, 5 and 6, on the other hand, showed that there was no significant difference in the scores between the treatment and the control groups.

The test result for the programming assignment 4 was $t(33) = -1.24, p=0.23$. Results for assignment 5 was $t(16.048) = 1.22, p=0.24$, and for programming assignment 6, it was $t(29) = -0.73, p=0.47$. All these results suggested that the use of text messaging had no effect on student achievement in the treatment group in assignment 4 ($M=15.05; SD = 3.59$), assignment 5 ($M=17.05; SD = 2.04$), and assignment 6 ($M=16.75; SD = 3.81$) compared to students in the control group ($M=16.40; SD = 2.561$); ($M=14.87; SD = 6.72$); ($M=17.87; SD = 3.60$) in assignments 4, 5 and 6 respectively. See Tables 10, 11 and 12 below for detailed results.
Table 10

Independent Samples Test for Programming Assignment 4

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test</th>
<th>t test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>for Equality of Variances</td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Programming 4</td>
<td>Equal variances assumed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>1.287</td>
<td>.265</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>-1.299</td>
<td>32.942</td>
</tr>
</tbody>
</table>
Table 11
Independent Samples Test for Programming Exercise 5

<table>
<thead>
<tr>
<th>Programming 5</th>
<th>Levene's Test for Equality of Variances</th>
<th>t test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal variances assumed</td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>9.874</td>
<td>.004</td>
<td>1.347</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>1.217</td>
<td>16.048</td>
<td>.241</td>
</tr>
</tbody>
</table>
Table 12

Independent Samples Test for Programming Assignment 6

<table>
<thead>
<tr>
<th>Levene's Test for Equality of Variances</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Programming 6</td>
<td>Equal variances assumed</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
</tr>
</tbody>
</table>
From the above test results, it might be concluded that students in the treatment group did perform better than students in the control group when completing the first three programming assignments during weeks 2, 3 and 4 of the study. However, from weeks 5 through 7, results of the test scores were not significantly different between the two groups. The implication of this finding will be discussed in the next chapter.

Independent Samples T-Test Results

To test the research hypothesis \( (H_1) \), which was that the use of text messaging as a complementary method of communication will have a significant effect on student academic achievement in an online course, independent samples \( t \) tests were used to analyze the test scores. For an independent samples \( t \) test to be conducted, certain assumptions need to be met, among which are the assumptions of normality and homogeneity of variance.

To assess that the dependent variables (proctored exam and the programming assignments) are normally distributed for each independent group, the Shapiro-Wilk test was used instead of the Kolmogorov-Smirnov test. This test was used because it is more appropriate for a small size sample up to 2000. The normality test results of the exams for both control and treatment groups were less than 0.05 \( (p = 0.00) \), indicating that the exams were not normally distributed. Additionally, with the exception of the programming exercises for the control group \( (p = 0.06) \), the normality test result for students in the treatment group \( (p= 0.32) \) was significant. This indicated that scores among the groups were not normally distributed and thus failed the normality assumption. Detailed information is shown in Table 13 below.
Table 13

Tests of Normality for the Proctored Exam and Programming Exercises

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Exam</td>
<td>.797</td>
</tr>
<tr>
<td>Treatment Exam</td>
<td>.742</td>
</tr>
<tr>
<td>Control Programming</td>
<td>.867</td>
</tr>
<tr>
<td>Treatment Programming</td>
<td>.861</td>
</tr>
</tbody>
</table>

To test the assumption of the homogeneity of variances of the dependent variables, Levene’s test was used. The results of the tests for the exam and programming exercises were 1.75 and 4.96 respectively. With the alpha value of 0.05, the Levene’s tests showed that only the assumption of the homogeneity of variances for the proctored exam was met ($F=1.75, p = 0.19$) but that of the programming assignments was violated ($F=4.69, p = 0.04$). Therefore, it could be concluded that variances of scores among the independent variables failed to meet the homogeneity of variances assumption. See Table 14 below for more details.

Table 14

Test of Homogeneity of Variances for Proctored Exam and Programming Exercises

<table>
<thead>
<tr>
<th>Levene’s test for Equality of Variances</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levene’s test for exam</td>
<td>1.75</td>
<td>0.19</td>
</tr>
<tr>
<td>Levene’s test for programming</td>
<td>4.96</td>
<td>0.04</td>
</tr>
</tbody>
</table>

In spite of the violation of normality and homogeneity of variance assumptions, I still conducted an independent samples $t$ test to answer the research question, which was to assess the
impact of text messaging on student academic achievement in the online course. The $t$-test results of the proctored exam showed there was no significant difference in the scores for the treatment group ($M=68.40$, $SD=33.15$) and the control group ($M=56.08$, $SD=37.87$); $t(48)=1.22$, $p = 0.23$. These results suggested that using text messaging as a communication tool in the online computer programming course had no significant effect on student achievement in the treatment group compared to those in the control group. The results failed to reject the null hypothesis.

Detailed results are shown in Tables 15 and 16 below.

Table 15

Independent Samples $T$-Test Results for Proctored Exam

<table>
<thead>
<tr>
<th>Conditions</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>exam</td>
<td>25</td>
<td>68.4000</td>
<td>33.15620</td>
<td>6.63124</td>
</tr>
<tr>
<td>control</td>
<td>25</td>
<td>56.0800</td>
<td>37.87471</td>
<td>7.57494</td>
</tr>
</tbody>
</table>

________________________________________________________________________
<table>
<thead>
<tr>
<th>exam</th>
<th>Levene's Test for Equality of Variances</th>
<th>t test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal variances assumed</td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>1.754</td>
<td>.192</td>
<td>1.224</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>1.224</td>
<td>47.175</td>
<td>.227</td>
</tr>
</tbody>
</table>
An independent samples t test was also conducted for the programming exercises to compare the scores of the two groups. The results of the tests indicated there was no significant difference in the programming exercise scores between the treatment and the control groups, \( t(21.837) = -0.40, p=0.69 \). These results suggest that the use of text messaging as a communication tool in the online computer programming course had no effect on student achievement in the treatment group (\( M=97.29, SD =21.07 \)) compared to those in the control group (\( M=100, SD =12.81 \)). The results failed to reject the null hypothesis. Tables 17 and 18 below show detailed results.

Table 17

Programming Exercises Independent Samples T-Test Results

<table>
<thead>
<tr>
<th>Conditions</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>programming</td>
<td>14</td>
<td>97.2857</td>
<td>21.06557</td>
<td>5.63001</td>
</tr>
<tr>
<td>treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>12</td>
<td>100.0000</td>
<td>12.81335</td>
<td>3.69889</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 18

Independent Samples Test

<table>
<thead>
<tr>
<th>programming</th>
<th>Levene's Test for Equality of Variances</th>
<th>t test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
</table>
Mann-Whitney U Test Results

The violations of the normality and the homogeneity of variances assumptions showed that using an independent samples $t$ test was inappropriate to answer the research question. The most appropriate test was the Man-Whitney U test. A Mann-Whitney U test is a non-parametric test that is used to compare two sample means from the same population and also when the $t$-test assumptions are not met. Results of Mann-Whitney tests were not significant for either the proctored exam ($U = 250.00, p = 0.22, r = -0.017$) or the programming exercises ($U = 82.00, p = 0.92, r = -0.02$), indicating that the use of text messaging in the course had no impact on student achievements in the treatment group compared to their counterparts in the control group. These results supported the same conclusion, which was the failure to reject the null hypothesis ($H_0$).

Tables 19 and 20 below show detailed results of the Mann-Whitney Test.

Table 19

<table>
<thead>
<tr>
<th>Ranks</th>
<th>Test Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Exam</td>
</tr>
<tr>
<td>Sum of Ranks</td>
<td>Mann-Whitney U</td>
</tr>
<tr>
<td>N</td>
<td>Wilcoxon W</td>
</tr>
<tr>
<td>Rank</td>
<td>Z</td>
</tr>
<tr>
<td></td>
<td>Asymp. Sig. (2-tailed)</td>
</tr>
<tr>
<td>control</td>
<td>Grouping Variable: conditions</td>
</tr>
<tr>
<td>treatment</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>conditions</th>
<th>N</th>
<th>Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam control</td>
<td>25</td>
<td>23.00</td>
<td>575.00</td>
</tr>
<tr>
<td>Exam treatment</td>
<td>25</td>
<td>28.00</td>
<td>700.00</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>35.00</td>
<td>1275.00</td>
</tr>
</tbody>
</table>
Table 20

Mann-Whitney Test Results of the Programming Exercises

<table>
<thead>
<tr>
<th>Conditions</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming control</td>
<td>12</td>
<td>13.33</td>
<td>160.00</td>
</tr>
<tr>
<td>treatment</td>
<td>14</td>
<td>13.64</td>
<td>191.00</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test Statistics\(^a\)

<table>
<thead>
<tr>
<th></th>
<th>Programming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann-Whitney U</td>
<td>82.000</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>160.000</td>
</tr>
<tr>
<td>Z</td>
<td>-.103</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.918</td>
</tr>
<tr>
<td>Exact Sig. [2*(1-tailed Sig.)]</td>
<td>.940(^b)</td>
</tr>
</tbody>
</table>

\(^a\) Grouping Variable: conditions
\(^b\) Not corrected for ties.

Chapter Summary

The findings of this study did not support the assumption that the use of text messages as a communication tool would have a significant impact on students’ academic achievement in an online computer programming course at a community college. No significant difference was found between the treatment and the control groups. The study involved 50 online students who were randomly assigned into either a treatment group or a control group. Students in the treatment group were able to send and receive text messages from the instructor in addition to communicating with her via Blackboard and email, unlike students in the control group who
could only communicate with the instructor via email and through Blackboard. The next chapter discusses plausible explanations of the results, compares findings from similar studies, and makes recommendations for further study.
CHAPTER 5
DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

Introduction

Student enrollment in online courses at community colleges and universities have continued to increase exponentially over the past ten years (Seaman et al., 2018). College administrators are aware of the impact and the benefits of offering more online courses to address some of the budgetary shortfalls they encounter due to lower enrollment in face-to-face courses (Anderson, Boyles & Rainie, 2012). Distance learning is seen as the “future” of education as more institutions are expanding their online courses to accommodate unserved and working adults who are unable to attend classroom instruction. According to Kim (2018), 71% of all 4,717 degree-granting institutions in the United Stated reported that they offered some online courses, which may indicate the growing interest and willingness of institutions to serve both traditional and non-traditional students wherever they are located. However, the problem of low completion rates among online students remains a major hurdle, which institutions are still working to improve by investing in student support services and infrastructure in order to ensure that these programs become more accessible. Notwithstanding these investments, the effective integration of technology that supports quality instruction and interactions in an online environment is a critical factor that can help improve student academic achievement.

This chapter presents information in the following areas: summary of the study, discussion of findings, limitations, implication and recommendations for future research.
Summary of the Study

The purpose of this research study was to examine the impact of mobile phone text messaging as a two-way communication tool on student academic achievement in a computer programming course. Fifty students who enrolled into the online course were randomly assigned into two groups of 25. The course was taught by the same instructor and both groups interacted with the same course content and completed the same assignments in Blackboard. Interactions in the course were mainly done via email exchanges, announcements, and Blackboard Collaborate Ultra sessions, a live conference tool. In addition to that, only students in the treatment group exchanged text messages with the instructor via Remind, a text messaging application. The research question for this study was: Does the use of text messaging as a complementary method of communication have an effect on student academic achievement in an online course?

The hypotheses of the study assumed that there would be an increase in academic achievement for students who used text messaging as a complementary method of communicating with the instructor in the online course. Using the alpha score of 0.05, findings showed that there was no significant difference between the treatment and the control groups regarding the programming exercises and the proctored exam. This finding suggests that the use of text messaging had no significant effect on student academic achievement in the online computer programming course. However, a discussion of this finding in comparison to the pilot study results of the programming exercises at different time points as well as past studies that integrated text messaging in classrooms is warranted.
Pilot Study Discussion

The results of the pilot study that was conducted in Spring 2016 had shown that the effect of the treatment was significant between the two independent groups. Despite the fact that they current study utilized the same research method and text messaging application (Remind) to communicate with students, there were, however, some notable differences in regards to the frequency and the personalized nature of the communication between the instructor and students and the type of information sent out to students in the treatment group.

As the instructor in the pilot study, I encouraged students to ask questions and checked in on them when I noticed they were either falling behind in course work or missing assignments. I often initiated conversations with students and adopted a proactive approach to keep students on task. On average, about five text messages were sent out to students in the treatment group per week, excluding responses to inquiries and questions received from students. Furthermore, the majority of students in the treatment group interacted with me and asked questions more frequently. The treatment in this study was stronger and created a learning environment that supported meaningful interactions (dialogue) with students in the treatment group, which resulted in a higher success rate by students in the treatment group compared to their counterparts in the control group.

On the other hand, the current study did limit text messaging exchanges to three per week. The instructor did not take any additional steps to start conversations with the students and only replied to students’ questions when asked. Additionally, the content of the text messages to students in the treatment group was just an extension of the information posted on the course announcement page and sent to students via email. The lack of constant communication and meaningful interactions between the instructor and the students might have negatively impacted
their academic achievement in the course, which supports the dialogue construct of the transactional distance theory.

Individual Programming Assignment Discussion

Findings of the study were arrived at by comparing the total scores of both dependent variables (programming assignments and proctored exam) between the two groups. Yet, a look at each programming assignment result at different point times showed different outcomes. For programming assignments 1, 2, and 3 (see Tables 7, 8 and 9), findings indicated there was a significant difference in students’ achievement scores between the two groups. On the other hand, results for assignments 4, 5 and 6 (see Tables 10, 11 and 12) suggested there was no difference between the two groups. A plausible explanation about the difference in these results might be due to a couple of factors such as the redundancy of the text messages and the difficulty of the module contents.

Information posted on the course announcement page and sent via email to all students (both groups) were similar to the text messages students in the treatment group received. Therefore, these text messages might be seen as redundant since students received a detailed version of the same message in their emails. Additionally, each programming assignment students completed was developed in such a way that students had to build on the previous assignments. That is, assignment 2 was an extension of assignment 1 because concepts learned in assignment 1 was necessary to complete assignment 2. Thus, it is likely that as the assignments became more “difficult,” students in the treatment group still did not make use of the communication tool to seek help and assistance from the instructor. A review of the number of text message exchanges between the instructor and students in the treatment group indicated that
only a handful of students actually asked questions and engaged with the instructor. The majority of them only acknowledged the text messages with a “thank you” reply to the instructor. This might have affected students’ performance in the course, indicating no significant difference in the achievement scores between the treatment and the control groups.

Text Messaging Intervention Discussion

Current literature about text messaging use in distance learning focuses on student retention (Boath et al., 2016; Ng, 2018), two-way communication between peers and instructors (Lauricella & Kay, 2013; Yao, 2011), and instructor social presence (DuVall et al., 2007; Kuyath et al., 2013; Shea, Li & Pickett, 2006). Findings of these studies showed that the use of text messaging helped improve student interactions, online community and their perceived satisfaction in online courses.

Although strong evidence supports the importance of integrating text messaging in education, there are some studies that suggest texting in the classroom negatively affects student performance (Dietz & Henrich, 2014; Kuznekoff, Munz, & Titsworth, 2015; Wood, Zivcakova, Gentile, Archer, De Pasquale & Nosko, 2012). In the current study, the conclusions did not show that the intervention had a significant difference on the academic achievement between the two groups. The mean score of the proctored exam for the treatment group was 68.40 against 56.08 for the control group (see Table 15). For the programming exercises, the mean scores were 97.29 for the treatment group and 100 for the control group (see Table 11). This finding partially supports conclusions from certain past studies that investigated the impact of text messaging on academic achievement in online courses.
One study that closely aligned with the current study was conducted by Ng in 2018. In the quasi-experimental study, the author sought to investigate the effect of text messaging and virtual one-on-one meetings on student retention in an online preparatory chemistry course. Participants were all full-time registered nurses who were seeking Bachelor of Science degrees in nursing. Ng, who was also the instructor, used text messaging to send announcements and information to students’ phones via Remind and also scheduled one-on-one online meetings with each student using Zoom, an audio-video conference tool. Analysis of the data collected indicated that 97% of students submitted their assignments on time and the attrition rates dropped from 57% to 15%. However, student academic performance with a grade of C and above as a passing grade did not change even after implementing these treatments. This conclusion supports the finding of the current research which also showed that there was no significant difference in student performance between the two groups.

Another study that is worth mentioning is the quasi-experimental study conducted by Sichani, Mobarakeh and Omid (2018) to determine the impacts of sending educational questions via text messaging on academic achievement and satisfaction of medical students in comparison to course lecturing. Forty-seven medical students enrolled in a general urology course participated in the study, which covered two chapters. One chapter was taught using texting (SMS) as a teaching method and the other chapter via lecture session. The study concluded that there was a significant difference between the two learning methods as shown on the posttest that students took. However, over 78% of participants were not satisfied with the text messaging learning method.

Conclusions from the above studies provided mixed results about the use of text messaging. The research settings, treatment, and participants’ characteristics were also different
from the current research. These studies used quasi-experimental methods, which means that study participants were not randomly assigned, causing the treatment and control groups to not be comparable at the start of the study. Therefore, the results of these studies could have been affected by other factors, which the researcher were unable to control. Unlike these studies, the current research used a true experimental research method, which is considered the gold standard for answering causal research questions. Since there are limited studies that have investigated the effect of text messaging on student academic performance in online courses, findings from the current study may be considered as a “springboard” for further studies about text messaging integration into online learning courses. This conclusion may be attributable to the limitations of the study that are discussed in the section below.

Limitations of the Study

The study had some internal and external limitations that could potentially have influenced student performance in the online courses.

External Validity Threats

While the study used a randomized assignment procedure to create the groups, which were statistically equivalent in regards to their observed characteristics, decisions to perform well in a course depend on a list of factors such as students’ socioeconomics, motivation, and academic support services (Baxter, Hungerford & Helms, 2011; Martin, Galentino & Townsend, 2014). Test scores based on a sample of students showed that students in the treatment group did perform better than their counterparts in the control group. The effect of this difference was,
however, not statistically significant, which might be due to participants’ demographic status, the sample size, or the instructor’s teaching experience with online courses.

There is strong evidence based on past research studies that students’ socioeconomic status (SES) has direct impact on student learning achievements (Guo, Marsh, Parker, Morin & Yeung, 2015; Hackman, Gallop, Evans & Farah, 2015). A study conducted by Merritt and Buboltz (2015) to examine the relationship between SES and student academic success in college indicated that SES was significantly related to students’ academic performance. Doerschuk et al. (2016) also did a study about student success rates in science, technology, engineering, and mathematics (STEM) programs and found that low-income students performed at a much lower rate in these programs than their counterparts who come from high-income families. However, in the current study, these factors were not accounted for and might have affected the results of the study.

Another external validity threat was that despite that participants were all first-year students, some of them might have had prior experience with online learning but others not, which might have contributed to the study findings. The researcher could not control who enrolled into the online course since it is a course that all first-year students pursuing a degree in Applied Sciences were required to complete as well as those interested in learning about basic programming concepts. Additionally, conducting the study at a community college might also be another threat to the validity of the study since, generally, students who are enrolled in community colleges differ from students in universities when looking at their demographic characteristics such as age, gender, and socioeconomic status. Again, the researcher had no choice in ensuring who would enroll in the course.
The small sample size of the study can be considered as an external validity threat to the study. Fifty students might not be large enough to generalize the finding of this study to a larger population of students enrolled in an online course in community colleges. Therefore, the small sample size of the study might mean a decrease in the statistical power, which led to a reduced chance of finding the true effect of the treatment in the sample. This problem can be seen as a limitation of the study considering that it was a quantitative research study.

Finally, the study might also be limited in terms of ecological validity, that is the way text messaging was used in the course might differ from how it is used in practice. The instructor in the study made herself available to answer students’ questions almost instantly, which in practice is not expected of an instructor teaching an online course. Likewise, limiting text messages to a certain number does not fall within a conventional practice because texting is considered to be an everyday communication method that the instructor was expected to frequently use in order to interact with her students and not only respond to them after receiving messages from them.

Internal Validity Threat to the Study

The instructor who taught the course was an experienced teacher with over nine years of online teaching experience. In addition to her timely responses to students’ inquiries in the treatment group and her consistent posting of the weekly reminders, she was also very engaged with students via email, posting on average two announcements per week in Blackboard, and was reachable by phone and Blackboard Collaborate Ultra during her office-hours. While students in the treatment group were only allowed to send and receive text messages from the instructor, those in the control group had the same opportunity to interact with the instructor.
using email, telephone calls, and office hour meetings. Therefore, the lack of text messaging communication with the instructor by students in the control group was compensated by other forms of communications available in the course. This might be considered as an implementation threat to the internal validity of the study.

One other potential internal validity threat was the mortality (attrition rates between groups) threat. The online computer programming course used in this study originally enrolled 58 students. By the time the study began, the total number of students fell to 50, which was randomly assigned to the treatment and the control groups. The possibility of having students dropping out of the course from either group was a potential threat to the internal validity of the study. Despite no one dropped out of the course during the study, few students failed to complete all programming assignments in the courses, which might have affected the findings of the study.

Delimitations

The study was delimited to a specific online course (two sections of the same course, Introduction to Computer Programming), and facilitated by the same instructor. Another delimitation of the study was about students who enrolled into the course. The course was primarily offered to students who declared their intention to pursue degrees in computer science, but there was no check in the system to prevent anyone from enrolling in the course. Therefore, the researcher had no control over who enrolled into the course.

Implications

The primary implication of this study result is that the use of text messaging as a supplementary communication tool may not by itself be sufficient enough to increase student
academic achievement in a fully online course. Text messaging should rather be part of an overall strategy that aims at supporting online students in their quest to attain academic goals. The use of text messaging as implemented in the study might not be the sole predictor of student academic success in a course. The utilization of text messaging as a communication tool in an online course should rather be part of an institutional strategy that leads to student success, which includes a list of services that support online students and improvement in the overall quality of online instruction. According to a survey conducted by Blackboard Institute in 2011, over 75% of online program directors found that student success in online courses was linked to the support provided to students. The availability of student support services similar to face-to-face support systems may increase student completion rates for online students where students mostly feel isolated and disconnected from the learning community (Britto & Rush, 2013; Stewart, Goodson, Miertschin, Norwood & Ezell, 2013). So, in addition to using text messaging to communicate with students, a combination of other factors, including student characteristics may affect student academic achievement in online courses.

Additionally, as the results from the pilot study indicated, the type of text messaging and how it is used might affect students’ performance in an online course. Although in both studies text messaging was used as a two-way communication tool between the students and the instructor, the content of text messages sent to students in the pilot study was supportive, instructional, frequent and intentional with the objective of creating a learning environment that promoted students interactions. Therefore, the type of text messaging and how it is used may positively affect student academic achievement in online courses.
Recommendations for Future Research

The objective of this study was to examine the impact of text messaging as a communication tool on student academic achievement in an online course at an urban community college. The research method selected to conduct this study fits well with the objective of the study and provides opportunities to examine the direct impact of the treatment on students’ academic achievement. The insignificant result of the study shows that there is a need to further investigate the integration of text messaging in distance learning in general and specifically in computer programming online courses. The following are recommendations for further studies:

- A similar quantitative study could be conducted using a larger sample size that is more representative of the population. Getting an “adequate” number of students to participate in the study can be accomplished by conducting a statistical power analysis prior to the start of the study. This will help determine the optimal sample size suitable to detect the effect of the treatment.
- A mixed-method study can also be used to further research this topic. The use of mixed research methods can provide more comprehensive data from participants about their perceived satisfaction and learning in the course. One of the main benefits of using a mixed method is that data collected from the qualitative section of the study may corroborate findings from the quantitative-method data about the treatment and will help provide a comprehensive understanding of the research problem.
- Further investigation is also needed about the way the instructor used text messaging to communicate with students. This study limited the number of initial communications with students to three messages per week. But in a follow-up study, the instructor can be allowed to change the content of the text messages to include other topics such as
instructional materials, videos and links to useful resources instead of solely using it to send announcements and reminders.

- Finally, understanding student attitudes toward the use of text messaging as a communication tool can shed more light on students’ perceptions and their effect on learning and academic achievement in an online course. This study did not examine students’ attitudes, which in a way could explain the reason why student-to-instructor interaction was limited in the study. So the definition of what is termed as the “right number” of messages that will affect students’ attitudes and contribute to their successes in an online course is worth investigating.

The integration of mobile technologies and especially smartphones in classrooms as learning tools is still a debatable topic among college administrators. Instructors’ positions on this topic depend on how they foresee their benefits. As such, the lack of a mobile technology use policy has slowed the adoption of such tools on college campuses. The fact remains that mobile phone ownership is on the rise as more and more college students use it for academic purposes, and there is the need to train and encourage faculty to effectively make use of it to enhance their teaching and students’ learning. With the continuous increase in student enrollment in distance learning courses, the problem of low academic achievement among online students may remain one of the biggest challenges that institutions of higher learning continue to face. There is an urgency for colleges to rise up to these challenges by investing in their student support systems and adopting and revising technology use policies that will encourage the use of mobile devices as an instructional tool in classrooms.
REFERENCES


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Pontes, M. C., & Pontes, N. M. (2012). Enrollment in Distance Education Classes Is Associated with Fewer Enrollment Gaps among Nontraditional Undergraduate Students in the US. *Journal of Asynchronous Learning Networks, 16*(1), 79-89.


APPENDIX A

EMAIL INVITATION TO STUDENTS
Subject: Invitation to participate in the study

Dear Sir/Madam,

You are invited to participate in a research study that will examine the impact of student-instructor communication on student academic achievement in an online course.

The study uses CIS 103 online session in which you are currently enrolled and scheduled to begin in Spring 2018. All data and information collected such as student score on tests and exams and messages during the study will be kept confidential.

Participation in the study requires that you own a cell phone that has texting capabilities. If you choose to participate in the study, you will be entered into a drawing for 1 of 3 Amazon Echo dots after you complete a 5-minute survey at the end of the course.

The consent form and additional information about the study can be accessed [here].

Thank you in advance for your participation. For more information, you can contact me at 312-553-3001.

Sincerely,

Selom Assignon  
Office of Academic Affairs  
City Colleges of Chicago.
APPENDIX B

PHONE CALL SCRIPT INVITING STUDENTS TO PARTICIPATE IN THE STUDY
Hello, can I please speak to [student’s name]?

My name is Selom Assignon and I work with the City Colleges of Chicago, Office of Academic Affairs. Our record shows that you are currently enrolled in the Introduction of Computer Programming (CIS 103) online; is that correct?

I am calling you because this course is going to be used as part of a research study that investigate the impact of student-instructor communication on student academic achievement in an online course.

Participation in the study requires that you own a cell phone that has a text message feature. If you choose to participate in the study, you will be entered into a drawing for 1 of 3 Amazon Echo Dots after you complete a 5 minute online survey at the end of the study.

I am going to email a copy of the consent form to your CCC email account. Please note that participation is voluntary and you may withdraw at any time without penalty or prejudice. If you choose to participate in the study, click on the link to in the email to indicate it and also provide your email address.

Thank you in advance for your participation. You can contact me by replying to the email or call me if you have any question.
APPENDIX C

STUDENT CONSENT FORM
STUDENT CONSENT FORM

I agree to participate in the research study, which will examine the impact of student-instructor communication on student academic achievement in an online course. I have been informed that the study will begin during the Spring 2018 semester.

I understand that if I agree to participate in this study, I am required to own a cellphone that has texting capabilities and approve to receive and possibly send text messages. Additionally, final test, exam and assignment scores received in the course as well as Blackboard communications and text messages will be collected for analysis and interpretation and will be destroyed at the end of the study.

I am aware that my participation is voluntary and I may withdraw at any time without penalty or prejudice, and that if I have any additional questions concerning this study, I may contact Mr. Selom Assignon, sassignon@ccc.edu, 312-553-3001. I understand that if I wish to get additional information regarding my rights as a research subject, I may contact the NIU Office of Research Compliance at 815-753-8588.

I understand that the intended benefit of this study is to provide instructors with practical ideas on how to increase course interaction, engage students, provide timely feedback and personalize teaching and learning to increase student academic achievement in their distance-learning course. In addition, if I choose to participate in the study, I am eligible to enter into a drawing for 1 of 3 Amazon Echo Dots after I completed a 5-minute online survey (and allowing the researcher access to my course performance data).

I have been informed that there are no known potential risks and/or discomforts I could experience during this study. I am aware that all information gathered during this study will be kept confidential and then made anonymous by de-identifying the data (i.e., stripping ID numbers and e-mail addresses from the dataset) once drawing winners receive their prizes and before data are analyzed.

I understand that my consent to participate in this project does not constitute a waiver of any legal rights or redress I might have as a result of my participation, and I acknowledge that I have read this consent form. I have been encouraged to print and retain a copy of this consent form for my own records.

Do you agree to participate in this study?
___ I agree to participate
___ I do not agree to participate [Respondent selects one]

If you agree to participate, write your CCC email address below.

_______________________________
APPENDIX D

REMINDER EMAIL TO STUDENTS WHO DID NOT RESPOND
Study reminder e-mail (send directly to students who did NOT reply to the original invitation).

Subject: Research Study Participation reminder

Dear Sir or Madam,

This is a reminder that you are invited to participate in a research study that will examine the impact of student-instructor communication on student academic achievement in an online course.

The study uses CIS 103 online session in which you are currently enrolled for the study, which is scheduled to begin in Spring 2018. All data and information collected such as student score on tests and exams and messages during the study will be kept confidential.

Participation in the study requires that you own a cell phone that has text message capabilities. If you choose to participate in the study, you will be able to enter into a drawing for 1 of 3 Amazon Echo dots after completing a 5-minute survey at the end of the course.

You can contact me if you have any question and thank you in advance for your participation.

The consent form and more information about the study can be accessed [here].

Thank you in advance for your participation. For more information, you can contact me at 312-553-3001.

Sincerely,

Selom Assignon,
Office of Academic Affairs
City Colleges of Chicago
APPENDIX E

EXAMPLE OF A PROGRAMMING ASSIGNMENT
QUESTION 1
Library functions are built into the programming language, and can be called any time they are needed.
- True
- False

QUESTION 2
Which of the following errors occur when a real value is attempted to be assigned to an integer variable?
- Assignment
- Type mismatch
- Integer value
- Conversion
- None of the above

QUESTION 3
Random numbers are useful in simulation programs where the computer must randomly decide how an object will behave.
- True
- False

QUESTION 4
Which of the following statements is true after the execution of the following statement?
Set needANumber = random(5, 10)
- The random number is assigned to the variable needANumber.
- A random number is generated between 5 and 10.
- The numbers 5 and 10 are the arguments of the random number function.

QUESTION 5
Which of the following is optional when writing a function definition?
- Data type
- Function body
- Function header
- Return statement
- None of the above

QUESTION 6
Programming languages have not yet started to support localization.
- True
- False

QUESTION 7
In the IPO chart, the _______ column describes the data that is passed to the function as arguments.
- Input
- Function
- Process
- Output
- None of the above

QUESTION 8
The function body follows the function header in a function definition.
- True
- False

QUESTION 9
A _______ is a module that returns a value back to the part of the program that called it.
- For
- Loop
- While
- Function
- None of the above

QUESTION 10
The function _______ comprises one or more statements that are executed when the function is called.
- Header
- Body
- Datatype
- Definition
- None of the above
APPENDIX F

EXAMPLE RUBRIC OF A PROGRAMMING ASSIGNMENT
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Novice</th>
<th>Competent</th>
<th>Proficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comment &amp; Alignment</td>
<td>0 Points - No proper comments - Incorrect alignment and indentation - Improper design approach</td>
<td>2 Points - Include proper comments/documentation - Use some alignment and indentation - Use some design approach that calls sub-modules</td>
<td>4 Points - Include proper comments/documentation - Use proper alignment and indentation - Use proper design approach that calls sub-modules</td>
</tr>
<tr>
<td>Logic Decision</td>
<td>0 Points - Does not use decision logic, and or looping structure - Algorithm does not show all the steps and look not to be well thought out - Algorithm no written in plain English</td>
<td>0 Points - Use decision logic, and or looping structure if applicable - Algorithm does not show all the steps and look not to be well thought out - Algorithm written in plain English with keywords i.e. Get, Multiply, Display, Set, etc...</td>
<td>6 Points - Use decision logic, and or looping structure if applicable - Algorithm should show all the steps and be well thought out - Algorithm written in plain English with keywords i.e. Get, Multiply, Display, Set, etc...</td>
</tr>
<tr>
<td>Flowchart Format</td>
<td>0 Points - Flowchart is incorrectly formatted. It did not contain all steps defined in your pseudocode and show some part of the pictorial flow of the program</td>
<td>2 Points - Flowchart is correctly formatted. But did not contain all steps defined in your pseudocode and show some part of the pictorial flow of the program</td>
<td>6 Points - Flowchart is correctly formatted. Contain all steps defined in your pseudocode and show pictorial flow of the program</td>
</tr>
<tr>
<td>Symbols and Modules</td>
<td>0 Points - Use incorrect symbols including terminal symbols, processing symbols, input and output symbols and diamond symbols in decision structure including modules - No connector symbol is used if the chart breaks into parts</td>
<td>2 Points - Some symbols used are correct terminal symbols, processing symbols, input and output symbols and diamond symbols in decision structure including modules - Use a connector symbol the chart breaks into parts</td>
<td>4 Points - Use correct symbols including terminal symbols, processing symbols, input and output symbols and diamond symbols in decision structure including modules - Use a connector symbol if the chart breaks into parts</td>
</tr>
</tbody>
</table>
APPENDIX G

EXAMPLE OF A WEEKLY ANNOUNCEMENT POSTED IN THE COURSE
Week 2 [Jan. 22 – 28] Chapter 2 Assignments

Posted on: Monday, January 22, 2018 8:00:00 AM CST

Greetings Students,

A program’s designing phase is the most important part of the program development cycle. In Chapter 2, we will learn to write pseudocode and draw flowchart to create models of programs in the design process. In this chapter, we will learn about:

- Sequence structure
- Declaring variables and constants and using them in a program
- Assigning initial values to variables
- Variables naming convention and data types

Section 2.8 includes an example of designing your first program, and the features of good program design. Chapter 2 course resources and assignments are posted on Blackboard. To get started, please read and walk-through the examples in the textbook; review PowerPoint notes and watch the videos for this chapter. Please attempt the following assignments when you are ready:

- Programming exercises #2, 4 on page 77.

Note: Pseudocode should be written in a Word document. Please download the RAPTOR application to draw the flowchart. If you have problems installing RAPTOR to your Mac computer, please feel free to draw your flowchart in Word instead. Refer to the assignment section for more details.

- Chapter 2 Discussion and Reflection forum. Please keep in mind that there are two parts of this forum, besides posting your reflection on chapter 2 contents, please review your fellow classmate’s postings and make appropriate comments. Initial postings are due by the middle of the week.
- To test how well you understand chapter 2 contents, please attempt chapter 2 quiz as the last assignment of this week.

All chapter 2 assignments are due by Jan. 28. Please feel free to contact me if you have any questions.