

Spring 3-30-2020

## The Use of Digital Applications and Websites in Completing Math Assignments

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Concordia University–Portland  
College of Education  
Doctorate of Education Program

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# The Use of Digital Applications and Websites in Completing Math Assignments

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Concordia University–Portland

College of Education

Dissertation submitted to the Faculty of the College of Education

in partial fulfillment of the requirements for the degree of

Doctor of Education in

Higher Education

Belle Booker-Zorigian, Ph.D., Faculty Chair Dissertation Committee

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Concordia University–Portland

2020

## **Abstract**

There are a large assortment of digital applications and websites available for students to use in completing their math assignments. The problem is how and why they are using these applications. This study looked at the different applications and websites used by students, including Slader, Wolfram Alpha, Symbolab, Desmos, and Photomath. The study then explored why students used these applications and websites. The idea of plagiarism in mathematics was presented to the students in this study. The review of the literature included the concepts of plagiarism and cheating and illustrated that students have a history of using tools for accomplishing tasks. Nine students were interviewed by implementing a phenomenological approach. The themes that developed from these interviews included confidence building, learning, and easy access. Students stated that they planned to continue using digital applications and websites to complete their math assignments.

*Keywords:* math, Slader, Wolfram Alpha, Symbolab, Desmos, Photomath, plagiarism, cheating, confidence building, digital applications

## **Dedication**

I dedicate this paper to my family and my students. These are the people who inspire me to continue teaching and to reach new heights, once thought to be unattainable.

## **Acknowledgments**

I would like to extend my deepest gratitude to my dissertation committee faculty chair Dr. Belle Booker-Zorigan for her invaluable patience and support through this long process. I would also like to acknowledge the assistance I received from Dr. Angelo Letizia and Dr. Megan Cavalier, my committee members. From these two individuals, I learned how to present my data and how to research more effectively.

I also want to thank my friends and my family. My friends have supported me by asking how things were going. Even when it seemed dull, they were willing to listen to my challenges. My children, Eric and Julie, were supportive as I struggled with the frustrations of completing this process. My sister, Randa, has never failed to remind me how proud she was of my accomplishments. Finally, my last thank you goes to my husband, John. I would never have embarked on this journey without him. The list he gave me is now complete.

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## **Chapter 1: Introduction**

### **Introduction to the Problem**

In Bowers' (1966) seminal study, 75% of the surveyed students admitted to participating in academic dishonesty, which was defined by Bowers as using the words or ideas of others without giving credit to the source. Bowers (1966) used the phrases *academic dishonesty* and *cheating* interchangeably. According to Simkin and McLeod (2010), cheating, their term for academic dishonesty, has become even easier for students due to the popularity and easy access to the Internet where students can find and copy work. While most of the academic dishonesty studies center on writing, Bidgood and Merrill (2017) found plagiarism extends beyond writing into computer programming as well. Bidgood and Merrill (2017) defined plagiarism as a subset of academic dishonesty, where a person uses the ideas or words of others without giving proper credit. For example, Bidgood and Merrill (2017) examined student plagiarism in a computer programming class focused on coding data. Their research discovered that 100 out of 700 students copied their assignments from the Internet, many changing one symbol to try to make their work look different (Bidgood & Merrill, 2017). This example from computer programming illustrates how the concepts of academic dishonesty, specifically plagiarism, can be applied to the field of mathematics.

Students often use digital applications and websites such as Slader, PhotoMath, and Wolfram Alpha to complete their assignments (Linshi, 2016). These applications allow students to input their problems to receive a step-by-step solution. The students might copy the solutions directly from these sites, or the students may use the solutions to learn the process (Linshi, 2016). Either way, the students should always cite the sources to avoid plagiarism. However, according to Jones, Reid, and Bartlett (2008), a shared belief among many students is that all

items found on the Internet are in public domain, and therefore, students believe that the acknowledgment of these kinds of internet programs as sources is not necessary. It is unclear whether students sharing this belief are aware that copying solutions from these digital applications and websites are considered plagiarism. No studies exist that investigate the link between student behavior (i.e., using the application to complete assignments) and student cognition (i.e., perception and intention for using the application). This connection is one of the areas I explored in this research. More specifically, in this research study, I sought to examine (a) how and why students use digital application and websites to complete math assignments, (b) how students perceive plagiarism in math assignments, and (c) how the use of these applications, in mathematics, is a form of plagiarism.

### **Background, Context, History, and Conceptual Framework for the Problem**

In this phenomenological study, I used two related conceptual frameworks to examine why and how students are used digital applications and websites for completing math assignments. These two conceptual frameworks are social constructivism, which is considered a large paradigm, in which falls the second framework, social cognitive theory (Bandura, 2001). These conceptual frameworks explain how information is learned through social means (McCabe & Trevino, 1993). In social constructivism, one component of this social interaction is called the zone of proximal development (ZPD), whereby a learner accomplishes a task with guidance from someone more knowledgeable (Vygotsky, 1978). Social cognitive theories suggest learning occurs through observation and imitation (Bandura, 2001). Social learning theories emphasized the importance of learning through example (McCabe, Trevino, & Butterfield, 2002). This notion of learning through observation of others is a lens through which to understand plagiarism in completing math assignments. Previous research has shown that watching others cheat or having



known of their cheating encourages other students to choose the same path (Rittinger & Kramer, 2009).

The Internet provides easy access to references and examples which some students use to complete their assignments (Ma, Wan, & Yong, 2008). This manner of completing assignments is plagiarism, using a source without proper citation (Aasheim, Rutner, Li, & Williams, 2012; Bowers, 1966; Ma et al., 2008). As electronic sources become more available, there is an increase in plagiarism using these sources (Ma et al., 2008). Often students believe the information available through these sources is in the public domain and therefore free to be used by everyone without citation (Jones et al., 2008). These ideas lead to the phenomenon of many students in mathematics courses plagiarizing by copying solutions from digital applications and websites, such as Wolfram Alpha or Mathway, without learning the material (Hindin, 2010; Tantra, 2016). Given the rise in plagiarism in mathematics, it is critical to understand students' intentions behind their actions, which was one purpose of this investigation.

Various research projects into plagiarism used quantitative, qualitative, and mixed-method approaches. The first studies of plagiarism in higher education began with Bowers (1966) and continued with McCabe and Trevino (1993, 1996, 1997) and McCabe, Trevino, and Butterfield (1999, 2001a, 2001b, 2002, 2003, 2011). Most of these studies involved exploration of using honor codes in controlling academic dishonesty, the act of being dishonest in an academic setting (McCabe & Trevino, 1993). One emerging idea from these studies is that peers can control the behavior of others by employing honor codes. These honor codes establish clear rules regarding academic dishonesty and encourage students to “police” the behavior of others (McCabe & Trevino, 1993). Often, academic dishonesty is a result of following the example of others, an idea from social constructivism (Fox, 2010; McLeod, 2016; Vygotsky, 1978). Many of

these studies used a quantitative approach seeking to discover the percentage of people committing academic dishonesty in higher education. Other quantitative studies were designed to arrive at a description of a person who cheats. Some of the researchers sought to understand the connection between the Internet and academic dishonesty. Finally, some of the research studies seek to find a commonality in the definition of plagiarism between students and instructors, while these studies arrived at some ideas individually, there was still no common definition between the two groups (Aasheim et al., 2012; Bryan, Adams, & Monin, 2013; Molnar & Kletke, 2012; Shu, Gino, & Bazerman, 2011; Trushell, Byrne, & Simpson, 2012). In the research, students defined plagiarism differently depending on the source used, while instructors found plagiarism to have the same definition, that of copying someone else's work and turning it in as your own, regardless of the source (Aasheim et al., 2012).

A few other studies used a qualitative approach, seeking to understand the reason students plagiarize, to define plagiarism, and to categorize the different types of academic dishonesty (e.g., Burnett, Smith, & Wessel, 2016; Eraslan, 2011; Ma, Lu, Turner, & Wan, 2007). Gullifer and Tyson (2010) used discussion groups and writing prompts to achieve these goals. In another study, Shu and Gino (2012) set up experiments that allowed individuals the opportunity to choose between honesty and cheating. A few studies were based in a mixed research method, usually with a survey as the quantitative portion, and a discussion group or writing prompt as the qualitative part to examine why students plagiarize (e.g., Boehm, Justice, & Weeks, 2009; Comas-Forgas & Sureda-Negre, 2010; Rittinger & Kramer, 2009). Although each of these studies contributed to the collective understanding of academic dishonesty and plagiarism by college students, most focused on writing assignments. Few existing studies have examined plagiarism in completing math assignments through the use of electronic devices.

Hamadneh and Al-Masaeed (2015) are the exception; they examined using a digital application, PhotoMath, for teaching students math concepts. This research is important because the researchers sought to obtain information on the topic of plagiarism in math courses. This area has received little attention in the past. The authors found that PhotoMath could be used to teach students mathematical concepts, by first establishing a firm foundation and then allowing the students to explore the concepts through the application (Hamadneh & Al-Masaeed, 2015; Webel & Otten, 2015). This research study was unique from Hamadneh and Al-Masaneed's research in that it explored the use of many digital applications and websites available, including PhotoMath, a common tool used to copy solutions in completing math assignments. In this study, I used a phenomenology method to understand why and how students use digital applications and websites for completing math assignments and how students understand plagiarism in math. In this study, I explored the lived experience of individuals who commit plagiarism in math courses using the social learning theories of social constructivism and social cognitive theory.

### **Statement of the Problem**

The widespread use of the Internet presents students of mathematics courses with digital applications and websites that provide solutions for completing their math assignments. In other subjects, students find cutting and pasting from the Internet an easy task (Walker, 2010). This manner of acquiring information leads to students plagiarizing solutions to math problems on their assignments, rather than learning the material. It is not yet clearly understood how students understand plagiarism in math or whether students recognize the use of these applications as plagiarism in math. This dissertation aided in determining students' reasons for using digital applications and websites in completing math assignments.

## **Purpose of the Study**

The purpose of this study was to discover why and how students in higher education used digital applications and websites to complete math assignments. I aimed to discover why students used these digital tools to complete math assignments, using social constructivism and social cognitive theory as conceptual frameworks. The use of electronic devices has grown in the last two decades, with some students using these tools, and the software apps available on them, to copy solutions without learning the material and some students using the tools to learn the material (Ma et al., 2008). Either way, if the student does not properly credit the software, the use of the software is defined as plagiarism, which is using someone else's work without citing the source (Perry, 2010; Shashikiran, 2014). In this study, my goal was to describe and understand this phenomenon using social learning theories to understand the increase in academic dishonesty as students follow the examples of others.

## **Research Questions**

The following research questions and sub research questions guided this study:

RQ1: How do college students perceive the use of digital applications to complete assignments in math courses?

SRQ1: What reasons do college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests?

RQ2: How do college students perceive plagiarism in math courses?

SRQ2: What is the shared essence of plagiarism in math courses?

## **Rationale, Relevance, and Significance of the Study**

Most studies of plagiarism address academic dishonesty in writing (Chace, 2012; Gullifer & Tyson, 2010). This study was significant in that it addressed plagiarism in completing math

assignments, an area lacking research. One area of difficulty in plagiarism in writing is the need for a clear definition, between instructors and students, of what constitutes plagiarism (Jones et al., 2008). This study expanded on the body of literature on defining plagiarism in writing by attempting to understand how students define plagiarism in mathematics.

In the current body of literature, only a few references were made to copying solutions in math classes. In one such study, Hamadneh and Al-Masaeed (2015) addressed using outside sources to complete math assignments. They explored using PhotoMath as a teaching resource. When using the PhotoMath application, a student takes a picture of a math problem with a smart device. PhotoMath then provides the step-by-step solution to the question (Hamadneh & Al-Masaeed, 2015; PhotoMath, n.d.). In this research on the negative and positive influences of PhotoMath on the students, the researchers determined that the application was useful to students as an exploration tool following a proper introduction to the concepts (Hamadneh & Al-Masaeed, 2015).

One goal of this research was to determine why and how students use digital applications and websites to complete math assignments. Another goal was to determine if students saw their use of these applications and websites as plagiarism in mathematics. I used social constructivism and social cognitive theory as sequential frameworks. Both of these theories provided a basis for exploring the social phenomenon of plagiarism in mathematics. Another potential benefit of this study was that it established a shared “essence” of plagiarism as defined by students. This common definition may benefit students, instructors, and administrators of schools of higher education. Furthermore, this study has the potential to help create a dialogue between instructors and students about ways to use applications to teach math concepts.

## Definition of Terms

The following definitions are used for the purpose of this study:

*Accommodation.* Adaptation and adjustment to conditions (Accommodation, 2018).

*Assimilation.* The process of fully understanding information to which the person is exposed (Assimilate, 2018).

*Classical conditioning.* The act of learning a new behavior through a process of association (McLeod, 2016).

*Desmos.* An online graphing calculator (Desmos, 2019).

*Digital applications and websites.* For this study, these are applications for smart devices and websites found on the Internet, which provide solutions to problems in math assignments.

*Disengage.* To release from responsibility or something else engaging as in disengaging by using neutralizing behaviors (Stephens, Young, & Calabrese, 2007).

*Essence.* Finding the things that make the phenomenon what it is (Vagle, 2016)

*Interpersonal.* Having to do with relations between people (Interpersonal, 2018).

*Intrapersonal.* Action is occurring within the person (Intrapersonal, 2018).

*Intersubjectivity.* Occurring between two objects, i.e., two people or a person and a digital application (Intersubjective, 2018; Moustakas, 1994).

*Math assignments.* These assignments include any tasks given to math students, which are taken home, leaving the students with choices on how to complete the assignments.

*Mathway.* This application is available as a digital application and a website. The student enters the problem in a box, clicks on evaluate, and the solution appears (Tantra, 2016). The goal of this application is to provide “on-demand math assistance accessible to all students (Mathway, n.d., para. 2).

*Moral disengagement.* The relationship between an individual and their unethical decision making, deciding ethical standards do not apply to them (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Detert, Trevino, & Sweitzer, 2008).

*Operant conditioning.* Learning achieved through rewards and punishments (McLeod, 2016).

*PhotoMath.* A digital application for a smart device providing solutions to math problems. The student takes a picture of the problem, then the solution appears (PhotoMath, n.d.; Webel & Otten, 2015).

*Plagiarism.* The act of using someone else's work to complete an assignment without giving proper credit (Perry, 2010).

*Scaffolding.* A supporting framework for building knowledge (Scaffolding, 2018).

*Social cognitive theory.* Where a moral agency is exercised and evident through the actions of a person (Bandura, 2001, 2011), this conduct permits students to plagiarize based on the idea that the behavior is socially acceptable because other people are not punished when plagiarizing (Bandura et al., 1996).

*Social constructivism.* This theory is based on the idea that learning is a process of “constructing meaning” based on what a person experiences (Amineh & Asl, 2015, p. 9). Vygotsky believed the “process of knowing” is determined by other people, where the community and the culture set the guidelines for the behavior, thus “learning is a social process” (Amineh & Asl, 2015, p. 13). For the present culture, the Internet is a place for students to learn; this learning can lead to plagiarism (del la Llave, Gruner, Kelly, & Tarantino, n.d.).

*Symbolab.* This application is an equation search and math solver that solves algebra, trigonometry, and calculus problems step by step (Symbolab, 2017).

*Wolfram alpha*. A digital application, website, and “add-on” application for Google. A student inputs the problem, then the step-by-step solution appears (Hindin, 2010; Wolfram Alpha, n.d.).

### **Assumptions, Delimitations, and Limitations**

Through this research, I sought to discover why and how students use digital applications and websites in completing their math assignments and how students defined plagiarism in mathematics. My assumption in approaching this study was that most student used digital applications and websites to further their knowledge on mathematical concepts. I also assumed that there were individuals who used the digital applications and websites as devices for cheating. This study had several limitations and delimitations. The delimitation included asking the questions in a way that would aid a student regarding their use of these tools and whether this use qualifies as plagiarism. I used a journal as a delimitator to aid in noting bias and changes to the research.

One limitation of this study was found when approaching a student regarding their use of applications and websites and attempting not to alienate the student by accusing them of academic dishonesty. Students may not have previously considered using outside sources to complete mathematics assignments as plagiarism since, for too many students, the definition of plagiarism can change depending on the source used (Aasheim et al., 2012).

### **Summary of Chapter 1**

Access to the Internet has become a tool for students (Ma et al., 2008). Sometimes students use the Internet to complete math assignments. The first chapter of this dissertation was an introduction to this issue. I stated the problem and purpose of the study, which was to discover why and how students use digital applications and websites in completing math



assignments. I also presented the research questions, definitions, and assumptions. Chapter 2 is a review of the literature on the topic of plagiarism. In this review, I examine the definition of academic dishonesty, specifically plagiarism, in higher education, along with best practices and methods for curtailing this behavior. In Chapter 3, I will explain the methodology used in this study and various attributes of data and its collection, including a discussion of instrumentation. I will also include a description of the research population, including the research site and research participants. In the final two chapters, I will present data analysis, findings, and conclusions. Specifically, in Chapter 4 I will list the results of the study, including analysis and interpretation, and in Chapter 5 I will present the results and the conclusion of the study.

The goal of this research was to examine how and why students used digital applications in math and to determine if students using digital applications and websites in completing math assignments defined this action like plagiarism. I also sought to learn whether there was commonality among college students' justification for the use of these tools. This study has the potential to help open lines of communication between students, instructors, and institutions as to the acceptable use of these items in completing math assignments.

## **Chapter 2: Literature Review**

### **Introduction**

Plagiarism, a form of cheating, is defined as copying work from a source and not giving proper credit (Plagiarism.org, 2017). Plagiarism has received much attention in the area of completing written assignments and tests (Plagiarism.org, 2017). According to a survey conducted by the International Center for Academic Integrity (ICAI) from the fall of 2002 to the spring of 2015, 39% of the 71,300 surveyed undergraduates admitted cheating on tests and 62% admitted cheating on written assignments (ICAI, 2017). Another study completed by this same organization in 2005, found among 50,000 undergraduates at 60 universities that 77% of the participants did not believe copying work from an online source was a serious issue (ICAI, 2017; Ma et al., 2007). The idea of plagiarism extends to the study of mathematics, where various apps and websites allow students to copy solutions (Harkins & Kubik, 2010).

As I explored the literature, I focused my search on academic dishonesty, a type of cheating occurring in education, which includes plagiarism. I found that most of the information available on academic dishonesty involves plagiarism in writing. There was little information on plagiarism in mathematics, except in the area of encouraging the use of digital applications and websites as teaching tools. The data collected in the studies I explored in this review came from public schools and institutions of higher education.

**The Context.** In this literature review, I explored academic dishonesty, specifically plagiarism, which occurred principally in written assignments. A student can commit plagiarism by completing math assignments through the use of programs and applications found on the Internet and smart devices. These applications provide solutions a student can copy and turn in as their work, without giving credit to the original author (Harkins & Kubik, 2010). This action fits the definition of plagiarism, which is passing someone else's work off as your own (Plagiarism.org, 2017).

I used the frameworks of social constructivism and social cognitive theory as the lens for this study. According to social constructivism, the determination of an object's existence occurs through communication (Comas-Forgas & Sureda-Negre, 2010; Keaton & Bodie, 2011). Vygotsky (1978), who developed the idea of social constructivism, believed knowledge is not constructed but rather co-constructed by using language, and that social learning usually comes before development. Sometimes a student feels they cannot learn the skills necessary to complete a task, or a student feels they do not have time to finish the assignment. These two instances may cause the student to resort to academic dishonesty to complete the assignment. The use of digital applications and websites is a method of construction by using language as discussed by Vygotsky (1978).

Social cognitive theory, which was first developed under the name social learning theory, was developed by Bandura (1971). Through this lens, almost all learning is seen as having resulted from direct experience and by observing the behaviors of other people. Learning is also believed to occur by observing the consequences of other people's choices (Bandura, 1971). In academic dishonesty, a student cheats because of the low likelihood of being caught or

receiving little or no punishment if they are caught. These are examples of behavior observable by others (Burrus, Graham, & Walker, 2011).

**The signifiance.** While there is a large body of information addressing plagiarism in written assignments, there is very little research addressing plagiarism in mathematics. This research contributed to the current body of literature by providing information in this area. Additionally, this study may be beneficial to administrators and instructors of higher education, who are often unaware of the various applications and websites available for students. This lack of knowledge constitutes a gap in understanding the actions and needs of students. This knowledge allows administrators and instructors to assist students in completing assignments in a way that enhances their learning instead of enabling actions that circumvent learning.

In this study, I targeted not only higher education but also mathematical education in high schools. When a student copies answers without practicing the mathematical skill, they do not learn the skill. When students do not learn, schools often find themselves lowering their standards (Arum & Roksa, 2011). This problem leads to schools producing students with a weak background in mathematics. As I searched the literature, I also included correlations to other similar fields, such as the sciences.

**The problem statement.** Mathematics is a subject best learned by practice; it is this practice that disappears when a student plagiarizes. Completing assignments by copying involves methods deemed dishonest by some teachers and defined as dishonest by some students (Harkins & Kubik, 2010). As the Internet and digital applications continue to grow, a clear definition of plagiarism in mathematics needs to be defined, and the use of technological applications needs further investigation (Harkins & Kubik, 2010).

Several researchers explored why students choose to practice dishonesty in their academic work. Some of the reasons included wanting a better grade as well as peer culture and mismanagement of time to complete the assignment (Geddes, 2011; Ma et al., 2007; Scott, 2016). Additional reasons included student perception of no real punishments if caught being dishonest and the excuse of poor teaching practices (Geddes, 2011; Ma et al., 2007; Scott, 2016). The most prevalent reason found by researchers was the neutralizing or minimizing of the action by the students (McCabe et al., 2001).

Anytime someone copies work without acknowledging the creator of the work, it is considered plagiarism (Plagiarism.org, 2017). The idea of plagiarizing is extendable to completing math assignments through the use of programs and applications such as Symbolab, PhotoMath, Wolfram Alpha, and Slader. These applications provide solutions students use to complete math assignments. In one example, researchers explored the use of the Photo Math application for completing math assignments in Irbid, Jordan (Hamadneh & Al-Masaeed, 2015). Photo Math allowed students to use their smartphones to complete the mathematics questions. Students took a picture of the math problem, and Photo Math displayed the solution to the problem (Hamadneh & Al-Masaeed, 2015). The students did not usually give credit to the application for the answer and instead, turned the assignment in as their work (Harkins & Kubik, 2010). This action fits the definition of plagiarism (Plagiarism.org, 2017).

Two other similar applications are Symbolab and Wolfram Alpha, which are both step-by-step calculators. The student enters a math problem, clicks a button, and the solution to the problem is provided (Symbolab, 2017; Wolfram Alpha, n.d.). Both of these programs are available for free on the Internet or as paid applications. Slader is a "free source of step-by-step solutions to homework problems in popular math and science books" (Edshelf, 2017, para.1).

There is also a version available for digital devices making Slader easy for students to access (Slader, 2017).

**The organization.** This literature review begins with a discussion of the problem of plagiarism in school; specifically, how plagiarism in mathematics occurs. The following section contains a description of the conceptual and theoretical framework used to collect and study the problem of plagiarism in mathematics. The conceptual framework for this study was social constructivism; the theoretical framework was social cognitive theory. In the next section, I present a discussion of the methods used in researching academic dishonesty, especially plagiarism. The remaining sections of this literature review contain an examination of methodological issues, a synthesis of research findings, a critique of previous research, and a summary of the literature review.

### **Conceptual and Theoretical Frameworks**

Technology has enabled cheating, especially plagiarism, to become easier for students (Aasheim et al., 2012). In this study, I explored academic dishonesty through the lens of social constructivism and the social cognitive theory.

**Social constructivism: Conceptual framework.** For this study, I used the conceptual framework of social constructivism in understanding academic dishonesty. According to social constructivism, the determination of an object's existence is through communication, both intrapersonal and interpersonal (Keaton & Bodie, 2011). This process of defining the object, or its construction, is social and allows a person to understand the object within a social context. Maturana (1978) explained social constructivism by noting that

knowledge implies interactions, and we cannot step out of our domain of interactions, which is closed. We live, therefore, in a domain of subject-dependent knowledge and

subject-dependent reality. . . . We literally create the world in which we live by living it.  
(pp. 17–18)

This study falls into this domain of subject-dependent knowledge.

One of the assumptions of constructivism is that a student's previous knowledge contributes to new learning (Keaton & Bodie, 2011; Vygotsky, 1978). This idea applies to plagiarism because one of the reasons students give for plagiarizing is that of learning from previous experience. One example of learning from previous experience is the case of video game players who are encouraged to 'cheat' to advance in their games (Kafai & Fields, 2009). The information for video game cheats is usually in the public domain on the Internet. These video game players often grow up with the idea that all information on the Internet is in public domain and may be used however the individual deems necessary (Jones et al., 2008). The idea of cheating may lead people to believe that the information on the Internet is in the public domain and therefore do not see copying or plagiarizing from the Internet as cheating (Jones et al., 2008).

Another assumption of constructivism is the idea of assimilation and accommodation. When a student cannot assimilate the new knowledge, they then make an accommodation for the new knowledge (Vygotsky, 1978; Zhang, 2012). When students cheat because of poor time management, or too much work in the class, the student is making an accommodation for their learning (Gullifer & Tyson, 2010; Vygotsky, 1978). Other examples that lead to cheating due to accommodations include striving for a certain GPA, poor pedagogy, and assignments deemed as unnecessary by the student (Geddes, 2011; Gullifer & Tyson, 2010; Vygotsky, 1978).

Vygotsky (1978) proposed that knowledge co-constructed using language, calling this idea of social constructivism (University College Dublin [UCD], 2015; Vygotsky, 1978). As

shown in Figure 1, social learning usually occurs before development. Learning takes place in the zone of proximal development (ZPD), where the student acquires new knowledge with the help of a “more knowledgeable other” (UCD, 2015; Vygotsky, 1978). A “more knowledgeable other” could be a human or, in the case of those who engage in plagiarism in completing math assignments, a nonhuman resource (UCD, 2015; Vygotsky, 1978). In Vygotsky’s (1978) theory, the “more knowledgeable person” is an integrated part of the ZPD.

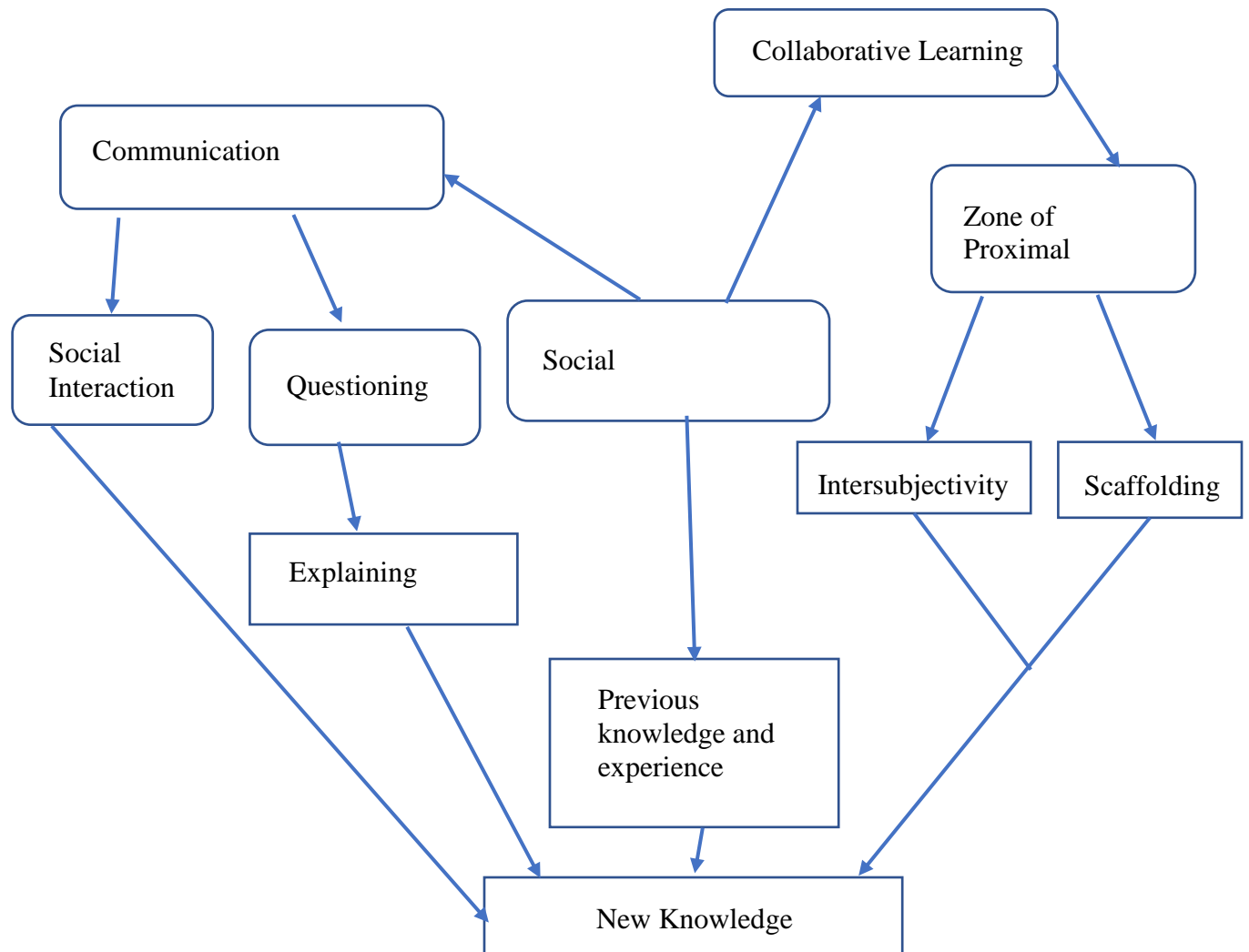


Figure 1. Vygotsky’s (1978) social constructivism theory.

The zone of proximal development (ZPD) contains many features that result in student learning. The first feature is intersubjectivity, where the two people in the ZPD start their journey



together with different knowledge and understanding (UCD, 2015; Vygotsky, 1978). The second feature is scaffolding, where teaching is adjusted to fit the student's current knowledge and level of performance (UCD, 2015; Vygotsky, 1978). Vygotsky (1978) defined the ZPD as the distance between the developmental level of learning and the potential level of learning, and viewed skills or learning as in the process of maturation. The basis of Vygotsky's theory was learning through collaboration; it is in the ZPD, where collaboration for learning takes place (Applefield, Huber, & Moallem, 2001; Vygotsky, 1978).

Students bring prior knowledge into learning situations; one belief in social constructivism was that students must critique and re-evaluate their understanding of prior knowledge in learning new knowledge (UCD, 2015; Vygotsky, 1978). Students may find it easier to resort to academic dishonesty rather than working towards gaining the new knowledge (UCD, 2015). Dishonesty is often a learned behavior, as in the example of players of video games who are encouraged to "cheat" to advance in their games (Kafai & Fields, 2009). These individuals learn cheating behaviors through websites and communication boards, where players exchange information. This experience in "cheating" at games often manifests in educational situations where students do not see a problem with dishonesty as long as they advance towards their educational goals (Kafai & Fields, 2009). In Selwyn's (2008) research, 98% of the 1222 undergraduate students surveyed reported that they looked up information on the Internet, while 50% claimed to use the Internet as a resource "all the time" (p. 16).

Plagiarism of math assignments is a social phenomenon. Every day, more digital apps and websites become available for completing homework assignments. Students share these objects through communication. This action, according to social constructivism, allows the person to define the object within a social context (Keaton & Bodie, 2011; Vygotsky, 1978).

When a student uses these new objects to complete their assignments, they were leaning on their previous knowledge. This previous knowledge usually consists of another student gaining success in plagiarizing assignments, thereby setting an example to follow. Another reason a student may use digital apps and websites to complete assignments is their lack of foundational knowledge. Within the context of social constructivism, the individual is making accommodations to achieve a specific goal (Geddes, 2011; Gullifer & Tyson, 2010). These examples show how social constructivism was a suitable theory for this study.

**Social cognitive theory: Theoretical framework.** In this study, I used social cognitive theory (SCT) as the theoretical framework through which to examine academic dishonesty (Bandura, 1971). Behaviorist theories provided the classical and operant conditioning use in the social cognitive theory (McLeod, 2016). Almost all learning resulted from direct experience and occurred by the observation of other's behaviors (Bandura, 1971). People also learned by observing the consequences of other people's choices. These consequences help people develop thoughts or hypotheses as to which behaviors will yield the best results. These hypotheses then become guides for future actions. Another feature of the social cognitive theory is the ability to understand future consequences and convert those ideas into motivators influencing current behavior (Bandura, 1971). Future consequences and ideas become important in the examination of academic dishonesty. Bandura based his social cognitive theory on the behaviorist learning theories of classical conditioning and operant conditioning (Bandura, 1971; McLeod, 2016). According to the social cognitive theory, people learn by observation (Bandura, 1971; McLeod, 2016). In the example of plagiarism, one reason students gave for cheating is the observation of other students cheating (McCabe & Trevino, 1993). People also learned by observing the

consequences of the behavior of others (McLeod, 2016). Cheating students often discover there are few consequences when caught cheating (Gullifer & Tyson, 2010).

Consequences are imposed by schools when a student is caught cheating. The campus where the research occurs has consequences which range from a warning to expulsion. At a local university, when a student commits academic dishonesty and is caught, the student may find themselves receiving a warning, the student may be required to take a course regarding academic integrity, or perhaps the student is required to write a reflective essay examining the actions which lead to the misconduct. Sanctions against offending students can also include disciplinary probation, suspension, and expulsion.

Hudd, Apgar, Bronson, and Lee (2009) revealed that more than 40% of the instructors employed at colleges are part-time. They also showed that part-time instructors are less likely to spend time looking for academic dishonesty (Hudd et al., 2009). Hudd et al. concluded that part-time instructors are likely to be more lenient than full-time instructors. The difference in the attitudes between full-time and part-time instructors extends to definitions and interpretation of academic integrity infractions (Hudd et al., 2009). The information regarding the possible penalties and the statistics about the part-time instructors shows why students might find that there are few consequences if caught cheating (Gullifer & Tyson, 2010).

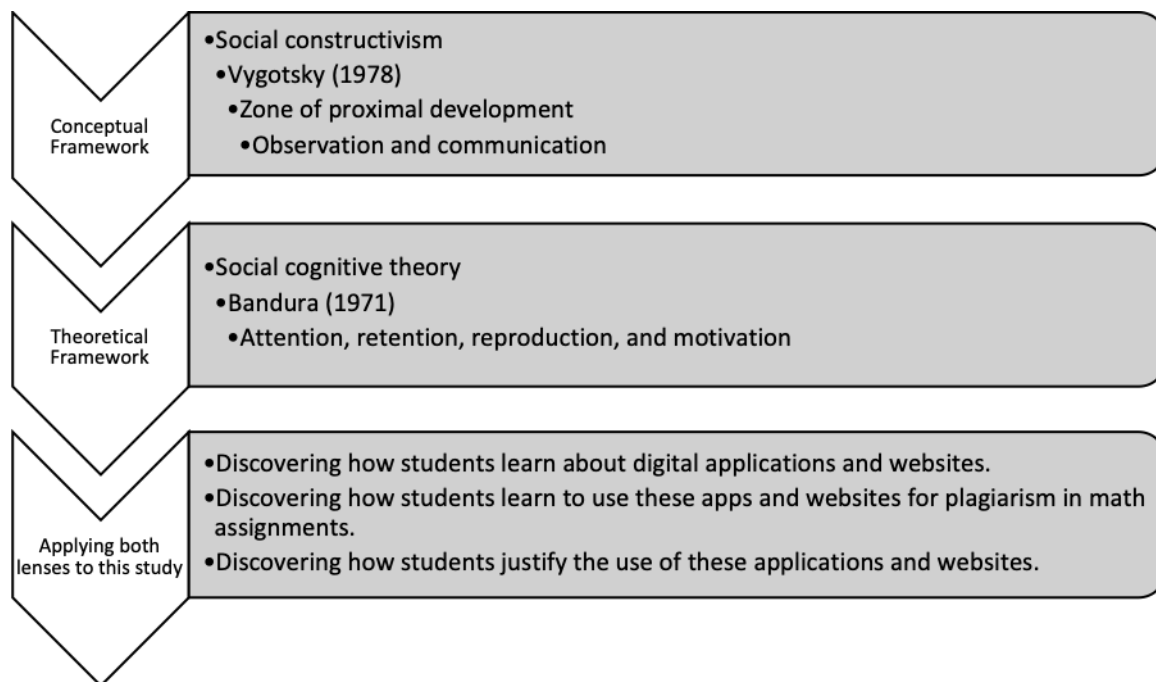
Bandura's (1971) theory contains four interrelated subprocesses or mediational processes: attentional, retention, reproduction, and reinforcement, motivational. Through these processes, Bandura explained that a person does not automatically observe a behavior and then immediately imitate it (Bandura, 1971; McLeod, 2016). The attentional process requires a person to recognize the features of the model's behavior (Bandura, 1971). The retention process involves behaviors reproduced when the model is no longer present, showing that memory must

exist (Bandura, 1971). To reproduce the behavior, a person assembles a set of responses that fit the given behavior; this action is a copy of the observed behavior (Bandura, 1971). In the final process, reinforcement and motivation, the levels of observable learning are affected by the reinforcement. If the behavior receives positive reinforcement or motivation, then the behavior is more likely to occur. These four interrelated subprocesses illustrate the learning of new patterns of behaviors before the performance of these behaviors (Bandura, 1971).

The social cognitive theory also includes three controlling processes of stimulus, cognitive, and reinforcement (Bandura, 1971). Some of the forms of stimulus control are emotional learning, persons, places, and events associated with experiences, both painful and pleasant (Bandura, 1971). One prime function of stimulus control is protection against potential threats (Bandura, 1971). Within the process of stimulus control occurred the two conditioning responses of symbolic conditioning and vicarious conditioning (Bandura, 1971). Symbolic conditioning explains strong emotional responses to situations, either positive or negative, based on previous conditioning (Bandura, 1971). Vicarious conditioning explains how vocal, facial, and the posture of another person led to a response, positive or negative, in another person (Bandura, 1971). The controlling process of the stimulus led to the controlling processes of cognitive and reinforcement.

In social cognitive theory, the concept of learning from direct experiences leads to an understanding of future consequences and allows the students to convert these ideas into motivators influencing their choice to cheat (Bandura, 1971). Another example of future consequences and motivators occurred with students running out of time to complete assignments and recognizing the consequences to their GPA (Geddes, 2011). These examples both illustrate how social cognitive theory applied to the study of academic dishonesty.

**Applying both lenses to academic dishonesty.** Social cognitive theory (SCT) falls under the category of social constructivism. In this study, I examined how social constructivism and, more specifically, social cognitive theory determined student's thoughts and actions when plagiarizing math assignments. Both of these theories formed their basis through the use of social means. Students often choose to commit academic dishonesty based on the behavior of others. The development of this learned behavior is through social interactions and the modeling of the behaviors. Within social constructivism exists the zone of proximal development (ZPD), where learning takes place through observation and other forms of communication (Applefield et al., 2001; Vygotsky, 1978). This concept is similar to the ideas of social cognitive theory, where people learn through the observation and communication of those who display the cultural patterns (Vygotsky, 1978). Vygotsky (1978), believed there was no doubt children learned speech from adults through observation and communication. This idea aligns with Bandura's (1971) social cognitive theory, where adults are seen as models from whom children learn.



*Figure 2.* Relationship between conceptual and theoretical frameworks in this study.

Bandura's (1971) theory contains four mediational processes of attention, retention, reproduction, and motivation. The attention process addresses the understanding that a person cannot learn without recognizing that there is something to learn (Bandura, 1971). The seminal studies in this research showed how the attention process applies to plagiarism (Bowers, 1966; McCabe & Trevino, 1993). These seminal studies illustrated that honor codes helped to eliminate cheating in the school (McCabe & Trevino, 1993). The honor codes defined cheating and the expectations, which then helped to eliminate academic dishonesty (McCabe & Trevino, 1993). Thus, there was no cheating behavior to observe and the undesirable behavior ended at the school (Bandura, 1971; McCabe & Trevino, 1993).

The retention process requires a person to create a memory of the learning, so the learning is then repeatable in the reproduction process (Bandura, 1971). Bandura (1971) addressed how the student first learned of the various digital applications and websites they chose to use for plagiarizing math assignments. Bandura also explored the reason a student had to use these sites. The observation of the students showed a correlation with the motivational process, where the learner had to have a desire to reproduce the learning (Bandura, 1971). These processes tied to the framework of social constructivism as they all are forms of communication (Keaton & Bodie, 2011; Vygotsky, 1978).

These four processes—attention, retention, reproduction, and motivation—illustrate that new patterns of behaviors are learned before being performed (Bandura, 1971). This concept relates to Vygotsky's (1978) theory that social learning occurred before development. Vygotsky (1978) believed children learned by imitation; this idea fit into the reproduction process of Bandura's (1971) theory. Past studies showed that when someone admits to plagiarism, they often stated that they were reproducing the successful behavior of another person; this is an

example of Bandura's (1971) reproduction phase and Vygotsky's (1978) imitation stage (Ma et al., 2008). When a person continues to commit plagiarism, their behavior is aligning with motivation process from SCT, where a person continues the learned behavior (Bandura, 1971).

In this study, I used the overarching framework of social constructivism as well as the more specific concepts in social cognitive theory to understand the phenomena of academic dishonesty, especially plagiarism. These two frameworks helped guide this research, where students learned about applications and plagiarizing through social means, observations of others' behavior, and the success of their behaviors. Specifically, it was my goal in this study to understand the *hows* and *whys* of plagiarism in higher education mathematics courses.

## **Literature Review**

### **Introduction**

In this literature review, I explore the different facets of academic dishonesty and the ways this action threatened intellectual honesty and integrity. Some of the facets of this review are a description of the seminal studies, types of academic dishonesty, and why people cheat. In particular, in this literature review, I look at information involving plagiarism in mathematics.

### **Seminal Studies**

Bowers (1966) completed the first major study of cheating in universities or colleges. In his research, Bowers sent questionnaires to deans and student body presidents at 1,134 schools of higher education. A more intensive study followed this initial action with the students of 100 colleges and universities receiving more comprehensive questionnaires (Bowers, 1966). Students evaluated themselves on these surveys, and when returned, 75% of those surveyed admitted they engaged in or more incidents of academic dishonesty during their time in higher education (Bowers, 1966).

In 1993 and 1997, McCabe and Trevino conducted two studies similar to Bowers (1966). The first study involved 6,096 students from 31 colleges (McCabe & Trevino, 1993). This study showed that academic dishonesty, or cheating, was determined by observing the behaviors of other people. If peers frowned on cheating, such as in a school with an honor code, then individuals usually would not cheat. Sometimes the pressure from peers was related to the special privileges enjoyed by schools with honor codes, such as the self-proctoring of tests.

The second study by McCabe and Trevino (1997) involved students at nine state universities. These results indicated that males in the first years of study with low GPAs were more likely to participate in academic dishonesty. Also, extracurricular activities influenced academic dishonesty; some of these undertakings included fraternity or sorority membership and intercollegiate athletics, where many of these extra-curricular groups have academic requirements to retain membership. Another factor in these groups was students watching fellow students cheat and get away with it (McCabe & Trevino, 1997). Students used these observations as one of the reasons to explain their participation in academic dishonesty. Research has determined the greatest deterrent to academic dishonesty was peer disapproval, especially in the form of honor codes (McCabe & Trevino, 1997).

In the years following Bowers' initial research, McCabe et al. completed two studies. The first study was comparing at schools with honor codes and those without honor codes (McCabe et al., 2001b). In this study, the students were from 31 schools, 14 with honor codes, and 17 with other policies. Research showed that there was significantly less cheating and a somewhat higher level of reporting dishonesty at schools with an honor code. This research supports the ideas of social cognitive theory, which explained students modeled the behavior for each another (Bandura, 1971). Once expectations were established with honor codes, the students were able to



model the non-cheating behavior. Students at schools with honor codes usually report academic dishonesty infraction so that they may maintain the special privileges, such as self-proctoring of tests, allowed by the honor code (McCabe et al., 2001b). The 2003 study involved more than 2000 students at 21 schools and included the faculty at 17 of these schools (McCabe et al., 2003). The research conducted in these studies found honor code schools experienced less cheating (Bowers, 1966; McCabe et al., 2003).

Specifically, these researchers found that academic dishonesty was higher among male students and all students involved in intercollegiate athletics, sororities, or fraternities, where grades determined eligibility for these groups (Bowers, 1966; McCabe, & Trevino, 1997). These seminal studies laid the foundation for studying plagiarism. Some later research supported some of the results found in the seminal studies (i.e., McCabe et al., 2003), while other research showed plagiarism was not specific to gender or members of organizations (i.e., Walker, 2010). In Bowers (1966) and McCabe et al. (2003), identification of the students was through self-identification based on their interpretation of cheating by the researchers. Walker (2010) used Turnitin to code different types of plagiarism and discovered few differences between the categories, i.e., gender, year of enrollment, as identified by earlier studies. Turnitin was used primarily to detect plagiarism in written assignments; it is not used often in math. These differences between the two sets of studies may be due to the self-identification approach. One study showed that females or first-year students are less honest about their dishonesty than are males and upper-level students (Walker, 2010).

### **Academic dishonesty: Who, why, and how it happens.**

Academic dishonesty includes different types of cheating, including plagiarism, collusion, falsification, and replication (Jones et al., 2008). Plagiarism is benefiting from someone else's

work without giving them credit (Perry, 2010). When students collaborate without the permission of the teachers, this is collusion (Jones et al., 2008). Falsification occurs when a student invents or falsely presents information, such as inventing a citation (Jones et al., 2008). Replication is using the same piece of work for more than one assignment (Jones et al., 2008). Some researchers found a variety of factors that influence students to use academic dishonesty. These factors include how and why people cheat, who cheats, and the results of the cheating, including methods to stop cheating.

In various studies, students identified their reasons for choosing to cheat. Some of these reasons are personal, such as poor time management skills and procrastination (Murdock, Beauchamp, & Hinton, 2008). Some of the reasons were external reasons in the form of neutralizing behaviors, where individuals blame other people for their choices (Murdock et al., 2008). In one study, students with higher neutralizing scores were more likely to cheat (Murdock et al., 2008). The final results showed when students blamed teachers for their lack of learning; these students saw cheating as justifiable (Murdock et al., 2008). In performance-based classes, the basis for the student's grade is the product produced in the class rather than on mastery of the concept (Murdock et al., 2008). Many students find performance-based classes boring with many assignments, which the students deemed as "busy work" (Murdock et al., 2008). These "busy work" assignments are seen as unimportant and sometimes lead to the students completing them by academic dishonesty (Murdock et al., 2008).

A common issue in the literature is the lack of a definition of academic dishonesty, cheating, and plagiarism (Aasheim et al., 2012; Bisping, Patron, & Roskelley, 2008; Gullifer & Tyson, 2010; Jones et al., 2008; Perry, 2010). Students are frustrated by instructors 'threatening' the students with dire consequences when plagiarizing, instead of teaching how not commit the

offense (Power, 2009). Gullifer and Tyson (2010) used information from a study by Roig (1997) to show that many students could not identify examples of plagiarism and that this inability leads to anxiety for some students. Some students consider sharing answers during an examination as cheating but do not consider plagiarism as cheating (Owunwanne, Rustagi, & Dada, 2010). In a study by Perry (2010), 27% of first-year students admitted to using material from the Internet to complete assignments but did not believe this was plagiarizing. Even when students understand academic dishonesty, they still perceive a difference in acceptable behaviors depending on the assignment type (Aasheim et al., 2012).

Another issue in plagiarism is the lack of punishment upon the discovery of academic dishonesty (Burrus et al., 2011; Schmelkin, Gilbert, Spencer, Pincus, & Silva, 2008). Many teachers believe a cheater only hurts themselves and chose to ignore the behavior (Chace, 2012). This ignoring of behavior leads some students to see a few consequences for cheating (Ma et al., 2008). Students claim that cheating is easy because of the low likelihood of being caught and if they are caught receiving little punishment (Burrus et al., 2011). The students receive encouragement in academic dishonesty when they see others receive high grades by cheating and receiving no punishment (Eraslan, 2011).

**Social groups, academic groups, and other activities.** Some research has indicated membership, in particular, social, academic, or other groups encourage academic dishonesty. Some of these groups are gamers, athletes, and participants in other extracurricular clubs (McCabe et al., 1999). Video game players advance in their games by seeking answers from others or cheating when encountering a difficult part of the game (Kafai & Fields, 2009). Cheating is allowed in gaming and is even encouraged with most cheats found in the public domain (Kafai & Fields, 2009). Video players then extend the idea of the public domain to

everything found on the Internet, believing it is okay to use this information without citing the source (Jones et al., 2008). Cheating is also higher among the groups of students participating in intercollegiate athletics and those who are fraternity and sorority members (Bowers, 1966; Stannard & Bowers, 1970). Perhaps this occurrence of cheating is because these groups require students to maintain their grades for participation (Bowers, 1966; Stannard & Bowers, 1970). Other determining factors that seem to encourage academic dishonesty include membership in social groups, increased television watching, and participation in clubs or groups (Pino & Smith, 2003; Wotring, 2007).

A student's GPA may also correlate with cheating (Bowers, 1966; Geddes, 2011; McCabe & Trevino, 1997). According to Geddes (2011), students with a high GPA have heavy workloads and high expectations. Research shows these students admit to academic dishonesty to maintain their GPA (Geddes, 2011). Bowers' (1966) and McCabe and Trevino's (1997) research showed students with low GPA cheat more often. Some results indicated students with higher GPAs engaging in academic dishonesty tend to choose methods that are less common and less obvious (Choong & Brown, 2007). While students with low GPAs often have low motivation to master the body of information and choose to cheat because it is easier often using methods that are detected easier (Jordan, 2001). Researchers have shown students with high GPAs and students with low GPAs participate in academic dishonesty for different reasons (Pino & Smith, 2003). Students with high GPAs feel pressured to maintain their grades, while students with low GPAs often cheated because of poor time management skills (Gullifer & Tyson, 2010; Pino & Smith, 2003).

**Neutralizing behaviors.** Neutralizing behaviors are actions based on external forces (Murdock et al., 2008). Students use neutralizing behaviors to explain away the responsibilities

of their choices; in other words, the students are taking little responsibility for choosing to cheat (Murdock et al., 2008). These external forces include the teacher, the teaching style, the structure of the classroom, and the time of the day of the class (Murdock et al., 2008). Students who cheat often consider their behaviors acceptable when they neutralize the behavior (Comas-Forgas & Sureda-Negre, 2010). Shu and Gino's (2012) findings suggested that memory, or lack of memory, may contribute to neutralizing behaviors. Murdock et al. (2008) surveyed 256 students who admitted cheating, claiming two reasons for blaming their teachers these were "too much assignment work" and "lack of respect for the teacher." Some of the issues cited by other students included poor teacher pedagogy; including performance-oriented teaching style where students believe the assignments are "busy work" or irrelevant assignments which the students feel is unimportant to their educational future; failure of the teacher to motivate the student; and the relationship between student and teacher (Chace, 2012; Comas-Forgas & Sureda-Negre, 2010; Geddes, 2011; Ma et al., 2008; Murdock et al., 2008; Pulvers & Diekhoff, 1999). Neutralizing behaviors are common among students who commit academic dishonesty. In this study, I examined how students used neutralizing behaviors as a reason for committing plagiarism in completing math assignments.

Technology and the Internet have made it easier to access information and have had a profound impact on the academic world, providing increased opportunities for students to cheat and to learn (Aasheim et al., 2012). In a study by Selwyn (2008), 98% of the students responding reported completing assignments using information from the Internet, 50% reported doing this all the time. Research has shown students do not believe cheating with technology carries the same stigma as "regular" cheating (Molnar, Kletke, & Chongwatpol, 2008). Some people believe everything available on the Internet is in the public domain, and thus, it is not cheating to copy or

plagiarize using the Internet (Jones et al., 2008). Some examples of how technology aids in cheating include the buying of assignments and plagiarizing (Aasheim et al., 2012). Some researchers have argued the availability of digital sources is the reason for the growth in academic dishonesty (Simkin & McLeod, 2010). This idea is apparent in plagiarism in math assignments, as more information becomes available through digit applications and websites, the more a student is tempted to plagiarize in completing their math assignments (Ma et al., 2008).

### **Plagiarizing in mathematics**

This study explored plagiarism through the lens of social constructivism, where the determination of an object's existence is through communication and observation (Keaton & Bodie, 2011). In social constructivism, learning takes place in the ZPD, where a “more knowledgeable other” aids the student in acquiring new knowledge (UCD, 2015; Vygotsky, 1978). Plagiarism occurs most often in writing, but plagiarism occurs in other works such as music, art, diagrams, design, software code, and so on (Jones et al., 2008). For example, when a student did not learn the mathematical concept, the student may then be tempted to resort to a “more knowledgeable other” who helps him or her to plagiarize. This “more knowledgeable other” may be another person, or it could be a math application (Vygotsky, 1978). Students also learn to plagiarize by observing others participating in academic dishonesty and then applying this behavior to their studies. Learning by observation is a characteristic of social constructivism (Vygotsky, 1978).

Ma et al. (2008) viewed the Internet as a social constructivist learning environment where students engaged in learning that is relevant to their personal needs and interest. In social constructivism, social interaction, through communication and dialogue, is a critical factor for acquiring knowledge (Vygotsky, 1978). Using the Internet leads students to develop a shared

understanding of what is acceptable behavior (Ma et al., 2008). Researchers found about two-thirds of the student participants were following the examples of other students who cut-and-paste (Ma et al., 2008). Most of the students in interviews talked about copying-and-pasting as if it was an ordinary occurrence (Ma et al., 2008). Ma et al. (2008) illustrated how the use of the Internet is viewable through the lens of social constructivism.

There is little published research on the topic of plagiarism in mathematics. One documented area where plagiarizing is occurring is in coding, which is a concept similar to mathematics (Bidgood & Merrill, 2017). Students are copying code from websites and friends and turning it in as their work (Bidgood & Merrill, 2017). One professor at the University of California, Berkley discovered approximately 100 of his 700 students copied code (Bidgood & Merrill, 2017). In 2015, about 20% of the students in one course at Stanford University were flagged for possible cheating, with many students changing one command in the code (Bidgood & Merrill, 2017). This student action is similar to how plagiarism occurs in English courses (Bidgood & Merrill, 2017). Computer programing, or coding, is comparable to math; in both fields, students share information and acquire answers from websites and other digital sources.

There are websites available for plagiarizing mathematical assignments. These include Wolfram Alpha, Mathway, Symbolab, PhotoMath, and Slader. Wolfram Alpha, Mathway, and Symbolab each require the user to input the information into the applications (Wolfram Alpha, n.d.; Mathway, 2016; Symbolab, 2017). With PhotoMath, the user takes a picture of the question, and the solution is produced (PhotoMath, n.d.). Slader consists of a database of textbooks with solutions provided (Slader, 2017). In research by Ma et al. (2008), students admitted to copy-and-pasting answers for a math assignment. There is little documentation as to how many students use these sites to complete their assignments, but according to a study by

Eraslan (2011), 81% of 41 surveyed prospective mathematics teachers admitted they cheated on exams and written assignments in college by using crib notes, copying from others and sharing answers. The reasons given by these prospective teachers included not wanting to memorize facts for one test, wanting to ensure a good grade, not studying enough, and observing other students getting high grades by cheating and then receiving no punishment (Eraslan, 2011).

## **Review of Methods**

Most of the studies reviewed in this dissertation used a quantitative approach, “where a theory composed of variables was tested and then measured with numbers and analyzed using statistical procedures” (Creswell, 1994, p. 2). Some of the procedures used experiments and surveys in these quantitative studies (Creswell, 1994). Some of the surveys required the students to self-report themselves (Burrus et al., 2011; Geddes, 2011; McCabe & Trevino, 1993). These surveys often included a question about whether the student has engaged in or ever witnessed academic dishonesty. These were distributed through the mail, online, and in person. All the surveys were anonymous. Administrators and alumni also participated in some of the surveys (Bowers, 1966; Yardley, Rodriguez, Bates, & Nelson, 2009). Most of the surveys used Likert scales or something similar for the students to rank their behaviors. The quantitative approach using surveys was the chosen method of many of the studies reviewed in this paper. For this research, I will use a qualitative approach, as the intent of this study is not to count the number of students committing plagiarism in completing math assignments.

Molnar and Kletke’s (2012) evaluated quantitative research from an economics viewpoint using cost and benefit analysis within economic theory. The researchers looked at graded and ungraded cheating, which includes downloading music or other copyrighted material. Student participants completed questionnaires asking how often they engaged in cheating; then factor



analysis was used to determine if students perceived differences in the two categories of cheating. The goal of this study was to determine if an economic benefit encourages more cheating (Molnar & Kletke, 2012).

Molnar et al. (2008) conducted another research project to determine if students perceived the difference between ethics and ethics with IT. A total of 708 questionnaires were returned and analyzed using Azjen's theory of planned behavior, and IT versus non-IT intellectual property violations. Most of the students surveyed were enrolled in introductory information system courses. The questionnaire identified specific cheating behaviors and used a Likert scale. The results showed students differentiate between cheating personally and cheating using IT (Molnar et al., 2008).

Most of the seminal studies used a quantitative approach with surveys. The first study by Bowers (1966) used the theoretical framework of anomie to explain academic dishonesty through the lack of social ethics (Johnson & Duberley, 2011). The initial survey in Bowers' (1966) study went to 1,134 deans and student body presidents. From this list of 1,134 colleges, students of 100 colleges received more intensive questionnaires (Bowers, 1966). The study was analyzed through the lens of anomie, which resulted in 75% of the surveyed students being labeled as cheaters (Bowers, 1966).

The social learning theory is the original title of the social cognitive theory (SCT), which Bandura (1971) renamed to illustrate the importance of a person deciding to complete the behavior. One study which used the social learning theory involved 31 colleges with 6,096 out 15,904 surveys returned (McCabe & Trevino, 1993). The students responded by indicating the frequency they engaged in academic dishonesty using a four-point Likert scale (McCabe & Trevino, 1993). Another study involved 31 schools; 14 with honor codes and 17 with other

policies, this survey has about 41.4% of the 12,100 surveys returned (McCabe et al., 2001). In 2003, the study involved 2,000 students at 21 schools and the faculty at 17 schools (McCabe et al., 2003). These surveys were analyzed using statistical methods such as regression (McCabe et al., 2003). These initial studies into the field of academic dishonesty used the methods of anomie theory and social learning theory.

A few studies used a qualitative approach to research a problem in a natural setting (Creswell, 1994). The reason for this type of study was to build a holistic picture, reporting detailed views of the informants (Creswell, 1994). Power (2009) used grounded theory and phenomenology to collect and analyze the information she gleaned from focus groups. For this study, the researcher chose two undergraduate writing courses for the focus groups. The focus groups were 90 minutes long, with additional private interviews with some of the students. Burnett et al. (2016) used social cognitive theory and grounded theory to study students at a 4-year liberal arts college, with 39 students participating. This study included nine scripted questions adapted from previous studies (Burnett et al., 2016). Another approach to qualitative research using grounded theory involved students writing a one- or two-page reflection paper about their experiences in academic dishonesty, their own, or someone else (Eraslan, 2011). The paper contained open-ended questions given to 48 prospective mathematics teachers. These written responses were then analyzed using grounded theory to find the most common themes (Eraslan, 2011).

A few projects used a mixed method of both qualitative and quantitative research. For McCabe et al. (1999), the project contained a qualitatively scored comment section. This section asked the student's opinion about the effectiveness of policies regarding academic integrity. The answer was analyzed to learn more about their thoughts and feelings regarding academic

dishonesty. The framework was a social learning theory with the comment section coded. This project is the only one where McCabe and Trevino (1999) used a mixed method.

There were also research projects which were executed in a manner to catch people cheating. One of these research projects used a mixed-method approach. The first part of the study involved a matrix task where the students were asked to put numbers into a matrix to fit a pattern (Shu & Gino, 2012). The students, 199 college students, were then allowed to self-check their work. For every correct entry, the student received a small amount of money. The students then placed the paper in a box and collected the money. Secretly, Shu and Gino (2012) coded the sheets of paper in a way that indicated the identity of the student who completed the work. The list was then checked for those who took money for the correctness and discovered 32% of the students had over-reported their success rate on the matrix exercise (Shu & Gino, 2012). The construction of this study was interesting; instead of asking people if they committed academic dishonesty, the study gave the students the chance to show their academic dishonesty.

Most of the studies reviewed in this dissertation used a quantitative approach. A few used qualitative and mixed methods. For this study, I used a survey initially to aid in identify students willing to participate in the study. Based on previous research, the idea of self-identification of students may be reliable to a point, but this self-identification should not be the only way used to understand plagiarism. I did not limit this study to the collection of numbers, as seen in previous studies. Rather, in this study, I used interviews and other personal contacts with the students to arrive at a greater understanding of the phenomenon of plagiarism

## **Methodology Issues**

Most of the studies reviewed in this dissertation used a quantitative approach, where a theory composed of variables was tested and analyzed using statistical procedures (Creswell,

1994). These quantitative studies primarily used surveys. Therefore, this review of methodological issues explored the strengths and limitations of using surveys in the quantitative approach.

Most of the studies in this literature review used a survey design allowing the researcher to collect information by asking questions and then to use the answers for a generalization of the information to a population (Creswell, 1994). These surveys required students to self-identify, asking students if they had engaged in or ever witnessed academic dishonesty (Bowers, 1966; Burrus et al., 2011; Geddes, 2011; McCabe & Trevino, 1993; Yardley et al., 2009). Asking students to self-report has issues, perhaps, some students may not be open about their experience with academic dishonesty, or the student does not believe the behavior described is cheating. Even though all the surveys were confidential and anonymous, students may not trust the testers (Choong & Brown, 2007). Most of the surveys used Likert scales or something similar for the students to rank their behaviors. The quantitative approach of using surveys was the chosen method of many of the studies reviewed in this paper.

Surveys as research tools have several limitations. Even with these issues, they were a good tool for these studies. Some groups gave the survey to convenience groups; these captive audiences were handed the surveys during class time. For example, in the case of Choong and Brown (2007), 198 surveys were handed out to students in teacher education classes. Students who chose not to participate were asked to keep busy with personal activity. Chances to win an Apple iPod or iPod Shuffle was an enticement for students participating in another survey (Rittinger & Kramer, 2009). While another group received class credit for participating in the survey, either one of these approaches rewarded the students for their answers; in one case, there could be the temptation for the student to complete more than one survey (Williams, Nathanson,

& Paulhus, 2010). In all the situations, there was a chance a student rushed through the survey to gain the final prize.

Another limitation of surveys was the identification method. For most of the surveys, anyone indicating they had participated in academic dishonesty received identification as a cheater, whether they realized it was academic dishonesty or not. The issue with this identification method becomes evident in one study, where alumni were asked to identify behaviors they followed in college. Then the alumni find out these behaviors were academic dishonesty (Yardley et al., 2009). The former students did not see reusing a paper in another class as cheating, believing instead, that since they wrote the paper, the use of the paper should be up to them (Yardley et al., 2009). Another example where the students did not feel there was academic dishonesty was collusion or working with another student (Yardley et al., 2009).

Some students were participating in activities they do not see as dishonest behavior; this leads to a large number of “cheaters” in the final analysis. One of the issues discussed in several studies was the need for a definition as to what constitutes academic dishonesty (Aasheim et al., 2012; Bisping et al., 2008; Gullifer & Tyson, 2010; Jones et al., 2008; Perry, 2010). This lack of clear definition may contribute to students' unknown participation in dishonest behavior. Students are often told not to cheat by their instructors, but received no clarification as to what constitutes cheating (Aasheim et al., 2012; Bisping et al., 2008; Gullifer & Tyson, 2010; Jones et al., 2008; Perry, 2010). Some students experience anxiety due to the lack of a clear definition; these students are afraid they will “accidentally” commit academic dishonesty (Gullifer & Tyson, 2010). This lack of clarity led to limitations in the results of a survey, with students admitting to behavior without realizing the behavior is considered academic dishonesty.

Most of the studies reviewed in this dissertation used surveys. There are a couple of issues causing limitations in these examples of research. One is the self-reporting of students, and another is the need to define academic dishonesty. This dissertation did not seek to count the number of students participating in academic dishonesty. Instead, this dissertation sought to determine which applications the students are using for completing math assignments, how and why students are using these applications. Also, this dissertation sought a clearer definition of plagiarizing in math. There was a survey asking students which types of digital tools or websites they used in completing the math homework and why they used these applications. By asking this type of question will perhaps lead to a better understanding of math students in a higher education setting.

### **Synthesis of Research Findings**

Research regarding academic dishonesty in college and universities began with Bowers' study in 1966. Bowers (1966) based his research on the anomie theory, a concept studying deviant behavior, to explain academic dishonesty (Johnson & Duberley, 2011). In Bowers' (1966) research, anyone who identified themselves as participating in academic dishonesty one time, or more, were classified as cheaters. This system of identification resulted in about 75% of the surveyed individuals receiving the label of a cheater (Bowers, 1966).

McCabe et al. (2001) performed a large amount of research in the study of academic dishonesty, duplicating much of Bowers' (1966) research. The conceptual framework used for their research was the social learning theory, which later became the social cognitive theory, developed by Bandura (1971). The basis of the social learning theory was the idea that all learning was founded on experiences or learned by observing modeling (Bandura, 1971). McCabe et al. (2001) explained that when students watched others cheat and then saw them get

away with the cheating, the student was learning a behavior (Bandura, 1971). The conceptual framework of social learning theory helped to explain why people chose academic dishonesty over honesty. The basis for learning was personal experiences and observations of the behaviors of others. Individuals pursue behaviors based on the consequences or rewards the observed behavior gains (Bandura, 1971). Bandura modified the social learning theory in 1986 and renamed it the social cognitive theory to emphasize the cognitive control individuals have over their actions (McLeod, 2016).

Some research groups used Bandura's (1986) theory to explore the impact of the Internet and academic dishonesty. Shu et al. (2011) and Burnett et al. (2016) believed student cheating was on the rise since the inception of the Internet. The research from both of these groups attempted to prove the hypothesis that the use of the Internet leads to increased cheating. The research arrived at different results. Shu et al. (2011) decided the Internet was not a factor in student dishonesty. Their study showed that students would be dishonest in a permissible environment, but signing an honor code helps eliminate cheating (Shu et al., 2011). The research by Burnett et al. (2016) showed the ease of accessibility of the Internet led to more academic dishonesty among college students. Students were finding it easier to cheat, sometimes not realizing they were cheating (Burnett et al., 2016). Students observed others committing academic dishonesty and copied the behavior. Bandura's (2001) theory explains imitation this way; when a student sees another student cheating, this can act as a catalyst for duplicating the behavior. According to Bandura (2011), when individuals see others like themselves, succeeding in their goals, they will follow the example. This imitation is the case when another student sees a peer gaining something through the act of academic dishonesty (Burnett et al., 2016).

One idea specific to Bandura's (2011) theory is moral disengagement. Moral disengagement deals with individuals deciding ethical standards do not apply to them (Bandura et al., 1996). Moral disengagement was the focus of the studies by Detert et al. (2008); and Stephens et al. (2007). In a study by Detert et al. (2008), moral disengagement was the relationship between an individual and their unethical decision making. This study further showed that moral disengagement could be turn off and on by the individual (Detert et al., 2008). This disengagement was a demonstration of how an individual has cognitive control over their actions (Bandura et al., 1996). The research of Stephens et al. (2007) measured the moral cognition exercised by the student in making a decision involving academic dishonesty. This study revealed that students exercising moral responsibility would refrain from cheating more often than students not exercising moral responsibility (Stephens et al., 2007). Students often disengage by using neutralizing behaviors; these are common with individuals lacking morals (Stephens et al., 2007). These behaviors allow students to blame others for their misfortunes rather than taking responsibility themselves (Stephens et al., 2007).

There were many reasons that students claimed to engage in academic dishonesty. One of the most common issues found in the research was the lack of clear definitions of plagiarism and academic dishonesty. McCabe et al. (1999) found there was less cheating when definitions surrounding cheating were clarified, in the form of honor codes. Honor codes defined the rules involving cheating and also required students to hold each other to the stated rules (McCabe et al. 1999).

Stephens et al. (2007) showed that students found cheating easier when the instructor did not establish definite policies. A study illustrated that faculty definitions of academic dishonesty were more comprehensive than the definition of a student (Burrus et al., 2011). The definition of



academic dishonesty may differ between faculty members (Jones et al., 2008). Studies have found that faculty members are tougher on cheating if they perceive their colleagues were also vigilant in fighting the dishonesty (Burrus et al., 2011). One suggestion for eliminating the issue of definition differences was to train the faculty members on academic issues (Boehm et al., 2009). Owunwanne et al. (2010) discovered most students did not read the information regarding academic dishonesty, and usually, the statements only inform the students that cheating was not allowed. These students did not understand the specific concept of cheating as it was not clarified because the teacher did not break down the concept for them (Owunwanne et al., 2010).

These were a few of the areas this dissertation explored using the social cognitive theory in conjunction with the social constructivism theory to guide the research. Social constructivism believes the determination of an object's existence is through communication (Keaton & Bodie, 2011). Social constructivism and social cognitive theory worked well as conceptual frameworks for the research for this dissertation, as both theories contained ideas based on learning through observed behavior. Most of the previous research showed individuals often choose to cheat because of their observations of other students participating in the behavior. No matter which conceptual framework used by the previously discussed researchers, the information they found provided a solid base for this dissertation. The research questions for this dissertation attempted to determine how college students and instructors defined plagiarism in math courses and how college students and faculty perceived the use of digital applications in a math course. The hope was that this research would lead to an understanding of math teachers as to how their students were using emerging technology. Perhaps the students and the teachers may agree on the way to use technology as a tool for teaching and learning mathematics.

## **Critique of Previous Research**

Bowers (1966) first explored academic integrity at the college and university level. He sent questionnaires to the students of 100 schools, chosen from the original 1,134 institutions of higher education. Bowers (1966) defined anyone who previously participated in one of 17 common types of academic dishonesty as cheaters. This identification method labeled 75% of the surveyed students as cheating. Another study with 675 surveyed arrived at 47% of individuals committing some academic dishonesty (Pino & Smith, 2003). Most of the results of other studies fall below both of these numbers and show that no one is certain how many students participate in academic dishonesty.

The identification system used by Bowers (1966), whose study was the seminal research in this subject, seems harsh given a study by Yardley et al. (2009). This study involved 664 psychology department alumni (Yardley et al., 2009). About 80% of the students surveyed identified themselves as cheaters, given the parameters of the study. Students filled out a comment section at the end of the survey, where many of the students explained they did not realize the behavior listed was cheating. In this study, 52.6% of the students surveyed admitted to being one-time offenders in the area of academic dishonesty. This nonrealization of the impact of behavior is related to two separate issues; the first one is how students rank different types of cheating, and the second was ignorance (Choong & Brown, 2007; Kafai & Fields, 2009). To students, some types of cheating were less severe than other types of cheating (Kafai & Fields, 2009). Many students did not see collusion, working with someone on an assignment, as cheating (Yardley et al., 2009). These same students rank helping someone during a test as definitively cheating. The second issue, ignorance, was a common excuse given by students for

participating in academic dishonesty (Choong & Brown, 2007). The goal of this study was not to label a student as a cheater as they used some of these avenues to complete their homework.

One reason for the excuse of ignorance in academic dishonesty was the need for a definition as to what constitutes academic dishonesty (Wotring, 2007). Many of the researchers suggested the development of a definitive definition, including how students use the Internet. Some students believed it is okay to use the Internet to complete assignments. These individuals considered the material on the Internet in the public domain and that it was not cheating when they used the material (Jones et al., 2008). This dissertation attempted to identify the digital and internet sources students use to complete math assignments. Further, this dissertation attempted to clarify the definition of academic dishonesty in the use of these items.

In some previous research, the conclusions established the importance of honor codes in preventing cheating. The studies by McCabe et al. (2001) reported less cheating at schools with honor codes than a school without these codes. Scott (2016) believed adding an honor code would improve learning, but Scott also suggested those students bound by honor codes may not be honest in their self-identification on surveys. McCabe and Trevino (1996), felt there was no clear reason for the reduction of cheating in environments with honor codes. Perhaps the success with honor codes is based on students receiving the necessary guidelines regarding what constitutes academic dishonesty (Wotring, 2007). This dissertation attempt to clarify the definition of plagiarism in mathematics from the viewpoint of students.

Some of the surveys addressed cheating during the entire educational experience of the student, while others used a course-by-course approach (Jordan, 2001). College Algebra classes are required to obtain a degree, and according to some research, cheating occurs most often in courses required to obtain a degree (Yardley et al., 2009). The requirement of the College

Algebra class and the lack of interest in mathematics for many students found many students using digital applications and websites to complete their homework (Yardley et al., 2009). This research was interested in participants who previously or are currently taking College Algebra classes, which is a requirement for many degree programs.

Most of the researchers used quantitative methods, with Likert scales. A few studies used a qualitative approach utilizing focus groups and staged experiments. All the quantitative surveys ask students to self-identify themselves as participating in academic dishonesty. This dissertation used a qualitative approach with interviews to identify the digital applications used to complete math assignments. This study asked the student to identify themselves as users of these digital applications. This study then used interviews as a vehicle to allow the participants to explain how they first observed the behavior and the motivation behind repeating the behavior of using digital applications and websites to complete math assignments.

The technique used to gather the information in the research projects studied in this review varied. Some surveys were mailed or e-mailed; some were passed out to random students, while other surveys used samples of convenience. Trushell et al. (2012) required students to fill out the survey as a class requirement; this sample yielded only 47 participants in the survey. Other methods of distribution of surveys, that of using e-mail or mailing method would always yield students who do not participate. This lack of participation could create selection bias (Bisping et al., 2008). For example, perhaps individuals who participate in academic dishonesty are reluctant to participate in the survey. This dissertation dispersed the initial surveys in common student areas. After these initial surveys, the students who indicated their willingness to participate in the study were selected to participate. These individuals were interviewed to gain the information needed to complete this study.

Based on the review of the literature and using the conceptual framework of social learning theory (Bandura, 1971) and social constructivism (Vygotsky, 1978). I claimed this literature review provided strong support for pursuing a research project answering the following questions:

RQ1: How do college students perceive the use of digital applications to complete assignments in math courses?

SRQ1: What reasons do college students use for justifying the use of the Internet and digital applications in completing math assignments and tests?

RQ2: How do college students perceive plagiarism in math courses?

SRQ2: What is the shared essence of plagiarism in math courses?

## **Chapter 2 Summary**

The focus of this study was on plagiarism in completing mathematical assignments. Many of the articles reviewed for this study involve plagiarism in writing, as there is little information available for academic dishonesty in mathematics. The use of digital applications and websites was an important subject to understand, as most students were required to take math courses in a higher education setting. Practicing is the best method for learning mathematics, and the advent of digital material has allowed students to refrain from this needed practice. The use of the Internet and digital applications in completing math assignments required clarification to prevent academic abuse of these resources.

In this study, I used social constructivism and social cognitive theory as conceptual frameworks to guide this study. Social constructivism was a theory developed by Vygotsky (1978). This theory states the determination of an object's existence is through communication (Keaton & Bodie, 2011). The social cognitive theory by Bandura based learning on the imitation

of other behaviors (McLeod, 2016). The largest portion of this chapter was the literature review, which began with a discussion regarding the seminal studies and then described academic dishonesty. Bowers (1966) conducted a seminal study of academic dishonesty in higher education. Research by McCabe and Trevino (1997) and McCabe et al. (2001) followed this seminal research, which duplicated Bowers' work. Most of these studies supported the use of honor codes in schools as a deterrent to academic dishonesty. The description of academic dishonesty details the different types of behaviors such as plagiarism, collusion, falsification, and replication, which fall into the classification of cheating, with a list of reasons students, participate in cheating behaviors (Jones et al., 2008). Then there was a discussion regarding the need for clearer communication between teachers and students as to what constitutes academic dishonesty and a description of plagiarizing in mathematics.

Previous research revealed that students rank cheating methods at different levels (Kafai & Fields, 2009). Many students perceive digital cheating less severe than helping someone on a test (Ma et al., 2008). In the literature review, I explored the various writings and previous research regarding academic dishonesty. I used this information to provide the backdrop for conducting a comprehensive study regarding the use of digital applications in completing math assignments.

### **Chapter 3: Methodology**

According to numerous studies, such as those conducted by Bowers (1966), McCabe, Trevino, and Butterfield (2001b), and Bidgood and Merrill (2017), academic dishonesty, a type of cheating which includes plagiarism, is found on campuses of higher education. These studies revealed as many as 39% of students in higher education admitted to cheating on tests, and 62% admitted to cheating on written assignments (International Center for Academic Integrity, 2017). However, most of the documented studies are in the area of writing. Therefore, the goal of this study was to understand academic dishonesty, specifically plagiarism, as it applied to mathematics courses. The definition of plagiarism is using someone else's work as your own without acknowledging the original creator (Jones et al., 2008). This study examined the phenomenon of plagiarism in math courses from the perspective of students and employed a qualitative approach, specifically a phenomenological research design, for collecting data. The rationale for the use of phenomenology, the study of the world as it is lived, is that plagiarism occurs through shared experiences (Vagle, 2016).

I used two similar frameworks to guide the research: Vygotsky's (1978) social constructivism, and Bandura's (1971) social cognitive theory. Social constructivism explains how communication and social context determines an object's existence in the zone of proximal development (ZPD) where learning takes place (Bandura, 1971; Keaton & Bodie, 2011; University College Dublin [UCD], 2015). A student is guided in this stage of social constructivism by a person or other resource which has more knowledge. In the case of this study, a digital application or website constituted this more knowledge resource (Bandura, 1971; UCD, 2015). In social cognitive theory, Bandura (1971) explained all learning is from direct experience and can occur by observing the behaviors of others. Social cognitive theory uses

observation for learning socially through reproduction (Bandura, 1971). Students often claim that watching someone else getting away with committing plagiarism was one of the reasons for participating in the same act (McLeod, 2016). Together these two theories supported the rationale for the phenomenon of plagiarism.

Using the phenomenological method, the goal of this study was to explain how and why students perceive plagiarizing in math classes. With the growth of digital applications and websites, there are many new sources for the student to use in completing their math assignments (Ma et al., 2008). This study helps in understanding the use of various applications and websites in math courses. Another goal of this study is to clarify the definition of plagiarism as it applies to the field of mathematics (Harkins & Kubik, 2010).

The information in this chapter appears in the following order. First, there is this introduction followed by the research questions guiding this study. Next is the description of the purpose and design of this study, the research population and sampling method, and the instrumentation and the collection of data. In the following section, I examine the identification of attributes and data analysis procedures. The chapter continues as I discuss the limitations of the research and the credibility and dependability validation. Next, I outline the expected findings and the ethical issues that arose from the study. Finally, the chapter closes with a summary of the information presented in the chapter.

### **Research Questions**

This research examined the phenomenon of plagiarism in mathematics by seeking answers to the following research questions:

RQ1: How do college students perceive the use of digital applications to complete assignments in math courses?



SRQ1: What reasons do college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests?

RQ2: How do college students perceive plagiarism in math courses?

SRQ2: What is the shared essence of plagiarism in math courses?

### **Purpose and Design**

The purpose of this research was to examine students' perceptions of plagiarism in mathematics. Most of the studies regarding plagiarism are in the area of writing assignments. These studies show that as many as 62% of students admit to this type of academic dishonesty on written assignments (ICAI, 2017). However, there is little research in the area of plagiarism in mathematics. There are two areas where the significance of this study is found; one is digital applications and websites for completing math assignments and the other in defining plagiarism in math assignments. Examining plagiarism in the area of mathematics included understanding how and why students use digital applications and websites to complete math assignments. This examination was significant since there is a division between the student's understanding of plagiarism and the instructor's definition of the student's actions.

**Methodology.** Most of the previous research regarding academic dishonesty, such as the seminal studies of Bowers (1966) and McCabe et al. (2001), focused on how many students were participating in the act. The methodology used for these studies was a quantitative approach with surveys attempting to ascertain the number of students who committed academic dishonesty and to develop descriptions of these individuals (Trushell et al., 2012). This study was seeking a different perspective: the how and why of academic dishonesty when completing math assignments. For this research, I used a qualitative phenomenological approach with semistructured interviews.

The area of phenomenology has been influenced by different philosophers. The study of the phenomenon was first proposed by Husserl, a philosopher who believed a subject could not be observed separately from the object (Polkinghorne, 2013; Vagle, 2016). Husserl believed the study of a phenomenon required looking at the relationship between the person and the object, specifically the intentional relations between the two groups (Vagle, 2016). Another philosopher, Heidegger, built on Husserl's ideas but proposed considering phenomenology and hermeneutics together. In the case of phenomenology, hermeneutics is concerned with the interpretation of the text surrounding the phenomenon, establishing an intersubjective relationship (Vagle, 2016).

Vagle (2016) described phenomenology as “internationality of different shapes, sizes, and contours running all over the place” (p. 41). Vagle (2016) considered phenomena to be social rather than belonging to the individual, summarizing his own ideas alongside the ideas of Husserl, Heidegger. He believed Husserl was concerned with the “of-ness” of a phenomenon and Heidegger with the “in-ness” of the phenomenon, while he was concerned with the “through-ness” of the phenomenon. Husserl's “of-ness” is the study of the “intentional relationship” between the subject and object, studying the directed “of-ness” toward something (Vagle, 2016, p. 36, 39). The idea of “in-ness” explains the relationship of subjects to one another and the object, as Heidegger called it, being “in” the world (Vagle, 2016, p. 39). The idea of “through-ness” signifies movement when the meaning occurs in the process of living the phenomenon leading to the social aspects of the phenomenon (Vagle, 2016, p. 41). Heidegger, Husserl, and Vagle were not the only philosophers and researchers who established rules and definitions for phenomenology; there are many other thinkers who have put forward slightly different phenomenological methods of researching and interpreting data. No matter the philosopher or

researcher, phenomenology describes a relationship. In this study, I used the “through-ness” described by Vagle (2016) to explain plagiarism in mathematics.

Phenomenology describes our relationship to the world and with others by allowing the researcher to study the phenomenon and how it appears in the world, rather than studying the individual (Vagle, 2016). In this research, I studied the phenomenon of plagiarism.

Phenomenologists contended there is a connectedness between subjects and objects called *intentionality*, which can be defined as the “inseparable connectedness between people and objects in the world” (Vagle, 2016). The subjects are people, while objects are any things with which these people interact— in this case, digital applications and websites. Intentionality connects humans to their surroundings, whether they are conscious of it or not. I tried to determine how and why students participate in academic dishonesty or how they are connected with the act of plagiarism (Vagle, 2016). In other words, I examined students’ intentionality toward the use of digital applications to complete mathematics assignments. I also examined students’ perceptions of plagiarism in completing math assignments.

**Research population and sampling method.** In this section, I will examine the research population and sampling method used in this research. The population used for the research was math students from a remote campus of a state university. According the information provided by the State, the campus offers general programs leading to an associate of arts degree or certificate Most of the students who attend the college are from the area; a few travel from nearby towns. A description provided by the local government describes the location of the college as being in a rural area with a population of 101,095.

The population contains many descendants of early colonists who farmed the region, and the early railroad workers. According to the AmericanImmigration Council, there are many

immigrants in the area. In 2017 it was determined that 8% of the population of the state are immigrants, with an addition 9% of the American born individuals having at least one parent who was born in a foreign country. The college also contains a population of Native Americans who grew up in the area or have come from their villages to attend school.

Students fall into one of three groups: traditional students, nontraditional students, and middle college students. The traditional students are those individuals who graduated high school within the last 6 years. An older group of students are nontraditional students, which consists of many working parents. The last group is the middle college, which contains students who are working towards a college degree and a high school diploma simultaneously. In 2016 a report stated that 79% of the students attending the school were part-time, and 59% of the total population of students was female.

The statistics from the main campus reflect that most of the students receive financial aid. The college has clubs for many different groups, including LGBT, computer gamers, movie buffs, and recycling. The college is a 2-year college with certificates and Associate Degrees available. Once students have completed a 2-year degree, many go on to other campuses or colleges to complete a 4-year degree.

In this research, I used convenience and purposeful sampling. First, I asked potential interviewees to sign a consent form (see Appendix A). Once the consent form was signed, I gave the student a survey (see Appendix B). The survey was used to determine if the student met the following criteria: (a) currently taking or have previously taken College Algebra, (b) using digital applications and websites to complete math assignments, (c) a willingness to be interviewed, and (d) demographics for the college. Nearly 60% of the enrollment at this campus is female; 70% of the students are White. The final group of interviews numbered nine. Of this

group, seven of the participants were white; one was Native American and one was Hispanic. The final division of genders was six females and three males. There were a variety of ages represented; 40% were in the age group of 20–24 years old, while 60% were 25 and above. No students under the age of 21 participated in the study due to possible legal issues. The surveys were handed out for two days in the common areas of the college. The goal was to collect about 300 surveys to find the seven to 10 individuals best suited for the study.

In this research, I explored how and why students use digital applications and websites to complete their math assignments in a college setting using a purposeful sampling procedure. The sample was purposeful as the individuals chosen for the study met specific criteria: to be 21 years of age or older, to have completed or currently be taking College Algebra, and to be using digital applications or websites in completing math assignments. Participants for the study were recruited by completing a survey.

### **Instrumentation**

Phenomenological research allows for the use of any instrument which provides first-person accounts, including questionnaires, electronic email dialogue, focus groups, and the most popular method, interviews (Smith, Flowers, & Larkin, 2012; Vagle, 2016). There are three types of interview processes: structured, semistructured, and unstructured. In this research, I used a semistructured interview to collect data.

I used a survey to determine the participants in this project and was available to the students for two days in an area common to the student body. Using the survey, I gathered demographic information and asked students if they recognized any of the applications and websites listed. The list included the following applications and websites: Slader, PhotoMath,

Symbolab, Wolfram Alpha, and Chegg. The questionnaire also included a question inquiring whether the student was willing to participate in the study by providing interviews.

After the survey, I used a semistructured interview to collect data. This type of interview was an informal approach to collecting data, more like a conversation (McLeod, 2016). The questions in this interview were open-ended; this was especially important in the semistructured interview format, where the researcher and participant work together in discovering the nature of the phenomenon (McLeod, 2016). I used face-to-face interviews as a vehicle for collecting data (Vagle, 2016).

I used an interview schedule in this semistructured interview process (Smith et al., 2012). This schedule contained a list of questions and with a suggested order to these questions (Vagle, 2016). The schedule guided me and allowed for standardization between the different participant interviews (McLeod, 2016; Smith et al., 2012). As the interview progressed, I modified the questions and order based on the responses provided (Smith et al., 2012). It was important in the semistructured interview process to build on the experiences of the interviewees, asking questions which constructed on their personal lives (Vagle, 2016). This approach allowed me and the interviewee to converse freely (Smith et al., 2012; Vagle, 2016). The questions in this semistructured process were open-ended and expansive, using two main questions followed by additional questions, clarifying questions, and conclusion questions (Vagle, 2016). The main topics of the interview process were the use of applications and websites in completing math assignments and the definition of plagiarism in math. The interview process began by allowing the interviewee to describe their lives outside of school. This question was presented to allow the student to relax and feel comfortable with me. Then I asked the participant to describe their experiences using digital applications and websites in completing their math assignments, along

with the participant's definition of plagiarism. I chose the questions that followed based on the responses from the participants, remembering the importance of not leading the interviewee but rather prompting them when necessary. The length of these interviews was between 20 and 40 minutes (Vagle, 2016).

Vagle (2016) suggested audio recording the interviews, taking a few notes during the interview of important ideas, and being aware of body language as the participant is speaking. The goal of the interviews was to listen carefully and to learn about the phenomenon as lived by the participant (Vagle, 2016). The audio recordings were transcribed, and then I conducted member checking.

The interview questions were designed to reveal the "participants' intentional relations with the phenomenon" by gaining an understanding of the perception of the use of these tools by the students (Vagle, 2016, p. 129). The purpose of this research was to study the phenomenon of plagiarism in completing math assignments. The participants initially learned that the study involved applications and websites providing solutions to math problems. Each interviewee was provided a list of applications and then asked if they recognize any of the applications and if they used these applications and how they used these applications. In a follow-up interview I asked questions regarding plagiarism and its applications to mathematics. The goal of this research project was to discover the experience of plagiarism in completing math assignments.

**Interview Questions.** I developed the interview questions (see Appendix C) specifically for this study with input from various individuals. The main questions asked what the student does to complete a math assignment with difficult questions. If the student responded that they used a digital application or website for dealing with these difficult questions, then I asked the student to identify the application or website. One of the clarifying questions I asked the student

was to describe an experience using this application or website. I used another clarifying question to attempt to create the connection between using these applications or websites and plagiarism, by asking if the interviewee felt the act of using these tools was plagiarism. In the final two questions, I asked the student how they felt they benefited from the use of digital applications and websites in completing math assignments and if they intended to continue using these tools in math courses.

### **Data Collection**

Most of the studies on plagiarism used a quantitative approach utilizing surveys to collect data (Bowers, 1966; McCabe et al., 2001a). These studies yielded statistics of students using plagiarism. None of these studies addressed the concept of plagiarism in mathematics. In this study, I was interested in the personal experiences of individuals when using applications to complete their mathematics assignments and if they perceive that to be plagiarism. I collected data for this study in the following manner:

1. I gained IRB (Institution Review Board) approval, including approval from the research site.
2. I administered the survey to determine the student's willingness and eligibility to participate in the research study.
3. I scheduled the participants for interviews.
4. I conducted interviews at the research site.
5. I collected and analyzed the data.

The first step was receiving the approval of the IRB of Concordia University Portland. This approval allowed the research to proceed. To gain this approval required completing a variety of forms, including the Research Proposal Narrative and gaining permission from the



institution where the research was held. I obtained permission from the institution for the research site and the university guiding the doctoral studies by submitting the proposal and supporting documentation to the IRBNet. After obtaining this permission, I obtained additional authorization from the IRB of the research site. Upon receiving IRB permission, I held a face-to-face meeting with the Director of the research site and made contact with the instructors of the math department of the research site through e-mail.

Once IRB and site authorization approval was given, I disseminated consent forms and surveys to participants. Before the students began the survey, they were asked to sign a consent form (see Appendix A). This consent form acknowledged their willingness to participate in the study, explained the interview process and the requirements from the student, including the ability of the student to end participation in the research at any point. The information found on the consent forms and the survey were confidential.

Recruiting participants for the surveys involved displaying flyers as well as announcements sent to instructors through e-mail. I conducted survey sessions for two consecutive days for four hours each day, and I was available to distribute the surveys during this time in areas common to students. The surveys took between three to five minutes to complete and were used to identify the student's qualifications to participate in the study. I used the surveys to collect demographic information and e-mail addresses. The surveys also allowed students to identify the digital devices or websites they used to complete math assignments.

I then the surveys, hoping to identify students who were best suited for the research. To be considered for the study, a student had to be 21 years or older, currently be taking or have taken College Algebra, not be a current student of the researcher, fit the demographics found on the college campus, use digital devices or websites to complete math assignments, and be willing

to be interviewed regarding these digital devices or websites. Qualifying students received invitations to participate in the study using the e-mail addresses collected during the survey process.

During the interviews, I asked students which digital applications and websites they used to complete their math assignments. In another question, I explored the reasons for using these digital applications and websites. Also, students were asked if they found these applications and websites helpful and if so, how were they helpful. Finally, the students indicated whether they believe completing math assignments in this manner was academic dishonesty and, if so, did they define this academic dishonesty as plagiarism. After the interviews were completed, I completed member checking of the interview answers by e-mailing each participant copies of their interview transcripts and the analysis and then asking participants to verify and clarify any information collected within 72 hours of receipt of the transcript. This time frame was established to keep the project moving forward. If no response is received from the student, I assumed the transcript met with their approval.

I also kept a research journal during this project. The research journal helped me understand changes made in the research and to verify and clarify these changes. I used the journal during each interview to note mannerism and answers of the participants. This journal, along with the survey and the interviews, constituted the data collected for this research project. I analyzed all three of these sources as outlined in the Data Analysis Procedures section of this chapter. I used triangulation to ensure validity; I achieved triangulation by the use of the survey, the semistructured interview, and the research journal. Member checking during and after the interview further ensured validity.

## Identification of Attributes

**Participants.** Students were chosen from a group of students at an outlying campus of a state university. According to the college, there are three types of students. There are the traditional students who have graduated high school within the last 6 years. Another group are the nontraditional students. These are students who graduated more than six years ago. This group includes many working parents. The third group are middle college students. These students are high school students who are working on an associate degree and a high school diploma at the same time. To be considered for this study, students were members of the traditional or nontraditional group of students. These students were individuals who used digital application found on phones, tablets, and other smart devices. Some of these applications include Mathway, Symbolab, and Wolfram Alpha (Tantra, 2016).

**Plagiarism.** A student using someone else's ideas or work, without acknowledgment, in a manner which suggests they are the creator of the work (Jones et al., 2008). For this study, the plagiarism studied consisted of the use of digital applications and websites, such as Symbolab, Chegg, Wolfram Alpha, Slader, Mathway, PhotoMath, for completing math assignments (Abel, 2012; Girard, 2012; Hindin, 2010; Love, 2013; Tantra, 2016; Webel & Otten, 2015). Students often employed these applications without acknowledging their use (Tyrell-Ferguson, 2014). It was the use of these applications that was specifically explored the use of these in this study. Students if they felt the use of these applications benefited their math studies. Also, in this study, students were asked to define plagiarism in completing math assignments.

**Research.** This research used a phenomenological approach, which is qualitative research studying a particular phenomenon and how it appears in the world (Vagle, 2016). The first step was accomplished using a survey to initially make contact with perspective students.

This survey was used for obtaining research information (Creswell, 1994). In particular, this study looked for students who indicated their use of digital applications in completing math assignments and their willingness to participate further in the study.

Interviews, an instrument for collecting data for research, were then conducted (Vagle, 2016). These interviews used a semistructured interview which is an informal approach to collecting data, these interviews were more like conversations (McLeod, 2016). An interview schedule, a list of questions, was used to ensure that all the participants were asked the same basic questions (Vagle, 2016).

Throughout the research a research journal was used as an instrument for obtaining research information (Smith et al., 2012). This journal helped to better understand the interview process by noting the mannerism and answers of the participants. In addition, this research journal was used to note changes that the research made during the research process.

**Analysis.** To achieve analysis the Modified VanKaam method was used. This method involved bracketing, which is a system used in phenomenological research to reduce the findings by overcoming the pre-established beliefs of the researcher (Smith et al., 2012; Vagle, 2016). Then bridling was used this is a system which incorporates the ideas of bracketing. Bridling is used to overcome the beliefs of the researcher, but also is used to “focus on each reduction in an attempt to move away from the preconceived ideas regarding the experience (Smith et al., 2012, p. 14)”. The analysis was seeking to find the intentionality or connectedness between the subjects and the objects (Vagle, 2016). This intentionality leads to finding the essences or the things that are shared in common between the various experiences (Vagle, 2016).

Triangulation was used to ensure validity of the information (Creswell, 1994). This triangulation was accomplished in several ways. There was the use of surveys, interviews, the

research journal and finally member checking. Member checking is an instrument for checking the validity of the data. It is used to reduce researcher bias in the project. In member checking the participants were asked to check and confirm the results of the interview (Birt, Scott, Cavers, Campbell, & Walter, 2016).

### **Data Analysis Procedures.**

When using phenomenological research, the gathering of information usually occurs through interviews (Vagle, 2016). There are several different types of phenomenology, each with similar techniques used for analyzing information. One step in the analysis is a reduction, which begins with epoché, which means to abstain (Van Manen, 2016, p. 215). In this research, I used the system of *bridling* to achieve epoché. *Bridling* incorporates the ideas of *bracketing* with some new concepts.

*Bridling* is a system used to overcome the beliefs of the researcher. Vagle (2016) describes the concept of bridling as a system that accomplishes two things. First, it completes the same goal as *bracketing*, which is a system that uses a series of reductions to overcome the pre-established beliefs of the researcher (Smith et al., 2012; Vagle, 2016). In this study, I changed “the focus with each reduction in an attempt to move away from the preconceived ideas regarding the experience” (Smith et al., 2012, p. 14).

The second feature of *bridling*, which goes beyond *bracketing*, helped to develop the “wholeness” of the phenomenon (Vagle, 2016, p. 67). This “wholeness” is the final goal of a phenomenological study, putting the information together to form a complete picture. *Bridling* acknowledges the information known by the researcher and seeks to understand the influence this knowledge had on the study. The influence of past knowledge may affect the questions used in the interview and how these questions are interpreted (Vagle, 2016). *Bridling* allows for

consideration of all possible influences through personal researcher knowledge. I used bridling for the purpose of this study, which includes the system of bracketing.

Bridling is one approach to reflexivity in phenomenological research. Bridling attempts to “bridle” the knowledge of the researcher by considering the influence of past experiences (Vagle, 2016). In this case, I had to take into account my experiences from teaching for many years at the college level (Vagle, 2016). It is important to become “skeptical of our seeing” and “mindful of the lived experience” of the phenomenon and to use these beliefs to develop a complete picture of the phenomenon (Vagle, 2016, p. 69). The *bracketing* portion of this process involved putting aside some of my closely-held ideas. The first was that most students are honest; the second was that the reason for plagiarizing in completing math assignments probably stems from two causes: poor time management and being overwhelmed. For the purpose of this study, I was more concerned with the analyzed results. One method I used to achieve this goal was reduction. I attained reduction by evaluating and re-evaluating the ongoing study for possible prejudice caused by pre-conceived notions. The goal of this reduction was to focus on the “uniqueness of the phenomenon” (Van Manen, 2016, p. 228).

I also used bridling as textual reflexivity, which involved “reflexive monitoring of the text in its production” (Vagle, 2016, p. 69). In phenomenological research, researcher reflexivity was more than a private examination of the relationship between the researcher and the study. Reflexivity made this relationship public to others, thus bringing about a deeper understanding of the research results for all involved in the study. One suggestion for reflexivity was to write an initial reflection statement, similar to a subjectivity statement, where the researcher describes their “assumptions, beliefs, perspectives and background” related to the phenomenon (Vagle, 2016, p. 133). For me as a researcher, this statement was as follows:

I believe all students to be honest. Most of the difficulty students experience in math classes is caused by procrastination, poor time management, and a general dislike of the learning of mathematics. I believe that some students use digital applications and websites to copy the solutions directly. These students will probably not pass the course. Some students use digital applications and websites to help them learn the material. These students will probably pass the math classes.

Another use of the journal is to write questions, thoughts, accomplishments, and frustrations during the research. This journal helped to establish an understanding of the pre-conceived notions of the phenomenon. One researcher calls this a post-reflection statement, while another researcher calls this a pre-reflective reflexivity (Smith et al., 2012). Examining these beliefs on paper gives the researcher the opportunity to understand their pre-conceived notions, which may influence the research (Smith et al., 2012; Vagle, 2016).

This study involved a small sample of nine students. I made a recording of each interview after securing permission from the participant. Then these recordings required transcription to a written form. There are several software options available to achieve this written form; for this study, I used Wreally, a program that will transcribe the data. Upon the completion of these transcriptions using Wreally, the interviews were garbled. I completed and then corrected the transcriptions. These copies were provided to the interviewee for corrections, or additional insights, in the form of member checking.

The next step involved analyzing information found in the transcriptions. I used a method that is a modification of the Van Kaam method first introduced by Moustakas in 1994. This method required analyzing the complete transcript of each interview using the method explained by Moustakas (1994) and clarified by Statistics Solutions (2018). The first step was to create a

“listing, and preliminary grouping,” with all the data treated equally (Moustakas, 1994, p. 120; Statistics Solutions, 2018). This grouping listed all the “expressions relevant to the experience,” this is also called horizontalization, where preliminary coding begins by listing every quote relevant to research (Moustakas, 1994, p. 120; Statistics Solutions, 2018).

The next step was to reduce and eliminate items from the grouping; this step had two requirements. The first of these requirements was to decide if the experience was necessary for understanding the phenomenon, and the second was the ability to label the expression. This information led to the formation of thematic groups. These groups were the “core themes of the phenomenon” (Moustakas, 1994, p. 121). I then checked these themes against the original transcript to ensure that the ideas expressed by the participant matched the emerging themes (Moustakas, 1994).

The next several steps in the process dealt with validation and aided in constructing a “picture” of each participant; these steps required the construction of descriptions and composites. The descriptions included the individual textural description and the individual structural description. The “individual textural description” created a description based on the words of the interviewee, including quotes from the interviewee (Moustakas, 1994, p. 121; Statistics Solutions, 2018). The “individual structural description” described the structure of the interview, the emotions, the body language, and other physical descriptions, including social and demographic information of the interviewees; this was the first step in interpreting the data (Moustakas, 1994; Statistics Solutions, 2018). I combined the information from the individual textural description and individual structural description to create an individual textural-structural description for each participant (Moustakas, 1994; Statistics Solutions, 2018). This



document created a complete picture of each individual, describing the essence of the experiences of using digital applications and websites in completing math assignments.

The final products of this analysis were two composites where the information from the individual textural and structural description was combined in a manner which described the meanings and essences of the entire group of participants (Moustakas, 1994, p. 121). In the composite textural description, common themes found occurred in the group through words (Moustakas, 1994; Statistics Solutions, 2018). The composite structural description combined the information from all the individual structural descriptions describing the common elements, such as social and demographic information, body language, and other physical and environmental commonalities (Moustakas, 1994; Statistic Solutions, 2018). This step is where the conceptualization of the phenomenon begins (Moustakas, 1994; Statistics Solutions, 2018).

The final step was the construction of the composite structural-textural Synthesis. I constructed this synthesis using the textural-structural description of each participant. In this report is found the essence and lived experience of the phenomenon (Moustakas, 1994; Statistics Solutions, 2018). Inter-subjectivity was the result of this process. This inter-subjectivity referred to the shared experiences of the studied phenomenon in the world or the ability to make sense of and communicate the experience (Smith et al., 2012).

I created a spreadsheet to accomplish the steps required to analyze the data. This spreadsheet was created based on the questions asked and emerging themes. The common themes were discovered by comparing quotations. The final goal was to establish a picture of the intentions of people who plagiarize math assignments.

## **Limitations and Delimitations of the Research Design**

Phenomenological research has several limitations, including the bias of the researcher, and the accuracy of the collected information. This difficulty in gauging the bias of the researcher-led to the need to apply the concepts of bracketing and bridling (Dudovskiy, 2017; Vagle, 2016). By using bracketing, I attempted to reduce the research bias while use of bridling made a note of the research bias and its uses in the analysis (Vagle, 2016.). Both of these ideas attempted to determine the effects my own bias had in the final analysis. Researcher bias can change the entire study if not carefully noted during and after the research is completed (Vagle, 2016).

At the time of this study, I had 18 years of experience teaching math classes in a higher education setting. I have also been open to the idea of students using printed solutions to learn the material. Some of the students may also have been aware of my openness to the use of printed solutions for learning. It was my responsibility to use bridling to identify the existing bias and collect and analyze the data with this known bias.

The accuracy of collecting the data may have been affected by the honesty of some participants due to barriers (Dudovskiy, 2017). When it comes to plagiarism, some students may not be willing to admit to using digital applications or honesty, reporting the extent to which they used these applications. Self-reporting of any behavior is problematic; self-reporting of dishonest behavior is even more challenging (Walker, 2010). Another reason students may be reluctant to identify themselves is because the students believe they may get into trouble if they admit to the use of these applications (Yardley et al., 2009). Another issue when collecting the data is the amount of time and use of resources required to complete the study (Dudovskiy, 2017). For this

study, finding the students to interview was a challenge due to the lack of willingness of students to admit to plagiarism in math.

Delimitations in this study included the sample size, which was small, and the time constraints. The small sample is a typical issue in phenomenological studies due to the interview process, where a large number of participants would be overwhelming (Dudovskiy, 2017). This small sample leads to a difficulty in establishing reliability and validity (Dudovskiy, 2017). The small sample size also led to difficulty in generalizing the results to a larger population. The time constraints made it difficult to follow the participants over an extended time as I was limited to three contacts: survey, interview, and member checking.

This phenomenological study provided a picture of the experience of using digital applications and websites in mathematics. The results from this study have the potential to lead instructors, administrators, and students to understand the impact digital applications and websites have on completing math assignments. Perhaps these results may lead to a better understanding of how students perceive the use of digital applications and websites in completing math assignments. This understanding may also lead to future studies discussing the development of a clearer understanding of what constitutes plagiarism in math and digital applications and the use of websites without violating ethical boundaries.

## **Validation**

In this dissertation, I employed a phenomenological approach. The results from some phenomenology studies can be considered less credible because samples are usually small and not generally transferable to a larger population (Center for Innovation in Research and Teaching [CIRT], n.d.). The credibility of the study depends on the amount of information gathered and the richness of this information (CIRT, n.d.). In the end, it is up to the reader to determine how

much of this research is applicable and transferable to their situation. However, an attempt to establish validity in this research occurred through three contacts with the participant and a research journal. These contacts included a survey, an interview, member checking, and a research journal. These contacts attained the triangulation necessary by collecting data from many sources (Vagle, 2016). While triangulation was necessary, the goal was to understand the importance of a single statement from a participant. These statements provided insight into the phenomenon (Vagle, 2016). This study created a full picture of the experience of plagiarism in completing math assignments by having several contacts with each participant.

One technique I used to ensure validity in the interview process was the use of member checking. This process reduced researcher bias by allowing the participants to be active in the interpretation of the results (Birt et al., 2016). Member checking involved returning my interpretation to the participants and allowing them to provide feedback as to the accuracy of the description. In this research, I used a variation of member checking called synthesized member checking, which sends the interview data and the interpretation to the participants, allowing them to add or remove data in addition to checking for accuracy (Birt et al., 2016). The use of this technique ensured that the data and the interpretation were as accurate to the experience of the participant as possible, thus providing for validity in the study.

### **Expected Findings**

In this study, I examined the phenomenon of students using digital applications and websites to complete math assignments. According to Aasheim et al. (2012), students usually believe copying information from the Internet and smart devices to complete assignments is more acceptable than copying from other sources. This belief is part of what leads to plagiarism (Aasheim et al., 2012).

I expected the results from this study to show that most students indicated their use of digital applications and websites was for learning the material. A further break-down of expectations by research question is as follows:

**Expected findings for research question 1.** My first research question read as follows: How do college students perceive the use of digital applications to complete assignments in math courses ? I also followed this question with a sub research question: What reasons do college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests? I expected to find that students used digital applications in a math course for two reasons. One reason was that the student was using these items to aid them in learning the material. This anticipated result aligned with findings from research conducted by Webel and Otten (2015), who found that PhotoMath, a digital application, provided the students with the ability to see the structure and strategies used in solving a problem. Another reason I thought students may report using application and websites for completing math assignments was the desire to finish the coursework. Some students choose to copy the solutions to problems so they may gain credit for the assignment. This anticipated result aligned with findings from research conducted by Comas-Forgas and Sureda-Negre (2010), who found that academic dishonesty occurs for many reasons including disorganization, poor time management, lack of motivation, and lack of the needed skills.

**Expected findings for research question 2.** My second research question read as follows: How do college students define plagiarism in math courses? To this question there was a subquestion: What was the shared essence of plagairism in math courses?I expected this study would reveal that the definition of plagiarism differs among college students and their instructors. These anticipated results aligned with findings from research conducted by Jones et

al. (2008), who found that students and instructors do not have the same definitions of plagiarism. Harkins and Kubik (2010) found that advancement in technology was causing some of these issues. Another cause of the issue, according to Jones et al. (2008), was the belief of some students that all information on the Internet is in the public domain.

This study aided in describing how students perceive their use of these applications in completing math assignments, which helped to discover the essence of the experience. Of the students who admitted using the material for learning, further questioning might reveal that some of these students copy the solutions when they do not understand the process. This information will aid teachers and students in understanding the perceptions of students in using digital applications and websites in mathematics.

### **Ethical Issues of the Study**

Phenomenology is the study of a lived experience; in this research study, it was the study of the lived experience of using digital applications and websites in completing math assignments (Van Manen, 2016). Found within a lived experience is the study of ethics, including informed consent, privacy, confidentiality, participant role, researcher role, the establishment of honesty and open interactions, and bias (Sanjari, Bahramnezhad, Fomani, Shoghi, & Cheraghi, 2014; Van Manen, 2016).

It was my responsibility as the researcher to take precautions to protect participants from harm. Obtaining informed consent from participants was one way to protect participants from potential harm as the form notifies participants of the study details and the potential risks associated with the study. Informed consent also served as an agreement regarding the terms of the study (Sanjari et al., 2014). For this study, I provided participants with informed consent detailing participant rights

Another ethical concern requiring cautious was that of participant confidentiality and privacy. For this study, I respected the privacy of the individual and minimized intrusion into participant lives to maintain confidentiality (Sanjari et al., 2014). I gave the participants pseudonyms to maintain confidentiality and privacy. I attempted to respect participant privacy by only using three contacts with the individuals. These three contacts were a survey, an interview, and member checking. The intention, therefore, was to obtain the necessary data for analysis while also respecting the participant's privacy. The data is stored in a locked safe at the home of researcher. The anticipated destruction of the material is 5 years.

The only instrument used to collect the data was the one researcher in this study (Sanjari et al., 2014). I conducted the interviews, collected, and analyzed the data. There was no deception used in this research or any financial gain for anyone aligned with the research. After the research, each participant received the opportunity to member check the interview responses and the interpretation. This action helped to elevate ethical issues that arose, such as preconceived notions.

### **Chapter 3 Summary**

Academic dishonesty occurs on many campuses of higher education. In this study, I sought to research one type of academic dishonesty, that of plagiarism in completing math assignments. I used two frameworks to guide the research, social constructivism, and social cognitive theory. A qualitative phenomenological methodology was used to explain how and why students plagiarize in math classes. In Chapter 3, I discussed the research questions, which included how student define plagiarism in a math course and how students justify using digital applications and websites in completing math assignments.

The purpose of the study was to explore plagiarism in mathematics, specifically the student's understanding and the instructor's definition of plagiarism. I used qualitative tools to obtain information, including a survey, interview, and a research journal. The survey was used to determine which students used applications for completing math assignments and who was interested in participating in the research. The semistructured interview was implemented to discover how a student perceives their use of digital applications and websites in completing math assignments and more specifically, their use of these items as related to plagiarism. Finally, the journal contained the information on interviews, reasons for changes, and other items important to the research. Data analysis procedures used a modified Van Kaam approach, including the concept of a bridling to overcome any preconceived notions of the researcher (Moustakas, 1994). Phenomenological research has limitations, including bias and the accuracy of the collected information due to the sample size. However, steps were taken to mitigate limitations such as the use of the research journal to note changes and other areas of concern as they arose in the study. Ethical issues included professional association with the research site and personal knowledge of students' accomplishments as well as concerns related to confidentiality and bias. I noted these concerns in the research journal and bridled as needed. In Chapter 4, I will present the research findings, and in Chapter 5 I will discuss these findings in the context and implications of this research.



## **Chapter 4: Data Analysis and Results**

Plagiarism is a form of cheating and defined as copying work from a source without providing proper credit (Jones et al., 2008). In subjects requiring writing, a student often finds cutting and pasting from the Internet to be an easy task (Walker, 2010). Many students believe that items posted on the Internet are in public domain (Jones et al., 2008). This same theoretical concept of cutting and pasting without providing credit to the source can be extended to the study of mathematics. It is unclear whether students understand the connection between using information from the Internet and plagiarism (Jones et al., 2008). In this research, I investigated the link between the student behavior (i.e., using the application to complete assignments) and student cognition (i.e., perception and intention for using the application). In this chapter, I describe the research, in which I used a phenomenological approach to discover the meaning of the essence of the lived experience. I studied students in college math classes who used a digital applications to complete math assignments to determine (a) how these students defined plagiarism and (b) if these students thought their use of this application fit the definition of plagiarism. In interviews, I asked the participants questions regarding their lives as college students and their use of digital applications and websites to complete math assignments. I identified four themes analyzed using the modified Van Manen method (Vagle, 2016; Van Manen, 2016). I then analyzed the data, which is presented in this chapter.

### **Description of the Sample**

The participants for this study were members of the student body of an outlying campus of a state university. The purposeful sampling targeted the same demographic as the whole school population, with no expected bias related to the recruitment method. In this dissertation, I used a phenomenological approach where samples are usually small. According to Van Manen

(2016), phenomenological research is to “gather enough experientially rich accounts that make possible the figuration of powerful experiential examples or anecdotes that help to make contact with life as it is lived” (p. 353). According to Van Manen, gathering information from “just the right number” of subjects is important (Van Manen, 2016).

Furthermore, Mason (2010) contended the ideal number of participants should be five to 25. For this study, the original intent was to have at least seven participants in the study. After interviewing nine participants, there were enough rich accounts, and the themes from the sources were beginning to emerge in the reasons for using digital applications and websites. Therefore, no additional interviews were needed. The final number of participants was nine.

**Population Demographics.** In the last census, conducted by the university, there about 1800 students enumerated at this campus of the state university. There were three demographics of concern for this study, that of age, ethnicity, and gender. The number of students in each age group was as follows: about 500 students in the group of 19 years and younger; 500 students in the group of 20–24 years and 800 students were 25 years or older.

There were many ethnic groups identified in the population; some are blended groups, where the individuals claimed ethnicity from several different groups. The ethnic groups represented in the population included 25 students who identified themselves as African American, 15 students who identified themselves as American Indian, 33 students who identified themselves as Asian American, 101 students who identified themselves as Hispanic American, 135 who identified themselves as Native American, 1,239 who identified themselves as Caucasian, and 227 who identified themselves as other ethnicities not listed previously. Regarding gender, of the 1,775 total students 729 identified themselves as male, 1,024 identified

themselves as female, and 2 identified themselves as other. These demographics are displayed in Table 1.

Table 1

*Demographics of the Population and Sample*

| Description           | Population | Sample |
|-----------------------|------------|--------|
| Age                   |            |        |
| Total                 | 1775       | 9      |
| 0–18 years            | 297        | 0      |
| 19 years              | 186        | 0      |
| 20–24 years           | 525        | 2      |
| 25 years and older    | 767        | 7      |
| Ethnicity             |            |        |
| Total                 | 775        | 9      |
| American Indian       | 5          | 0      |
| African American      | 25         | 0      |
| Asian American        | 33         | 0      |
| Hispanic American     | 101        | 1      |
| Other Native American | 135        | 1      |
| Caucasian             | 1239       | 7      |
| Other                 | 227        | 0      |
| Gender                |            |        |
| Total                 | 1775       | 9      |
| Male                  | 729        | 4      |
| Female                | 1044       | 5      |
| Not represented       | 2          | 0      |

**Participant recruitment .** I first recruited participants by posting flyers around campus advertising a recruitment table that I set up in a common area where students passed through as they moved between the buildings on campus. The first week of recruitment consisted of four days, which resulted in the recruitment of the first three volunteers. An instructor who taught classes in the fields of human services and behavioral sciences asked if she could take the information to her classes, as surveys and studies were part of her curricula. This action resulted in five volunteers; however, none of those continued to the interview stage. I then conducted short presentations for students in various math classes on what the study entailed and why it was important. These visits resulted in the remainder of the volunteers. Fifteen student participants filled out the survey. I contacted all 15 people via e-mail; some did not respond. A few students set up appointments for interviews and then did not show up. These participants ended up being dropped from the study, as I could not gain a commitment from these participants. All students were included in the study if they answered the e-mail, scheduled an appointment, and then participated in an interview. As mentioned previously, the final number of participants was nine.

**Sample demographics.** The goal of the study was to select at least seven participants for the sample. There were three demographic considerations in the study: age, ethnicity, and gender. When developing the first consideration, that of the age demographic, there were three groupings. Due to possible legal issues with signing a contract, there were no students in the age group of 21 years or less chosen for the study. In the group aged 21–24 years old, two students were chosen, and in the group aged 24 years and older, seven students were chosen.

The second consideration was ethnicity. One task in meeting the ethnicity consideration was to locate seven students who identified themselves as Caucasian. Additionally, the demographics required the recruitment of one student who identified themselves as Native

American and one student who identified themselves as Hispanic American. After much time and work, I recruited individuals meeting each of these group requirements. The final count for the sample was nine students. The sample demographics are displayed in Table 1.

**Eligibility criteria.** It was difficult to encourage students to participate in the study. There were two major mitigating factors: first, the students needed to be over 21 and second, the student needed to be currently taking College Algebra or have previously taken the class. These two factors sharply reduced the number of participants eligible for the study. These eligibility criteria were included in study (a) to be sure that students who signed consent forms were of legal age, (b) students who have made it to College Algebra have developed techniques for tackling difficult math problems, and (c) student must have used a digital application or websites to complete math assignments. These digital applications included Slader, Wolfram Alpha, PhotoMath, and Desmos. Second, because I am one of three College Algebra instructors, none of my current students were able to participate in the study, due to a possible conflict of interest. Of these 15 participants who completed the consent forms and initial survey, nine students met the eligibility criteria and participated in the full interview.

## **Research Method**

In this qualitative study, I used a phenomenological design using two similar frameworks to guide the research: Vygotsky's (1978) social constructivism and Bandura's (1971) social cognitive theory. Both of these theories explain how someone learns skills through social means. In the literature review for this study, one example of the influence of social means that students gave for plagiarism was the knowledge that other students were participating in this act (McLeod, 2016). According to Bandura (1971), almost all learning results from direct experience

and can occur by observing the behaviors of other people, including the consequences of their choices.

One goal of this study was to determine if students in math classes were using many of the new sources available via the Internet and smartphones to complete their assignments (Ma et al., 2008). Another goal was to attempt to clarify the definition of plagiarism as it applies to the field of mathematics and to determine if the student believes their use of this application and websites in math courses qualify as plagiarism (Harkins & Kubik, 2010). These goals lead to discovering the essence of the shared experiences found among the students in math courses. Many of the students described experiences with a commonality.

In this study, I used surveys, interviews, and a journal to gain the needed data to aid in answering the following research questions:

RQ1: How do college students perceive the use of digital applications to complete assignments in math courses?

SRQ1: What reasons do college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests?

RQ2: How do college students perceive plagiarism in math courses?

SRQ2: What is the shared essence of plagiarism in math courses?

The data collection process began with permission from the Concordia University Internal Review Board (IRB), the IRB of the research site, and from the director of the outlying campus where the study took place. The initial recruitment survey contained several questions outlined in Appendix A, to determine if the prospective participant had (a) taken College Algebra, (b) if the student recognized any digital applications and or websites listed, and (c) had the student ever used a digital application or website in completing a difficult math assignment.

Demographic information was next on the form, seeking the prospective participant's gender, age, and ethnicity. Before the students filled out the survey, they were asked to read and sign a consent form. In this consent form, included in Appendix B, I explained the purpose of the study and expectations from the student. I also used the consent form to address the issues of risks for participating in the study and the benefits. On the form, I addressed confidentiality and the participant's right to withdraw from the study at any time.

**Participant interviews.** I interviewed nine participants using the same set of questions outlined in Appendix C. As this was a phenomenological study, additional ideas were discovered during the interviews, which I then explored further. One of the additional questions I pursued was gaining self-confidence or immediate gratification in the math course. Interviews took place in quiet rooms on campus. The first interview took place in a conference room in the library; the remaining interviews occurred in an adjunct office on campus. The interviews lasted from 20 to 45 minutes, with the interviewees answering the same basic questions. Occasionally, a response from a participant would lead to another question.

Each interview resulted in a recording that I then transcribed. The original intent was to use the F4 Analyse program to transcribe interviews, but I had difficulty uploading the information to the software. I then made the decision to transcribe the interviews using Wreally. The transcription was garbled, but it was a beginning. I completed the final form of the transcription, as had prior experience in transcription. The transcription contained only the responses that addressed the interview questions; it did not include general conversation during the interview used to make the interviewee feel comfortable.

**Member checking.** After transcription was complete, I forwarded the extracted interviews to the participants for member checking, using encoded e-mail. Member checking helps to confirm the contents of the interview with the participant, to assure that the words contained in the transcript resonate with the lived experiences (Birt et al., 2016). Member checking also allows the interviewee the power to add or remove information from the interview (Birt et al., 2016). Only two participants responded; both felt the transcription was correct and were happy with the results. One of the interviewees asked to see the results at the end of the research.

## **Data Analysis**

**Descriptions.** The first step of the data analysis was to create an individual textual description, which contained quotes from each individual (Statistics Solutions, 2018). These quotes were about a variety of themes, including personal life, math classes, use of digital applications and websites, and plagiarizing. Within each of these themes were subthemes. For personal life, the subthemes were life outside school, the length of college attendance, and the goal or reason for seeking secondary education. In the theme of math classes, there were two subthemes: how important did the individual feel that math was to their degree and what was the final math class that they must complete to earn that degree. The theme of digital applications and websites had five subthemes: how do they handle difficult math problems, how do digital applications and websites help them, will they continue using digital websites or applications in math classes, do they find a growth in self-confidence or perhaps instant gratification in using digital websites or application, and finally, would they share a specific instance where they had used a digital website or application to aid them in completing a difficult math assignment. The final theme of plagiarizing contained two subthemes: did the student ever copy because of



frustration, and did they think using a digital application or website was plagiarism. The individual structural description contained the same four themes as the individual textural description. The difference between the two descriptions is that the textural description contains quotes describing what the experience and the structural description contains descriptive statements regarding emotional, social, and cultural connections, or how it was experienced; together these descriptions create the essence of the experience (Statistics Solutions, 2018).

The composite textural description and the composite structural description are similar to the individual textural descriptions and the individual structural descriptions. The composites differ as the goal was to find the reoccurring and prominent themes in an attempt to discover the themes common to the lived experience of the phenomenon (Statistics Solutions, 2018). I created the composite structural description to discover the themes common to the emotional, social, and cultural connections of the interviewees (Statistics Solutions, 2018). Finally, I combined all the information from the composite descriptions to form the composite structural-textural description. This final document gave a comprehensive picture of the phenomenon.

### **Summary of the Findings**

I collected the data in this study using the lenses of social cognitive theory and social constructivism theory. Both of these lenses view learning as a social event (Keaton & Bodie, 2011; Vygotsky, 1978). In the social cognitive theory, the exchange of information occurs during collaboration (Bandura, 2011). Social constructivism includes a zone of proximal development, where one person learns from a more knowledgeable person (Vygotsky, 1978). In this study, this collaboration or learning from a more knowledgeable person was seen as occurring from both a digital application and an individual.

This qualitative study consisted of a descriptive case study design approach using a survey, a journal, and interviews to collect data. The survey established the demographics, which were age, gender, ethnicity of the participant pool leading to purposive sampling. In the survey, I asked about the classes the students had taken in the area of math and if they used digital applications and websites to complete math assignments. Based on the survey results, nine people met the requirements for the study. I used purposive sampling, meaning that the inclusion criteria for participants reflected the enrollment at the college campus; this demographic information consisted of age, ethnicity, and gender. Further inclusion criteria required student to have completed or been currently enrolled in college algebra classes and to have used digital applications or websites to complete math assignments.

I also collected data through interviews, which helped establish a picture of each student. Upon examining the data, other information appeared that had the potential to influence the study. One category of new information was the importance that the students placed on mathematics in their degree program. In the following two paragraphs, I summarize the findings from this research.

With respect to the research question that addressed the use of digital applications to complete assignments in math courses, college students perceived their use of the digital applications to complete math assignments as an alternative method when other methods had failed. These other methods included finding a similar problem, looking at the back of the book, going over the directions, using class notes, and asking others for help. After exhausting these other methods, students turned to digital applications and websites. These digital applications and websites helped the students by guiding them in solving the problem, helping to find missing steps, and checking to see if their answers were correct. Regarding the research question that

addressed the reasons college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests, students used the tools to fill in missing steps in the problem, catching up because they missed class, and verifying the answers. Other reasons students provided were immediate feedback, the building of confidence in solving math problems, and the lack of the ability to formulate the questions to ask a professor or tutor. The most prevalent justification was using the tools to complete math assignments. Several of the students felt that the applications were tools, and they were going to use these tools.

Concerning the research question that addressed the college student's definition of plagiarism in math courses, the majority of college students did not define it but rather justified the use of these tools by saying it was not plagiarism because they were using the applications and websites for learning. Several students felt that while the use of the applications and websites may not be plagiarism, it is probably cheating in some manner. Some students felt that plagiarism in a math course was not possible because the final answers are the same, there is no uniqueness or ownership of the material, and thus plagiarism cannot occur. A few students felt plagiarism could only occur with words, not numbers. In this chapter, I will present detailed analysis and results of the study.

### **Presentation of Data and Results**

The data and results from this study are a direct result of the literature review, survey, interviews, and journal entries. I analyzed the data using the modified Van Kaam method, which leads to the creation of various documents (Moustakas, 1994).

**Detailed analysis.** After I finished conducting and transcribing the interviews with each of the individuals in the study, I began to analyze the data. The process started by creating excerpts or preliminary groupings for each person based on the questions asked; for example,

how they handled difficult problems or did they think their use of the digital applications and websites is plagiarism (Moustakas, 1994). These groupings included every quote and impression that was relevant to the experience of using digital applications or websites in completing math assignments (Moustakas, 1994). In the case of the category of handling difficult problems, Ulysses stated that he used when he was struggling he tried to find a way to understand the practical usage: “I use Chegg.” The next step was the reduction and elimination (Moustakas, 1994). During this step, I looked at each quote or impression to determine if it helped to (a) describe the experience; (b) if the description it illustrated was necessary to the experience; and (c) if the experience it could be labeled (Moustakas, 1994).

In the case of Ulysses, I did not need the information regarding his need to understand the practical usage of the concept, but the use of Chegg was important. It did not describe the experience, but upon further investigation I discovered that Ulysses used Chegg because he was renting his book from Chegg, and the book often populates the solutions. This use of Chegg helped to describe the experience; it was necessary to the experience, and it could be labeled. Upon meeting these criteria, the quote or impression passed to the next stage (Moustakas, 1994). I then developed themes from these descriptions and labeled them as the core themes of the experience (Moustakas, 1994). Ulysses’ experience with Chegg fit under the theme of “specific use of a digital application or websites.”

I developed an individual textural description for each participant containing quotes describing the essence of the experiences (Moustakas, 1994). The individual textural description, impressions from the interview, survey information, and the research journal helped to create the next document, the individual structural description (Moustakas, 1994).

The individual structural descriptions contained descriptive statements regarding how the interviewees felt. The grouping from each of these two documents, individual textural description and the individual structural description were combined to create a textural-structural description for each participant (Moustakas, 1994). This description contained the combined information from each of the individual descriptions to form the essence of that individual's experience with math applications and with plagiarism in mathematics (Moustakas, 1994).

The textural descriptions and the structural descriptions of each individual led to the development of the composite textural description and a composite structural description, which combined the information from all the individual textural descriptions and all the individual structural descriptions in an attempt to discover the shared essences of the experience (Moustakas, 1994). I used a spreadsheet to discover the emerging themes in each of the individual descriptions with a note made each time a similarity appeared (see Appendix D). Tables 2 and 3 show the emerging themes found in the textural descriptions and structural descriptions along with a portion of a related quotation and the participant who provided the quotation.

Table 2

*Textural Themes*

| Theme  | Quotation excerpt   |
|--|---|
| Personal life                                | “Full-time mom with two toddlers.” <i>Wilma</i>               |
| Number of years attending college            | “Six years part-time.” <i>Stella</i>                          |
| Educational goals                            | “Laboratory technician.” <i>Yvonne</i>                        |
| Importance of math to their degree           | “Math is extremely important.” <i>Zelda</i>                   |
| Last math class necessary for degree program | “Calculus one and two.” <i>Ulysses</i>                        |
| Techniques handling a difficult math problem | “Search Google for a tutorial.” <i>Raelyne</i>                |
| Uses of digital applications and websites    | “Immediate feedback.” <i>Xena</i>                             |
| Definition of plagiarism in mathematics      | “It is not plagiarism; it is for learning.”<br><i>Timofey</i> |

Table 3

*Structural Themes*

| Theme  | Quotation excerpt  |
|--|--|
| Digital applications and websites used to complete math assignments                | “Mathway, Wolfram Alpha, Desmos, Chegg, Sled.” <i>Ulysses</i>  |
| Rationale for using digital applications and websites to complete math assignments | “Looking for guidance and checking answers.” <i>Yvonne</i>     |
| Method for using digital applications and websites to complete math assignments    | “Pinpoint the areas where you are deficient.”<br><i>Quincy</i> |
| Plans to use digital applications and websites in future math classes              | “It is there, and it is available.” <i>Wilma</i>               |
| Definition of plagiarism in math classes   | “Not plagiarism, lots of people cheat.” <i>Stella</i>          |

The final document was the composite textural-structural description, which is found in Appendix E. This document combines the information from the composite textural description and the composite structural description to create a final description of the experience. This final description explains the essence of the experience shared by individuals in the study.

Analytical Themes. I discovered the analytical themes by studying the various ideas presented by the interviewees, to whom I assigned the pseudonyms Quincy, Raelyne, Stella, Timofey, Ulysses, Wilma, Xena, Yvonne, and Zelda, most of these students were non-traditional students. There were two students who were traditional students. The themes that arose from this study were many; included in the themes were why the students use digital applications and websites and which ones were used by the students. Other themes were the justification the students gave for using the digital applications and websites and the definition the students gave for plagiarism in mathematics. In the following section I will explore these many themes to help in the analysis of this study, using the pseudonyms to describe and provide examples when discussing these emerging themes.

**Emergent Themes.** *Why students use digital applications and websites.* In the literature review where the focus was cheating, time management skills, and procrastination were two reasons cited for cheating (Murdock et al., 2008). While the participants in this study did not explicitly state these reasons, some of their reasons echoed these ideas found in the literature review. Examples that echoed the theme of time management skills and procrastination included one participant, Zelda, who used the digital applications and websites for catching up on material covered when she missed a class. Zelda stated, “When I have missed classes, and I wasn’t there to be taught step-by-step, it is almost like having the teacher showing you how to do it.” Both Zelda and Ulysses discussed a habit of working on assignments during times that professors and tutors were not available; for example, Zelda often works until midnight, and she completes her math assignments after that work. Ulysses has a small son, and his schooling occurs in two different places, 45 miles apart. He also felt that “professors have a limited time in class; Chegg provides the answers to the little stuff, enhances the learning without bothering the teacher . . . Also, teachers have families; I don’t need to be blowing up their e-mail.”

Other reasons given by the participants included learning to check the correctness of an answer to a problem and the availability of the applications. Yvonne said that “I have a hard time getting my point across, and so asking questions can be difficult.” She struggled with forming questions in the class and found it easier to learn the material by looking up the problems in the assignment and follow through the steps. Timofey said that given the option between the digital applications and websites; and books, it was more comfortable to learn from the apps for him over learning from the books because the information was presented in an easier to follow format. All the students used digital applications and websites to check their answers to the problems and to discover lost steps in their processes.



Checking the correctness of the answers lead many students to gain instant gratification, or feeling good about their efforts. Zelda commented that “I need this pat on the back. I need it now. So, I think that it is really important.” Ulysses explained that there is “a little bit of pride when I figure out something on my own, or when it clicks.” Stella echoed the sentiments of many of the students when she said that “It helps to build confidence by confirming the steps.”

*Digital applications and websites used by students.* Inclusion in this study required the students to use at least one digital application or website. Three students used a combination of sites, which included Googling the question, Chegg, PhotoMath, Symbolab, Wolfram Alpha, Desmos, Slader, YouTube, and Khan Academy. Many students began their foray into digital applications and websites by Googling the question. This technique often provides a similar problem or sometimes the exact problem. This technique also leads students to different applications and websites, especially Chegg, which is a monthly paid service or provided free of charge when a student rents a textbook from Chegg (Chegg, 2019). Other applications or websites are programs that may be purchased by the student. These programs include PhotoMath, Wolfram Alpha, and Symbolab (PhotoMath, n.d.; Symbolab, 2017; Wolfram Alpha, n.d.). PhotoMath uses a picture taken by a student with their smartphone to provide a solution (Hamadneh & Al-Masaeed, 2015). Two other applications are Symbolab and Wolfram Alpha, which are both step-by-step calculators. The student enters the math problem, clicks a button, and the solution to the problem is provided (Symbolab, 2017; Wolfram Alpha, n.d.). Both of these programs are available for free on the Internet or as paid applications with enhanced features (Symbolab, 2017; Wolfram Alpha, n.d.).

Two other programs, Desmos and Slader, are free for the students to use. Desmos is a graphing program, similar to a graphing calculator (Desmos, 2019). Slader is a "free source of

step-by-step solutions to homework problems in popular math and science books” (Edshelf, 2017, para.1). Slader also has a version available for smart devices, thereby making Slader easier to access for students (Slader, 2017). The last two websites mentioned by students were YouTube and Khan Academy. Both of these sites guided the students through the process, but as Wilma said of Khan Academy: “He doesn’t provide solutions.” The interviewees felt that there was knowledge required to locate the correct video for guidance. Quincy felt that “you have to be highly organized and use a lot of discretion because there’s a lot of stuff that will just blow you away.” The organization of YouTube and Khan Academy require the students to know what the concept is titled; this requirement can be difficult when students do not know the concept. YouTube consists of videos created by students or teachers, while Khan Academy has lessons and quizzes for the student to use for learning concepts.

*Justification for using digital applications and websites.* Most of the students started their math studies by using other approaches; then, they would go to digital applications or websites. The book was the first resource for many of the students. Zelda explained that she goes

to my book and find a similar problem with the answer in the back. I will try to solve that problem. If that still doesn’t work, because sometimes the book doesn’t explain exactly how to solve the problem, I will go to Wolfram Alpha because it will give you step by steps on how to solve it.

Timofey said that he would “go through the books and everything, and I have; before going to Symbolab.”

Stella noted she used the apps and websites to fill in foundational skills. This practice is one of the justifications given by many of the students for using digital applications and

websites. Other students use the rationale of how the applications and websites provide the missing steps to the specific problem. Zelda explained,

It helps me because I can see how I should do it, and then I'll try and do it. It'll show me where I missed a step, what I missed. It is really nice, because sometimes you are so close, but still not getting the answer.

Quincy echoed this thought by stating, "I think it can because it can help provide you with a road map, to hopefully understand what you don't." Raelyne felt that applications and websites helped her "learn and allows me to consult right away."

One of the justifications given by many of the students for using digital applications and websites was checking the answers to their assignments. Yvonne, Stella, and Zelda all stated that they used the applications and websites for checking their homework. Quincy explained that "It is definitely a utility that is usable, but my thought is that you're doing it and you go, and you look at the answer when you're done and check the answer as you go."

Another idea that presented itself during the interviews was that of instant gratification or confidence building. Yvonne stated that the use of digital applications and websites help her "build confidence." Zena said she needed "this pat on the back. I need it now. So, I think that it is really important." Stella said that "it helps to build confidence by confirming the steps." Ulysses explained, "Using applications make me feel good that I figured it out. . . . I get a little bit of pride when I figure out something on my own, or when something clicks." Xena said she could sit in her room for three or four hours looking over materials, but with digital applications and websites "you get immediate feedback, and that helps build the confidence." Timofey did not gain confidence from his use of digital applications and websites, saying that the use irritated him. He explained, "I get really frustrated that I'm missing a step. . . . I don't use it unless I have

to.” Students all agreed that they plan to continue using digital applications and websites in completing math assignments. Ulysses felt that the applications were “like my wrenches in my garage; if I didn’t have it, then I wouldn’t be able to do the task.”

*Definition of Plagiarism in Mathematics.* None of the students gave credit to the application for the answer and instead, turn the assignment in as their work; this correlates with an article published by Harkins & Kubik, 2010. The action of not giving credit for copied work fits the definition of plagiarism (Plagiarism.org, 2017). None of the students outright agreed that their use of digital applications and websites was plagiarism. Zelda felt that it could be plagiarism saying “I can see how people would see it as that. I could see how people who don’t want to do their homework would just copy.” Yvonne stated that she

definitely feel it's kind of cheating because you're given questions for even numbers that are not in the back of the book and if you can you just copy down the answer, but that doesn't help you at all because it doesn't help you understand how you got to the answer. I definitely feel like its cheating.

Stella echoed this thought when she said it using digital applications and websites was “not plagiarism, lots of people cheat.”

Some individuals explained that the use of digital applications and websites could not be plagiarism. Wilma explained by saying,

I don’t think it is plagiarism, because it’s not words that are being stolen. It’s the problem. Okay, I don’t know how to explain it. You know, somebody writes something and you take it and claim it as your own. In a solution, there is only so many ways to do it. It’s either the right answer or the wrong answer. It’s not like you stole it from somebody else. No one is specifically being given credit for the solution.

Yvonne felt that it was not plagiarism stating that

How do you even know if it's plagiarized? The answers are all the same exactly. You're trying to get that answer. I don't know if I would considerate it plagiarism. . . . Yeah, when I think of plagiarism, I think of your ripping off somebody else's essay or something. Hmm, not necessarily a math problem, but I can see the similarities. Not necessarily in math because it's hard to say that that's unique, or somebody has ownership to that exactly because you're going for the same answer.

Some of the students answered the questions of plagiarism by justifying their use of the digital application or websites. Raelyne said it was not plagiarism because "I am using it to learn a little." Timofey noted that "It is not plagiarism, it is for learning. I am looking at a six-step problem and trying to figure out which step I missed. It helps me brush-up on the steps I am missing." Quincy echoed these thoughts when he said, "I am not copying; I am trying to understand to learn."

Students often justify their use of these tools when asked the question regarding plagiarism in math classes. Some of the students felt they knew someone who may be directly copying the solutions from applications and websites. Ulysses pointed out that

I know lots of Military buddies who are using applications. We are just trying to figure it out with limited resources. We need the classes for our degree . . . to get through the class. The VA holds us to a certain GPA stands. With online classes, the only way to understand the class is through these apps.

As Quincy stated, "It is used like any other tool, you know, I mean it can be used for some sort of nefarious purpose or used right."

The data and results gathered from this study provided information for the analysis. I began my analysis using the modified Van Kaam method, which resulted in various documents: individual textural descriptions, individual structural descriptions, and an individual textural-structural description for each of the participants (Moustakas, 1994). The information from all of the individual descriptions was combined to create the composite textural description and the composite structural description (Moustakas, 1994). I then merged these two documents to produce the final document, the composite textural-structural description, found in Appendix D. In this document, I combined all the information to create a description of the phenomenon (Moustakas, 1994).

#### **Chapter 4 Summary**

In this chapter, I examined the research used to study the sample population. I also looked at the methodologies, the results, and findings analyzed through the conceptual frameworks of social constructivism and the social cognitive theory (Bandura, 2001; Vygotsky, 1978). The goal of this qualitative study was to determine how and why college students use digital applications and websites in completing math assignments. I also asked students if they identified their use of digital applications and websites as plagiarism and how they perceived plagiarism in mathematics.

The research questions were as follows:

RQ1: How do college students perceive the use of digital applications to complete assignments in math courses?

SRQ1: What reasons do college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests?

RQ2: How do college students perceive plagiarism in math courses?

SRQ2: What is the shared essence of plagiarism in math courses?

I analyzed the research questions using the data derived from face-to-face interviews, surveys, a research journal, and member checking. I then analyzed the data using the Modified Van Kaam method (Moustakas, 1994). This involved creating individual textural and structural documents and then a combined textural-structural record for each participant (Moustakas, 1994). I joined these documents together to make composite textural and structural documents to represent the group (Moustakas, 1994). Finally, I created a composite textural-structural document to explain the phenomenon (Moustakas, 1994).

In my summary of the findings, I discovered that all the participants used digital applications and websites to complete math assignments. Some of the students did not believe that they were not committing plagiarism because they were using the applications to learn. Other students did not think they were committing plagiarism because, in mathematics, words are not copied. Instead, in mathematics, the reproduction is of solutions, and these solutions always arrive at the same answer. These solutions are not unique to one individual and are, therefore, not plagiarism.

In this chapter, along with the next section, I answered the research questions. The sample population provided the data through interviews, surveys, journal entries, and member checking. I then analyzed the data, and will present this analysis in the next chapter.

## **Chapter 5: Discussion and Conclusion**

The goals of this study were twofold. The first goal was to understand how and why students use digital applications and websites in completing math assignments. The second goal

was to determine the essence of the experience shared by students regarding plagiarism in completing math assignments. There were two related conceptual frameworks, that of Vygotsky's (1978) social constructivism and Bandura's (2001) social cognitive theory, used to examine the research questions, which were as follows:

RQ1: How do college students perceive the use of digital applications to complete assignments in math courses?

SRQ1: What reasons do college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests?

RQ2: How do college students perceive plagiarism in math courses?

SRQ2: What is the shared essence of plagiarism in math courses?

I conducted the research at an outlying campus of a state university. The questions posed during the interviews collected a list of digital applications and websites used by students and help to determine the definition of plagiarism. The data was gathered using a phenomenological approach (Van Manen, 2016). There were a variety of emerging themes as to why students used applications. Table 4 lists the emerging themes along with a quote from one of the participants which illustrates the themes.



Table 4  
*Emerging Themes*

| Theme   | Quotation excerpt  |
|---|--|
| Learning the process/ Filling in foundational gaps in knowledge | “Pinpoint the areas where you are deficient.”<br>Quincy  |
| Use is not plagiarism   | “It is not plagiarism; it is for learning.”<br>Timofey   |
| Immediate feedback  | “Using applications makes me feel good that I figured it out.” Ulysses                                     |
| Unavailability of instructor/Not wanting to bother instructor   | “Instead of having to bother your teacher 24/7.” Zelda   |
| Checking the answers  | “Looking for guidance and checking answers.” Yvonne  |
| Confidence builder  | “I need this pat on the back. I need it now.”<br>Zelda   |
| Tool to use/Continued usage                                     | “It’s like my wrenches in my garage; if I didn’t have it, then I wouldn’t be able to do the task.” Ulysses |

These emerging themes illustrate the phenomenon of using digital applications and websites for completing math assignments. Most students expressed that they were using these tools in learning the processes and in filling in foundational gaps in knowledge. The students believed that as long as they were learning, they were not committing plagiarism. Students also used these tools in checking answers which lead to the student receiving immediate feedback which then helped to build their confidence. Many students said that they did not want to bother their instructors, either because of the time when the student chose to complete math assignments or because the student did not feel that they could articulate the answer correctly. Finally, the students agreed that they would continue using digital applications and websites to complete math assignments.

In this chapter I summarize and discuss the information gathered through this qualitative study, including the final results of this study. I will also discuss the implications of this study in the use of digital applications and websites in completing math assignments and how students perceive plagiarism in mathematics. All names presented in this study were pseudonyms to create confidentiality and protect the identity of the study participants.

### **Summary of the Results**

In this study, I examined how and why students use digital applications and websites in completing math assignments, as well as how students define plagiarism in mathematics. This examination was necessary as there is currently little research addressing either of these topics of research. Bowers (1966) conducted the first studies regarding academic dishonesty in higher education. This research was continued by McCabe and Trevino (1993, 1996, 1997). These two were then joined by a third entity to become McCabe et al. (1999, 2001, 2002, 2003). However, there has been little research since these seminal works.

The purpose of this study was to discover why and how students in higher education used digital applications and websites to complete math assignments. Electronic devices provide students with tools that can be used to copy solutions without citing the sources (Perry, 2010; Shashikiran, 2014). Therefore, this study adds to the body of research regarding academic dishonesty in higher education, including the definition of plagiarism in math courses by describing and understanding this phenomenon.

**Learning the processing and/or filling gaps.** I triangulated the qualitative data obtained from participants located at an outlying campus of a state university. The use of a survey, interview, journal, and member checking helped me discover the answers to the two questions posed by this study. The first question asked the students “Do you feel your use of applications or websites benefits your math studies? How?” Students described the essence of this experience as tools for aiding them in math assignments. This question further provided students with a means for justifying the use of the Internet and digital applications in completing math assignments and tests. The reason given most often by students was that they were learning from the use of digital applications and websites. The students interviewed provided several reasons using these tools for learning. Two of these reasons involved learning the material in particular, concepts missed in class and missed foundational skills. Some of the students felt that digital applications and websites helped them learn the material presented in class or helped to reinforce the concepts presented.

**The question of plagiarism.** The second question was, “Do you feel your use of applications and websites is plagiarism?” None of the students felt that their use of these tools in their math classes constituted plagiarism. Most of the students believed that their use did not constitute plagiarism because they were learning by using these tools. The students also expressed the view that there was no uniqueness in math solution, therefore, they felt that no one could claim a creative license to the material. A few students thought that the use of digital applications and websites was cheating. The consensus was that plagiarism does not apply to math classes because of the lack of uniqueness of solutions, as Yvonne stated, “How do you even know if it’s plagiarized? The answers are all the same exactly.”

**Other emerging themes.** The emerging themes found in this study illustrated the essence of the phenomenon. The essence was found in the shared experience among the participants. These experiences included the idea of using the application and websites for learning; immediate feedback; confidence building. The essence is a quality that recognized after the experience (Van Manen, 1997, p. 37). The participants recognized how they were using their digital applications and websites. There was an intersubjectivity, a shared definition when the participants explained their uses. The students acknowledged that they used these applications to fill in gaps in their foundational knowledge, included the learning of the material to reinforce concepts, both those presented in the current class and concepts presented in previous courses. Also, students used the applications to check their answers. The participants also remembered using the applications for learning on their own without disturbing the instructor. The participants were able to reflect on their use of the applications for learning. This reflection is the essence of these actions, the attainment of a grade and knowledge.

### **Frameworks Used**

There were two frameworks used to guide this study, social cognitive theory (SCT) and social constructivism. Bandura (1971) developed the SCT. According to SCT, almost all learning is the result of direct experience and the observation of the behaviors of others (Bandura, 1971). Some of the interviewees in this study learned about digital applications and websites from other students and Internet searches. This learned behavior coincides with SCT, where the theories suggest learning occurred through observation and imitation (Bandura, 2001).

Bandura's (1971) theory contains four interrelated subprocesses or mediational processes: attentional, retention, reproduction, and reinforcement, and motivational. The establishment of an object's existence is through communication within a social context

(Bandura, 2001). Findings from this study aligned with the idea of the attentional stage from Bandura's (1971) theory of SCT as students in this study often learned about digital applications from other students or the Internet (Bandura, 1971; Rittinger & Kramer, 2009). The students in this study then reproduce the behavior they have seen or learned about by using digital applications and websites (Bandura, 1971). The students in the study were motivated to continue the use of these tools since they found success and received no punishment (Bandura, 1971). The continued use of the digital application or websites fits into SCT in the reinforcement and motivation stage, where people learn to understand future consequences and to convert those ideas into motivators influencing their current behavior (Bandura, 2001). The learning about applications through observation of others was a common theme found among the participants of this study. Sometimes this observation led to the use of the tools, and at other times the observation led to positive reinforcement in using the tools.

Two more concepts from SCT which aligned with the theory of SCT were previous knowledge and the idea of assimilation and accommodation. According to SCT, a student's prior knowledge contributes to new learning; in the case of this study, many of the students found that they lacked some understanding required to learn the new concept (Bandura, 2001; Keaton & Bodie, 2011). Participants in this study found that they needed to make accommodations for learning this concept (Bandura, 2001). It was because of their use of various applications that the students were able to learn and succeed in math classes. Students in this study indicated that they would continue using digital applications and websites based on previous experience. This continued use of applications aligns with the theory of making accommodations for their learning was a result of the inability to assimilate the material in class (Bandura, 2001; Zhang, 2012). Students in this study sometimes reported finding it challenging to learn a math concept in

the classroom or maybe a student had other issues, such as poor time management (Gullifer & Tyson, 2010). These were some of the problems shared by students in this study which caused them to accommodate their need to learn the material (Bandura, 2001; Gullifer & Tyson, 2010).

The second theory and the more encompassing theory used to guide this study was that of social constructivism (Vygotsky, 1978). According to social constructivism, the determination of an object's existence is through communication, both intrapersonal and interpersonal (Keaton & Bodie, 2011). This process of defining the object, or its construction, is social and allows a person to understand the object within a social context (Vygotsky, 1978).

In this study, students were using social context to understand the task placed before them. Many times they reported using the Internet to achieve this understanding. The Internet provided a means for the participants to have a shared experience. Upon reflecting on their use of the Internet, the students observed the essence of this use. The intersubjective was found in the use of digital applications and websites as a tool for completing math assignments. The participants shared the thought that these applications were to be used as tools for learning. The participants also believe that the use of these items was not plagiarism.

These efforts of the students in this study aligned with the idea of assimilation and accommodation that exists in social constructivism and is also found in SCT (Bandura, 2001; Vygotsky, 1978). According to social constructivism, when a student cannot assimilate the new information presented, they will then make an accommodation in the zone of proximal development (ZPD), where the student acquires knowledge with the help of a "more knowledgeable other" (Vygotsky, 1978). The ZPD is defined as the distance between the developmental level of learning and the potential level of knowledge or the difference between what a student can learn on their own and what they can only learn with the guidance of others

(Vygotsky, 1978). It is in the ZPD where collaboration for learning takes place; for the students in this study, the student collaborated with the digital application and website to complete the math assignment (Applefield et al., 2001; Vygotsky, 1978). The use of digital applications and websites are considered the “more knowledgeable other” for this study and led the students to succeed in their math courses. The results that follow indicate the different manner in which students used digital applications and websites to accommodate issues in their lives.

### **Discussion of Results**

The participants in this study were from an outlying campus of a state university. The participants all used at least one digital application or website in completing math assignments. The following is a discussion of the results that emerged from the study.

All students used other methods before resorting to digital applications or websites to solve math problems. Additional responses included asking for help from others, including the tutor in the resource center. The responses from the students regarding how they handled a difficult problem matched the expected results, which were that students would use class notes, the book, check with the tutor or other knowledgeable individuals, and then eventually move to the Internet (Vygotsky, 1978). The variety of digital applications and websites diverged from the expected results; many more digital options for checking and solving math problems were available than I expected.

**Digital applications or websites used by students.** There are a variety of digital applications and websites available through smartphones and the Internet. Most of the participants used a combination of sites or applications. Table 5 presents this the applications and websites participants reported using.

Table 5

*Digital Applications or Websites Used*

| Application or website | Description/How used  | Number of participants using this application |
|------------------------|---|---|
| Chegg                  | “Chegg is the one that pops the answers up for me. For a long time, I bypassed it because I didn’t want to spend the money. Now that I spend the money, it is not always the exact problem. It is close, close enough to where I can put in my numbers and work it the same way.” Wilma | 2   |
| PhotoMath              | The student uses a smart phone to take a picture of the problem. “Doesn’t work on applications problems.” Quincy  | 2   |
| Desmos                 | Used for graphing questions   | 1   |
| Slader                 | Answers for textbooks   | 1   |
| Symbolab               | Type in the question and the solution is produced   | 1   |
| Khan Academy           | Instruction through videos, quizzes, not problem specific   | 1   |
| Google                 | “For one whole semester, I Googled a lot of equations.” Wilma   |   |
| Google                 | “Googled for tutorial” Raelyne  | 2   |
| YouTube                | Videos (not problem specific).  | 3   |
| SLED                   | An assistant homework site that is free to any student, regardless of age, provided by the State.   | 1   |
| Wolfram Alpha          | Type in the problem and the solution is produced. “I will go to Wolfram Alpha because it will give you step-by-step on how to solve it [a problem]” Zelda   | 2   |



**Why and how participants use digital applications.** The research question, “What reasons do college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests?” led to asking how and why students use digital applications to complete math assignments. Many of the students indicated more than one reason. These reasons resulted in the emerging themes of this study. Some of these reasons were learning the process and filling in foundational gaps in knowledge; immediate feedback; and checking the answer. Timofey felt that if he had “a major issue, where I know the answer is wrong, and I suspect I missed a step, I go through Symbolab.” He liked that Symbolab gave “the breakdown of every step so I can run through the steps and see if I’ve missed one, which I usually have, and with me, it’s usually a sign.” He felt that this guidance was essential to his success in math. When completing math assignments, Symbolab became his more knowledgeable source, which aligns with the theory of Vygotsky (1978).

The emerging theme of learning the process and filling in foundational gaps of knowledge helps to explain why several of the students used digital applications and websites to explore different approaches to a problem or to find a hint as to how to proceed. Ulysses said that Chegg would provide “a hint and other nuances of small basic stuff.” Zelda felt that the use of the digital application helped her: “It’ll show me where I missed a step, what I missed. It is really nice, because sometimes you are so close, but still not getting the answer.” Raelyne said, “It helps me learn and allows me to consult right away” Timofey goes to Symbolab when he has tried everything else: “That is when I find the missing step. . . . That is how I use it.” This idea aligns with the concept of assimilation and accommodation from social constructivism (Vygotsky, 1978). When a student has tried everything else, then they will make accommodation for acquiring the necessary knowledge (Vygotsky, 1978).

Two students mentioned other ways to use digital applications and websites for learning the process. Yvonne had a problem that was unique in the study, probably not unique to the student population overall. She felt that she had “a hard time getting my point across, and so asking questions can be difficult to explain myself proper. Right? So being able to find what I'm looking for without explaining it is really helpful.” Zelda liked to use Wolfram Alpha when she “missed classes, and I wasn’t there to be taught step-by-step. It is almost like having the teacher showing you how to do it. It saved my life.”

**Unavailability of the instructor.** Another emerging theme was the unavailability of the professor or tutors because the student was doing the work late at night. Zelda, Quincy, and Ulysses each reflected on their use of digital applications and websites, stating that the use allowed them the freedom to complete their assignments whenever it fits into their schedules without bothering their instructors. Zelda noted,

Sometimes I do my math homework very late at night because I don’t get off work until then. No one’s awake at that time to help me. I can just log right on and learn by doing it that way.

Quincy agreed by saying that he worked “at weird hours. . . . It is definitely a utility that is usable.” Ulysses felt that “professors have a limited time in class; also, teachers have families, I don’t need to be blowing up their e-mail.” All three of these students show that this freedom is another aspect of the essence of using digital applications and websites in completing math assignments. The intersubjectivity found among the students explained how these applications were important to their individual success in math classes.

Some of the reasons given by students for using digital applications and websites to complete math assignments were unexpected, such as the problems with communicating the

questions correctly. Most of the reasons were expected, such as learning and guidance, as Quincy stated: “Yeah, I mean it can help you if you are able to pinpoint the areas where you are deficient, and you can definitely start to move past these points.”

**Checking answers and building confidence.** Checking the answers to their problems was not an unexpected response. Many students want to know if they are getting the correct answers. Quincy felt that “you look at the answer when you’re done and check the answer as you go.” Zelda said that she used “it for verifying more than anything. Sometimes I have tough questions, and I’m like, okay, I can figure how they’re doing this.”

According to SCT, when a behavior receives positive reinforcement, it is more likely to reoccur (Bandura, 1971). Students receive positive reinforcement from digital applications and websites. The idea of building confidence or instant gratification revealed itself in the first interview. When Zelda said, “I did it exactly right. I need this pat on the back. I need it now. So, I think that it is really important.” Yvonne felt that “it builds confidence.” Stella agreed, stating, “It helps to build confidence by confirming the steps.” According to Ulysses, using an application made him “feel good that I figured it out. . . . I get a little bit of pride when I figure out something on my own, or when something clicks.”

Xena and Timofey had a slightly different view of the uses of digital applications and websites. Xena used PhotoMath and said, “One of the nice the things about using apps is you get immediate feedback, and that helps build the confidence. . . . It’s immediate gratification and immediately helps build your confidence or kills you.” Timofey echoed some of Xena’s responses when he said, “I don’t like using it, it irritates me. I get really frustrated that I’m missing a step.” SCT includes the idea that there is emotional learning, both pleasant and unpleasant (Bandura, 1971). When a student finds positive reinforcement from the use of digital

applications, then there is a pleasurable emotional response (Bandura, 1971). When a student is irritated by the use of digital applications, there is an unpleasant emotional response (Bandura, 1971).

Most of the students found the use of digital applications and websites useful for checking their answers. They found that by checking their answers, there was instant gratification and confidence building for some. For other students, when they arrived at the incorrect answer, they experienced irritation and frustration. These responses were not surprising. Making sure that you are getting the correct answers is one of the reasons for checking answers. The idea that these correct answers can lead to confidence or irritation was a new insight. Confidence building was an item of intersubjectivity shared among the study's participants. All of the participants in this study began using the applications with the idea of learning and discovered that this learning lead to the confidence building.

**Continued usage.** The final emerging theme had to do with continued usage of digital applications and websites. All the participants in this study felt that the use of digital applications and websites produced positive results in their lives. When asked if they would continue using digital applications and websites, the answer was yes from all nine participants. These positive results align with the concepts of reinforcement and motivation from SCT (Bandura, 1971). Most students felt that digital applications and websites were tools, and these tools helped them achieve their goals in math classes. Ulysses thought he would not have passed College Algebra or Trigonometry without using digital applications and websites. He stated, "I will continue using these apps as tools. It's like my wrenches in my garage; if I didn't have it, then I wouldn't be able to do the task." Quincy said that he had many semesters left of math, but by using digital applications and websites, he found that he "enjoyed math a little bit more." This statement

reveals a bit of the essence of using digital applications. Quincy found that his confidence was growing in solving math problems, thereby making math a bit more enjoyable.

**Definition of plagiarism.** Most studies of plagiarism do not address this act in completing math assignments (Chace, 2012; Gullifer & Tyson, 2010). In the current body of literature, there are a few references made to copying solutions in math classes. There has been one study using PhotoMath as a teaching resource (Hamadneh & Al-Masaeed, 2015). The researchers determined that the application is useful to students as an exploration tool following a proper introduction to the concepts (Hamadneh & Al-Masaeed, 2015).

In this study, students did not believe they were plagiarizing, this shared belief is part of the essence of using digital applications and websites. People have different definitions of plagiarism; these different definitions could lead to the essence found in this study, such as the belief that plagiarism is not occurring when the applications are used for learning. Many responded by giving reasons to justify their use of the applications. Some people, such as Raelyne, said it was not plagiarizing because “I am using it to learn a little.” Timofey said, “It is not plagiarism; it is for learning. I am looking at a six-step problem and trying to figure out which step I missed. It helps me brush-up on the steps I am missing.” Zelda said,

I have to understand this in my brain. I have to know how this works because we have quizzes and tests. I feel like math is such a huge thing in my degree that I have to know it.

At the end of the day, if you can’t pass the test. I am sure there are people that are like that.

When asked about the possibility of application use being plagiarism, the answers of all the participants were best summed up by Yvonne, who said,

Yeah, that's a tough subject. How do you even know if it's plagiarized? The answers are all the same exactly. You're trying to get that answer, right? I don't know if I would considerate it plagiarism, I definitely consider it cheating. Yeah, when I think of plagiarism I think of your ripping off somebody else's essay or something. Hmm, not necessarily a math problem, but I can see the similarities. Not necessarily in math because it's hard to say that that's unique, or somebody has ownership to that exactly because you're going for the same answer . . . if you can you just copy down the answer, but that doesn't help you at all because it doesn't help you understand how you got to the answer. I definitely feel like its cheating.

Wilma concurred with this theme by saying,

I don't think it's plagiarism, because it's not words that are being stolen. It's the problem. Okay, I don't know how to explain it. You know, somebody writes something and you take it and claim it as your own. In a solution, there are only so many ways to do it. It's either the right answer or the wrong answer; it's not like you stole it from somebody else. No one is specifically being given credit for the solution.

One common theme presented by the participants was that their personal use was not plagiarizing. A few of the students eluded to the idea that the digital applications and websites could be used correctly used and incorrectly; as Timofey said, "It is a tool, and any tool can be used wrong." The idea that it is okay to use digital applications and websites, as long as the student is using them correctly, is not a new thought. The question remains as to whether the student knows when he or she is using the tools correctly.

## **Discussion of the Study's Results and the Literature**

The primary focus of this study was plagiarism, a type of academic dishonesty. Most of the articles in the literature review discussed plagiarism in writing; there is little information on plagiarism in mathematics. There was one study encouraging the use of PhotoMath in teaching math concepts to students (Hamadneh & Al-Masaeed, 2015).

There was also some research discussing the academic dishonesty involved with coding (Bidgood & Merrill, 2017). Students were using websites to copy the solutions to coding assignments. They would attempt to distinguish their work from the website work by changing a small portion (Bidgood & Merrill, 2017). This changing of a small portion is similar to how plagiarism occurs in written assignments, such as English papers (Bidgood & Merrill, 2017).

Students who copy the answers to math problems without practice do not learn the skill. This lack of learning a skill can cause a school to lower their standards (Arum & Roksa, 2011). Not learning a math concept leads to students graduating with a weak mathematical background.

A common problem in academia is the lack of a shared definition of academic dishonesty (Aasheim et al., 2012; Bispington et al., 2008; Gullifer & Tyson, 2010; Jones et al., 2008; Perry, 2010). Either the instructors do not clearly define academic dishonesty or instructors frustrate students by threatening consequences without explaining how to avoid committing the offense (Power, 2009). Students often cannot identify examples of academic dishonesty; in particular, they cannot identify examples of plagiarism (Gullifer & Tyson, 2010). In one study explored in the literature review, 27% of first-year students admitted to using the Internet to complete assignments (Perry, 2010). Even when the student understands academic dishonesty, their definition of acceptable behaviors often differs from the instructor's definitions (Aasheim et al., 2012). As the number of digital applications and websites grows, there is a need for a clear

definition of what constitutes plagiarism in completing math assignments (Harkins & Kubik, 2010).

Another issue in plagiarism and academic dishonesty is the lack of punishment (Burrus et al., 2011; Schmelkin et al., 2008). Cheating is seen as an easy solution to the challenges in the academic world because of the low likelihood of being caught and the lack of punishment (Burrus et al., 2011). Some students see the high grades gained by others in their academic dishonesty with little punishment and decide it is worth the risk (Eraslan, 2011). In this study, I was interested in the essence found among the participants in using digital applications and, achieving this goal required this study to rely on previous studies in academic dishonesty. I found data that lead to defining new essence for the use of digital applications including using these applications for learning and confidence building. Neither of these ideas were found in earlier studies.

The research studies discussed in the literature review usually used a quantitative approach using experiments and surveys (Bowers, 1966; Burrus et al., 2011; Creswell, 1994; Geddes, 2011; McCabe & Trevino, 1993). All the surveys were anonymous, with most of the studies employing Likert scales to rank the behaviors (McCabe & Trevino, 1993). The questions on these surveys usually asked about personal academic dishonesty or the knowledge of someone else committing academic dishonesty (McCabe & Trevino, 1993). The research for this project was accomplished using a qualitative method.

The focus of this dissertation was to discover how students used digital applications and websites to complete math assignments, why the students used these tools, and how do students define plagiarism in math classes. I asked these questions by meeting with the individual students for personal interviews. The students were asked the same basic questions to arrive at



the final results, which help to explain how and why students use digital applications and websites to complete math assignments. I triangulated the data using a survey, interview which included member checking, and a research journal. I also made notes in the research journal regarding the physical responses and the verbal responses. Each participant was allowed to member check their responses for accuracy.

This research benefits the current body of literature by addressing plagiarism in completing math assignments. This study will also help administrators and math instructors understand how students are using digital applications and websites in completing math assignments. Many instructors are unaware of the various applications available to the math student. This lack of knowledge is a gap in understanding the actions and needs of math students. My hope is that the results of this study will aid administrators and instructors to guide their students in the proper use of digital applications and websites in math classes. Participants in this study did not believe that using technology in their studies carried the same stigma as other types of academic dishonesty (Molnar et al., 2008). Several participants saw the digital applications and websites as tools to be used in their studies, which aligned with the concept that everything on the Internet is available for public use (Jones et al., 2008).

In this study, I explored the reasons that students choose to practice academic dishonesty. One of the ideas found in the literature review was the desire for a better grade (Geddes, 2011). Students also stated that poor time management skills and procrastination lead to their academic dishonesty (Murdock et al., 2008). Other reasons included the perception that other students were getting away with academic dishonesty and that there appeared to be no punishments if caught (Geddes, 2011; Ma et al., 2007; Scott, 2016). In the literature review, the most common reason found was neutralizing behaviors; this theme found in some studies show that student often

blames others for their choices (McCabe et al., 2001). In this study, neutralizing behaviors were usually justifications for academic dishonesty (Murdock et al., 2008). As found in the literature review, students in this study often consider their behaviors acceptable by using neutralizing behaviors (Comas-Forgas & Sureda-Negre, 2010). In this study, I found that neutralizing behaviors were a common theme among the participants in this study. Upon reflection, each student justified their use of digital applications and websites by saying it was for learning. This intersubjectivity occurred when students were asked to define plagiarism in math classes.

### **Limitations of the Study**

A discussion of limitations aids in identifying the potential weaknesses which occurred during this research (Creswell, 1994). There were several limitations of this research project. Some of these limitations may have affected the outcome of the study. Among these limitations was the ethnic makeup of the campus where the study was conducted, difficulty in filling demographic requirements, age restriction observed for the research, the size of sampling, possible bias, and the character of the participants of the study.

The unique ethnicity of the research campus was a limitation. The student body on this campus is 70% Caucasian, with the next largest group being local Native Americans at 8%. Other college campuses in other states have different ethnic compositions. There is a possibility that different ethnic makeup could bring about different results.

It was difficult to fill the demographic requirements of the study in the area of ethnicity. I originally sought seven individuals for this study; the division was as follows: five Caucasian participants, one Native American participant, and one Hispanic American participant. People in the last two groups were slow to volunteer. I eventually asked people to participate in the study

who were of these ethnicities. In the end, I conducted the study with nine participants; seven were Caucasian, one was Native American, and one was Hispanic American.

One delimitator was the age limitation. This study was limited to students who were 21 years of age and older, by the choice of the investigator. The reason for this limitation was cautionary, having to do with the legality of signing contracts. The legal age of consent is 18 years in the state where this study was conducted, meaning that another study could include students between the ages of 18 and 21. The results might be different if the research had included students in this age group. During the recruiting stage, many students ages 18 to 21 stopped and indicate that they used digital applications and websites.

Phenomenological research often has issues with the bias of the researcher and the accuracy of the data (Dudovskiy, 2017; Vagle, 2016). In this study, I used bridling to aid in analyzing the data. Bridling acknowledges the bias of the researcher and notes with bias in the analysis (Vagle, 2016). This bridling included the use of three contacts with the participants and a research journal. These tools were employed to curb bias and aid in obtaining accuracy in the findings. With another researcher with different biases, the results of this study may be different.

The last limitation to note in this study is that of the character of the participants. The students volunteered their perspective and time. The participants indicated they used digital applications and websites for learning. It is unlikely that students who plagiarize or copy the solutions to math assignments would volunteer for this study (Dudovskiy, 2017; Walker, 2010). If students who plagiarized or copied directly off these applications chose to participate in this study, a different definition of plagiarism in math courses may have emerged.

## **Implications of the Results for Practice, Policy, and Theory**

**Implications for Practice.** Repeated practice is the best way to learn mathematics. When a student chooses to commit academic dishonesty by copying the solutions from a digital application or website, it is the practice that disappears. The practice of copying solutions could lead to the student not learning the concepts. Additionally, copying the solutions from these applications may be deemed as dishonest by some instructors, and some students (Harkins & Kubik, 2010). In this study, I study explored several facets of students and their use of digital applications and websites, including why and how they used these tools in completing math assignments and if the students deemed this use as plagiarism.

Students are often frustrated by instructors who tell them not to plagiarize, but fail to clarify what constitutes plagiarism (Power, 2009; Stephens et al., 2007). Another study showed that the definition of academic dishonesty may differ depending on which faculty member was asked (Jones et al., 2008). Even when the instructor posts their definition of academic dishonesty in their syllabus, many students do not read it (Owunwanne et al., 2010). Instructors usually tell students that there are dire consequences for academic dishonesty, failing to teach their students how to keep from plagiarizing (Owunwanne et al., 2010; Power, 2009). The failure of the clarification causes students stress (Roig, 1997). The students in this study never mentioned their instructors or what their instructors might think of their use of digital applications and websites in completing assignments. The issue of academic dishonesty did not come up during class, and the only reference appeared on the syllabus, in the form of a statement indicating that students should not engage in academic dishonesty.

There are many different reasons students use to justify their use of digital applications and websites. One of the reasons students use digital applications and websites is the goal of

maintaining or achieving a certain GPA (Bowers, 1966; Geddes, 2011; McCabe & Trevino, 1997). One study's findings indicated students with high GPAs used these tools to retain their grades, while students with low GPAs often use these tools because of poor time management skills (Geddes et al., 2011; Gullifer & Tyson, 2010). Both of these reasons appeared in this study regarding the use of digital applications and websites. The participants gave various reasons for using digital applications and websites, including procrastination and completing homework at times an instructor is not available.

In other studies, students blamed academic dishonesty on their instructors, citing that the instructors gave too much work that did not seem important (Murdock et al., 2008). This reason is an example of a neutralizing behavior, which the individual blames other people (Murdock et al., 2008). This neutralizing behavior often leads a student to blame the instructor when the student does not learn the material presented in class (Murdock et al., 2008). Neutralizing behaviors appeared in this study when students claimed it was fine for them to use digital applications and websites because they were using them for learning.

As to the question of plagiarism in mathematics, two themes emerged. Most of the participants in this study said that using applications as learning tools was not plagiarism. The students said that the tools were being used to learn and therefore it could not be plagiarism. Another idea directly addressed the idea of plagiarism in math courses. Several students said that plagiarism required ownership. This ownership is not found in math solutions, as there is only one way to complete most math questions; thus, the uniqueness found in ownership is missing in math solutions. Some of the participants agreed that using digital applications and websites could be defined as cheating.

Instructors could teach students how to use digital applications and websites for completing math assignments without cheating. With guidance from their instructors, students could use these tools for learning. Hamadneh & Al-Masaeed (2015) found an example of this learning in their study about PhotoMath. Students learned mathematical concepts and then used PhotoMath to explore these concepts further (Hamadneh & Al-Masaeed, 2015). These results showed that students justified their use of digital applications and websites because they were using them for learning. Many of the students in this study were passing tests without using the applications during testing. Other students in this study found that they had to drop their classes because they fell behind in understanding concepts. An instructor can aid a student in learning from digital applications and websites by learning what is available to students. Then the instructors could guide their students in using the applications that would be most beneficial in learning the material.

Another possible use for digital applications and websites in completing math assignments is in providing students with additional support in teaching themselves. Several students in the study indicated that they used these tools when they missed classes. One student stated that she could often could not understand the teacher and therefore could not form proper questions. The websites helped her to learn the information that she could not understand in class. These tools might be especially useful for students who are attempting to complete a course online.

Digital applications and websites can be used in math classes as confidence builders. Students can determine if their answers are correct immediately, which helps to give them confidence. Another possible use for these tools is in eliminating or lessening the frustration that students feel when trying to solve a math problem. Having the solution in front of them aids

them in moving forward. The students might also find that they become dependent on this confidence boost and it might work against them on test day.

**Implications for policy.** The results from this study and the earlier literature provide instructors and administrators with tools for establishing policies about the use of digital applications and websites. Honor codes were one method found for preventing academic dishonesty (Bowers, 1966; McCabe & Trevino, 1993). Researchers found that schools with honor codes experienced less academic dishonesty (Bowers, 1966; McCabe & Trevino, 1993). McCabe & Trevino (1993) showed that when cheating was discouraged, as in a school with an honor code, then the students would not cheat. This lack of cheating was encouraged by the special privileges allowed to schools with honor codes, such as the self-proctoring of tests (McCabe & Trevino, 1993).

There is a gap in understanding the actions and needs of students. Students gave several reasons for engaging in academic dishonesty. The most common in the literature was the lack of a clear definition (McCabe et al., 1999). The previous research showed that honor codes provided a definition of academic dishonesty that is valuable for students and clearly defines the rules for students to follow (McCabe et al., 1999). In this study, I found a common definition. The students felt that plagiarism was copying something with clear authorship. Upon reflection, the students stated that copying solutions for math problems would not be plagiarism as there is no clear authorship. The students stated that copying without learning would be cheating.

Another issue in academic dishonesty is the inconsistent punishments meted out (Burrus et al., 2011; Schmelkin et al., 2008). Many instructors ignore the behavior because they believe the cheater only hurts themselves (Chace, 2012). One study concluded that part-time instructors were more likely to be lenient than full-time instructors (Hudd et al., 2009). Training the faculty

members on academic issues is a suggestion for aiding in the elimination of academic dishonesty (Boehm et al., 2009). As shown in previous studies with honor codes, if the faculty members presented a common definition of academic dishonesty, the policy would be enforced more consistently (Burrus et al., 2011). After the development of a common definition, then the instructor must communicate this definition to the students. This united effort could help to diminish the amount of academic dishonesty and the anxiety of the students who previously did not understand what constituted academic dishonesty (Owunwanne et al., 2010; Power, 2009). The administration and instructors need to define what uses of digital applications, and websites are acceptable in math classes. Without these clear definitions, there could be dire issues with students copying solutions and the lack of learning among the students.

**Implications for theory.** In this study, I used the frameworks of social constructivism and social cognitive theory as a lens. The essence found in this study were different from previous studies. In particular the themes of learning from the use of digital applications and websites and the building of confidence in solving math problem.

Social constructivism assumes that a student's previous knowledge leads to new learning (Keaton & Bodie, 2011; Vygotsky, 1978). It is in the Zone of Proximal Development (ZPD) where this learning occurs (Vygotsky, 1978). In the ZPD, someone with more knowledge guides a struggling learner (Vygotsky, 1978). In social cognitive theory, almost all learning results from direct experience and by observing the behaviors of other people (Bandura, 1971). These two theories are similar to social cognitive theory contained within the teachings of social constructivism.

In social constructivism are the twin concepts of assimilation and accommodation. Often a student feels they cannot learn the concept, or the student feels they do not have time to finish



the assignment. These are both instances that may cause a student to resort to making accommodations due to their inability to assimilate knowledge (Vygotsky, 1978; Zhang, 2012). This learning often takes place in the zone of proximal development (ZPD), where a “more knowledgeable other” aids the student in learning the required information (Vygotsky, 1978). In this study, some students expressed that issues in understanding concepts and problems in time management lead to their use of digital applications and websites. Other students said that they experienced difficulty in understanding concepts. This lack of assimilation led to accommodations, which led to the need for a “more knowledgeable other.” The applications were the “more knowledgeable other,” guiding students to the concepts.

Social cognitive theory explains that almost all learning results from direct experience and observing others (Bandura, 1971). Students share their experiences with digital applications and websites through communication. Students also observe the consequences received for personal choices (Bandura, 1971). Students in this study explained that they learned about digital applications and websites from other students or the Internet. These students were not concerned with instructors finding out about their use of digital applications. None of the students received any punishment, nor did they know of anyone who received punishment for using the applications and websites.

In SCT, individuals are often making accommodations to achieve a specific goal (Geddes, 2011; Gullifer & Tyson, 2010). One reason a student may use digital applications and websites to complete assignments is their lack of foundational knowledge (Geddes, 2011). In this study, students shared the common belief that each of them was using the digital application and websites for learning.

Another concept from SCT is the ability of individuals to see the future consequences of their current behavior (Bandura, 1971). These individuals then use these future consequences to motivate their current behaviors (Bandura, 1971). Students who cheat often see none or few consequences when someone is caught cheating (Gullifer & Tyson, 2010). This lack of public discipline is one motivator for the use of digital applications and websites in completing math assignments. Another motivator is achieving a certain GPA (Geddes, 2011). The students in this study saw no consequences in using these tools. Every student, in the study, was working to maintain or reach a certain GPA. Sometimes the students believed that their use was cheating, but they never believed that that the use of these tools was plagiarism.

Other reasons for using digital applications and websites are neutralizing behaviors. Usually, a student uses neutralizing behaviors to blame an outside force or person for their personal decision (Murdock et al., 2008). These outside forces may include the teacher, the teaching style, the structure of the classroom (Murdock et al., 2008). Students who cheat often consider their behaviors acceptable when they neutralize the behavior (Comas-Forgas & Sureda-Negre, 2010). In this study, students cited the inability to contact instructors, usually because of the odd time the student chooses to complete the assignment; or the desire to not “blow up” the instructor’s email. Students in this study also expressed the idea that while using digital application and websites to complete math assignments may be cheating when other do it, it was not cheating in their case because they were using it for learning. This action appears to be a neutralizing behavior.

In SCT, there is the theory of moral disengagement (Bandura, 2011). This moral disengagement is related to neutralizing behaviors, where individuals decide that ethical standards do not apply to them (Bandura et al., 1996). One study showed that moral

disengagement allowed the students to make their unethical decision (Detert et al., 2008). This study also showed that this moral disengagement could be turned off and on (Detert et al., 2008). The students in this study did not think there was anything wrong with using digital applications and websites; until they were asked to define plagiarism in math classes. Upon reflecting, many students realized that, perhaps, their use of these digital tools might constitute cheating. Still, with this realization, all of the students indicated that they would continue using these tools as long as they were taking math classes.

Both the study of social constructivism and SCT help to describe how a student's thoughts and actions when copying solutions from digital applications and websites. For both theories, the basis of learning is through communication (Bandura, 1971; Vygotsky, 1978). Many students choose to use digital applications based on the behavior of other students or learning about these tools from the Internet; both of these are social means. This idea lead to the essence of following each other. Through talking and social media, the students learned which applications and websites worked best for their friends and then began using these applications themselves. In these this is an example of the intersubjectivity of the participants, starting in different places and eventually arriving at the same conclusion, that a particular application was the best for their class.

### **Recommendation for Further Research**

The purpose of this study was to understand how and why students use digital applications to complete math assignments and do these students consider the use of these applications as plagiarism. In the course of the investigation, other questions and ideas presented themselves. These questions included punishment for the use of digital applications and websites and how students learn from the use of these tools.

One of these questions was the punishment received from using a digital application for completing math assignments. There was no punishment among the students in this study. This lack of punishment leads to another idea for studying how teachers feel about the use of these tools in their classes. Do the teachers encourage the use, discourage the use, or tolerate the use? If a teacher discourages the use, is there a punishment system set up? How does a teacher discern which students are using the applications? Another question for further research is the correlation of the use of applications to the grades earned in class. Do students who use digital applications and websites receive grades that are higher than their peers who do not use digital applications?

Most of the students in the study claimed to use the digital application as a tool for learning the material. One student said that digital applications helped her learn by showing her missing steps. The other students did not elaborate as to how the digital applications and websites helped them. Learning how students learn from these sites might help teachers in presenting material in a manner which is helpful for student learning.

With a different researcher, different findings may have resulted. I had more than 20 years of teaching experience at the college level at the time of this study. Additionally, I know from personal experience that I do not have a problem with students using tools that provide the solutions. Near the beginning of courses that I teach, I tell the students about digital applications and websites. I then explain to the students how best to use these tools for learning, telling them that the tools are to be used for checking their answers, to gain insight how to solve a problem, or to better understand the process. I further explain, that if they choose to just copy the solutions to the problems, they will probably fail the class. I cannot guarantee that the student will fail, but the chances are that they will fail because of the lack of foundational skills. Another researcher

with a different point of view might arrive at a different conclusion, as bias can affect the outcome of a study (Vagle, 2016).

The final consideration for further research was the methodology used in this study. This study was a phenomenological study using an interview process and a small number of participants. Because this was a phenomenological study, the consideration was for the experiences shared by the participants. Using another methodology would produce different kinds of data, such as quantitative approaches would produce data as numbers and not experiences.

More research using a different methodology or asking a different question would produce different results. Further research might discover how teachers view the use of digital applications and websites or what punishment some of these teachers may implement for the use of these tools in their classrooms. This study is a good starting place for further research, which might lead to more discoveries that will aid students, instructors, and administrators in learning how to best use digital applications and websites in completing math assignments.

If replicating this study, the following suggestions might help to improve the results, based on the limitations of the study.

- Start with a presentation in as many math classes as possible and then pass out surveys in the common areas. In this study, surveys were passed out first, and then the presentation occurred due to the shortage of participants. I believe that more interest would be generated if complete in this new order.
- Open the study up to the age group of 18–21 years of age. I was worried about legal issues or concerns with the parents of these students.

- Use a larger sample size for the study or use another method of analysis rather than phenomenology. Perhaps a study looking at the grades of those who use digital applications and those who do not use these devices. This type of study could be qualitative or quantitative. If employing a larger group, then a different method of gathering the information will need to be implemented, as using interviews with a large group would be difficult.
- Start the interviews with the definition of academic dishonesty, plagiarism, and cheating. Perhaps the participants would be able to align their behavior with one of the definitions. There is a possibility that starting with these definitions might also alienate your participants.

The results of this study showed that students who use digital applications and websites to complete math assignments feel justified in their use of these tools. None of these students believe that their use of these tools constituted plagiarism in math classes. In spite of its limitations, this study still yielded an interesting description of math students using applications to complete math assignments.

## **Conclusion**

I conducted this study to achieve two goals. One goal was to determine how and why students use digital applications and websites in completing math assignments. The second goal was to discover the students regarded their use of these applications and websites as plagiarism. Both of these goals led to answering this study's research questions, which were as follows:

RQ1: How do college students perceive the use of digital applications to complete assignments in math courses?

SRQ1: What reasons do college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests?

RQ2: How do college students perceive plagiarism in math courses?

SRQ2: What is the shared essence of plagiarism in math courses?

The participants provided several reasons for using digital applications and websites when completing math assignments. These concrete themes include learning because of a lack of foundational skills, missed classes, or difficult concepts. Another concrete theme was that of building confidence. All the students claimed that these applications and websites aided them in learning the material. Many of the students felt that using the applications gave them immediate feedback and helped to build confidence. Additionally, several participants expressed that digital applications and websites provided access to help with their homework at any hour of the day.

None of the participants in the study felt their use of digital applications or websites was plagiarism. Some of the participants felt that other people's use might plagiarize, but the way that they used the digital applications and websites was okay since it was for learning. Other participants felt that plagiarism could not exist in math courses. These students said that there was no uniqueness to the solutions to math problems; therefore, there was no ownership. Without ownership, there could not be plagiarism.

As digital offerings continue to appear, there will be more applications and websites. All learning institutions need a common definition and common procedures for the use of these applications. This study has the potential to help students, instructors, and administrators understand the use of digital applications and websites in math courses and help these groups to discover a common definition and procedures for mitigating academic dishonesty.

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## **Appendix A: Consent Form**

Concordia University–Portland Institutional Review Board

Approved: July 27, 2018; will Expire: July 27, 2019

**Research Study Title:** The Use of Digital Apps and Websites in Completing Math Assignments

**Principal Investigator:** Ronna Williams

**Research Institution:** Concordia University–Portland

**Faculty Advisor:** Belle Booker; Audrey Rabas

### **Purpose and what you will be doing:**

The purpose of this survey is to discover the reason college students use digital applications and websites for completing math assignments and to define plagiarism in mathematics, from a student perspective. We expect approximately seven to ten volunteers. No one will be paid to be in the study. We will begin enrollment on 8/31/2018 and end enrollment on 10/15/2018. To be in the study, you will first self-identify your use of digital applications and websites in completing math assignment in a survey. Then you will participate in an interview, which will last between 20–40 minutes. After the interview, you will be given the opportunity to verify the information noted during the interview.

Doing these things should take less than 3 hours of your time.

### **Risks:**

There are no risks to participating in this study other than providing your information. However, I will protect your information. Any personal information you provide will be coded so it cannot be linked to you. I (the principal investigator, Ronna Williams) will record the interviews. The interview will be transcribed by me. Then as soon as the transcript is checked for accuracy, the recording will be deleted when the transcription is completed. Any data you provide will be coded so people who are not the investigator cannot link your information to you. Any name or identifying information you give will be kept secure via electronic encryption on my password protected computer or locked inside a cabinet in my office. The recording will be destroyed as soon as possible; and all other study documents will be kept secure for 3 years and then will be destroyed.

### **Benefits:**

Information you provide will help us research the questions and perhaps open a dialogue regarding the use of digital applications and websites in completing math assignments. You could benefit from this by learning more about digital applications and websites and how these could be used to benefit you in learning math.

### **Confidentiality:**

This information will not be distributed to any instructors, administrators or other agency and will be kept private and confidential. The only exception to this is if you tell us about abuse or neglect that makes us seriously concerned for your immediate health and safety.

## Right to Withdraw:

Your participation is greatly appreciated, but we acknowledge that the questions we are asking are personal in nature. You are free at any point to choose not to engage with or stop the study. You may skip any questions you do not wish to answer. This study is not required and there is no penalty for not participating. If at any time you experience a negative emotion from answering the questions, we will stop asking you questions.

### Contact Information:

You will receive a copy of this consent form. If you have questions, you can talk to or write the principal investigator, Ronna Williams at email [redacted] or text [redacted]. If you want to talk with a participant advocate other than the investigator, you can write or call the director of our institutional review board, Dr. OraLee Branch (email obranch@cu-portland.edu or call 503-493-6390).

### Your Statement of Consent:

I have read the above information. I asked questions if I had them, and my questions were answered. I volunteer my consent for this study.

Participant Name \_\_\_\_\_ Date \_\_\_\_\_

Participant Signature \_\_\_\_\_ Date \_\_\_\_\_

Investigator Name \_\_\_\_\_ Date \_\_\_\_\_

Investigator Signature \_\_\_\_\_ Date \_\_\_\_\_



Investigator: Ronna Williams; email: [redacted]  
c/o: Professor Belle Booker; Professor Audrey Rabas;  
Concordia University–Portland  
2811 NE Holman Street  
Portland, Oregon 97221

## Appendix B: Survey

Thank you for participating in this survey. This survey will help to locate the individuals who will best represent the college, as a whole, in this study. This study is seeking to find out how students use digital applications and websites to complete math assignments. All information shared on this survey and in further research will be kept confidential. Thank you again for your participation.

Name: \_\_\_\_\_

E-mail: \_\_\_\_\_

Have you taken or are you currently taking *College Algebra for Calculus* Yes No

Do you recognize any of the following digital applications or Websites:

Slader      Wolfram Alpha      PhotoMath      Symbolab      Mathway

Do you use any of these digital applications or websites to complete difficult math assignments? Yes No

If so, which ones?

Slader      Wolfram Alpha      PhotoMath      Symbolab      Mathway

Other apps/websites you may use to complete difficult math assignments?

\_\_\_\_\_

Please provide the following demographic information:

**Gender**      Male      Female      Other

**Age**      Under 21      21–25      25–up

**Race or Ethnic Group**      Native American      American Indian      African American  
*Indicate all that apply*

Hispanic/Latino      White      Other \_\_\_\_\_

Thank you for filling out this survey. You will be notified via e-mail at the end of this portion of the study to inform you of the outcome.

## **Appendix C: Interview Questions**

### **Main Question:**

How do you complete math assignment with difficult questions?

### **Additional Questions:**

What are some digital applications or websites you know are for completing math assignments?

Do you recognize any of the applications or websites listed? Slader, PhotoMath, Symbolab, Wolfram Alpha, and Chegg. Are there other applications or websites you use for completing math assignments?

### **Clarifying Questions:**

Describe a specific experience using one of these applications.

Do you feel your use of applications and websites is plagiarism?

### **Conclusion Questions**

Do you feel your use of applications or websites benefits your math studies? How?

Will you continue using applications or websites to complete math assignments?

Will you continue using applications or websites to complete math assignments?



## Appendix D: Portion of Quote Spreadsheet

|                                   | Yvonne  |   | Yvonne  |
|-----------------------------------|---|---|---|
| <b>Outside school</b>             | <p>I don't really have a lift outside of college</p> <p>On the weekends I tattoo and then I take care of my animals. I have a boyfriend and a roommate [that I take care of]</p>  | <b>Difficult math problem</b>   | <p>Read the direction. PowerPoint slides that were provided and then I'd usually go through the entire problem and get my answer, and then I check in the back of the book, and if I didn't do it right and it doesn't explain then I find out sort of outside resources</p> <p>Chegg, I bought a subscription for 151 and then YouTube. That's the most helpful. It's very helpful. Sometimes the questions are the answers, and sometimes they don't give me what I need.</p> |
| <b>How long going to college?</b> | I started in 2016. I did a year in 2007, 2008. It took me a while to figure out what I wanted.  | <b>How does it help?</b>  | [looking for guidance] and checking answers   |
| <b>Goal</b>                       | <p>: Laboratory technician. If I can get through chemistry.</p> <p>Processing blood samples and just anything the doctor needs</p> <p>Like phlebotomy or like urology, toxicology. My dream is to be a pathologist, but you have to be a doctor, and I don't want to be a doctor</p> <p>Bachelor of Laboratory Science, I want to say it is under Laboratory Technician. Medical Science.</p> | <p><b>A specific example of the use</b></p> <p><b>Use benefits studies?</b></p> <p><b>Instant gratification</b></p> <p><b>Continue using?</b></p> | <p>Yes, I have a hard time getting my point across and so asking questions can be difficult to explain myself proper. Right? So being able to find what I'm looking for without explaining it is really helpful.</p> <p>It builds confidence.</p> <p>So I use YouTube and Khan Academy definitely, but for the most part everything can be answered out of my textbook. I feel like it's helpful, but I never thought of it as cheating, and I feel kind of guilty.</p>         |

|                                   | Wilma  |  | Wilma  |
|-----------------------------------|--|--|--|
| <b>Outside school</b>             | I'm a full-time mom with two toddlers. And I work on the fire department where I respond when they have big fires. I bring them snacks. I am just very down-to-earth. I married a military man.  | <b>Difficult math problem</b>  | I go to my husband, also my mother-in-law. For one whole semester, I Googled a lot of equations.<br><br>Chegg is the one that pops the answer's up for me. For a long time I bypassed it because I didn't want to spend the money. Now that I spend the money, it is not always the exact problem. It is close, close enough to where I can put in my numbers and work it the same way. I've looked at Khan Academy, but he doesn't provide solutions. |
| <b>How long going to college?</b> | 2014 was my first semester. I took a couple of semesters off and on since 2014. A couple of breaks to have kids. I took a break when I was pregnant, and then my husband got deployed.   | <b>How does it help?</b>   |  |
| <b>Goal</b>                       | Currently I am enrolled in Natural Science, but I am switching to nursing. I wanted to be a doctor. I decided that would be really cool, but not for me. So, I'm going back to nursing because I am a people person and doctors don't have a lot of interaction with patients. I am actually looking at forensic nursing. They are a nurse, but they do forensic to investigate crimes, a lot of sexual assault, which means you see people at their worst. Somebody has to be there to help the victims and then be a liaison between the victim and law enforcement. So, it is like studying the evidence of the crime, but dealing with the patient medically. You're taking evidence. They do a lot of swabs and | <b>A specific example of the use</b><br><br><b>Use benefits studies?</b><br><br><b>Instant gratification</b><br><br><b>Continue using?</b> | Chegg has helped] Sure, It's helped me with trigonometry. But as a particular instance, I can't pull one off the top of my head.<br><br>Not too much, but I can see where it would have if I had started it earlier in the class.<br><br>It is there, and it is available. You're paying the money for it you might as well use it.  |

|                                   |  |                               |   |
|-----------------------------------|--|-------------------------------|---|
|                                   | checking out bruises, blood, anything like that, and then they take evidence.  |                               |   |
|                                   | <b>Ulysses</b>   |                               | <b>Ulysses</b>  |
| <b>Outside school</b>             | <p>I am a single parent with a two-year-old boy. I am a full-time college and a full-time dad. So, I am trying to balance him and a full-time workload in school and all that wonderful fun stuff along with flight school. There are lots of challenges and fewer resources available to a single dad compared to a single mom. There is not a lot of sympathy or empathy for single dads. I am not out there looking for it, but it would be nice if there were some understanding.</p> <p>Yes. I take a class out here, but about 90% of my stuff is in Anchorage. I am in a pilot program at Merrill Field. I hope to one day work for UPS or FEDEX.</p> | <b>Difficult math problem</b> | <p>I am struggling with trig trying to find a way to understand the practical usage. I use Chegg. I have tried PhotoMath; it is very simplistic. I also use Demos for graphing questions.</p> <p>Mathway, Wolfram Alpha, Desmos (graphing), Chegg, Sled. [other webs]</p> |
| <b>How long going to college?</b> | Since Feb 2015   | <b>How does it help?</b>      |   |

## **Appendix E: Composite Textural-Structural Description**

Technology has enabled cheating to become easier for students (Aasheim et al., 2012). This study explored cheating, specifically plagiarism, through the lens of social constructivism and the social cognitive theory. According to Ma et al. (2008), the Internet is a social constructivist learning environment where students engage in learning that is relevant to their personal needs and interest. In social constructivism, learning takes place in the zone of proximal development (ZPD), where a “more knowledgeable other” aids the student in acquiring new knowledge (University College of Dublin [UCD], 2015). This “more knowledgeable other” can be seen as the digital application or website that the student is using to complete their math assignment.

This study consisted of nine individuals, with the following pseudonyms; Quincy, Raelyne, Stella, Timofey, Ulysses, Wilma, Xena, Yvonne, and Zelda, with three demographics considered in the study, that of age, ethnicity, and gender. In this study, there were two individuals in the age group of 20 to 24 years, with the other seven individuals 25 years or up in age. The ethnicity grouping consisted of seven Caucasians, one Native American, and one Latino. There were six females and three males in the study. Other social grouping considered were marital status, having children, veteran status, employment, and disability. Six of the participants were single, and three were married. There were five individuals with children, two veterans, five with outside employment, and three that were disabled. All the males were single, one with a child. Three females were married, two of the females had children. Three of the participants had employment outside of school.

### **Importance of Math to Degree**

The importance a person places on math in their degree program may lead to plagiarism. The participants saw the importance of math to the degrees differently. Three people felt that math was essential to their degrees. These students were seeking degrees in Mechanical Engineering, Commerical Pilot, and Geomatics. Ulysses, the future pilot, stated that “Math is very important for the weight and balances, which is basic. I still want to do calculations by hand. I want to understand how I use the concepts in real life.” Two other individuals, Zelda and Timofey, echoed the sentiment of understanding the concepts with one of them, with Zelda stating that “I feel like math is such a huge thing in my degree that I have to know it.”

Two of the interviewees, Xena and Wilma, felt that math was not relevant to their degree programs. Xena said that “[Math is the requirement that] can keep people with different kinds of learning abilities and levels from certain things.” She felt that the math requirement for her degree of Early Childhood development was too much. She is required to take trigonometry and admitted to copying answers when frustrated. Xena feels that math is a roadblock to many people getting degrees in Early Childhood Development. Wilma felt that math was not important to her degree program, which is nursing, because people do not do math in their heads anymore.

When a person cannot learn a concept or does not want to learn the idea, they will make accommodation for the new knowledge (Zhang, 2012). As more information becomes available through digit applications and websites, the more a student is tempted to plagiarize in completing their math assignments (Ma et al., 2008). Another reason a student may use digital apps and websites to complete assignments is their lack of foundational knowledge. Within the context of social constructivism, the individual is making accommodations to achieve a specific goal (Geddes, 2011; Gullifer & Tyson, 2010). Sometimes students who cheat neutralize their

behavior, justifying their cheating in some manner (Comas-Forgas & Sureda-Negre, 2010).

Technology has made it easier to access information for cheating (Aasheim et al., 2012).

Research shows students do not believe deception with technology carries the same stigma as “regular” cheating (Molnar et al., 2008).

The remainder of the students felt math was not a necessity for their degrees, but it was a requirement. These individuals are the ones who struggled with foundational skills in their math assignments. Quincy, who was working towards a degree with a concentration in property management, felt that math was important to everyone stating that math is “Incredibly important, it is crucial for crunching number. It is crucial because if for nothing else, you need to know how to crunch numbers to find your earnings and to figure out what you’re paying out. Everybody needs to know how to crunch numbers. If you don’t know how you can’t even budget. You have no idea what’s going on.” Those participants who felt math was essential to their degree or life insisted that they were using the digital application and websites to learn the material. Technology has made it easier to access information and has provided more opportunities for students to learn (Aasheim, Rutner, Li, & Williams, 2012).

### **Use of Digital Applications or Websites**

Most of the participants said that they started somewhere else when seeking help on math assignments. These other places include working a similar problem, going over the notes from class, or asking someone else for help. In the end, all of the participants have used digital applications or websites to complete math assignments. Most of the students felt that they used digital applications or websites to learn the material; these individuals did state that they all knew someone who used the applications or websites for cheating. Other reasons stated for the use of digital applications and websites was that it was easier to use these tools than looking in a book,

the filling in of missing foundational steps, such as making sign error when distributing a term across parenthesis; guidance in completing the assignment; and difficulty in formulating questions to ask.

One emerging theme was the idea of the availability of digital applications and websites. Ulysses stated that “Professors have a limited time in class; Chegg provides the answers to the little stuff, enhances the learning without bothering the teacher. . . Also, teachers have families; I don’t need to be blowing up their e-mail.” Zelda completed her assignments at hours, usually after midnight, that was not convenient for access to the Tutoring Center or the professor. Other students felt that using digital applications and websites allowed them to go “down a different road to try to do the same problem.”

Another emerging theme was the idea of using these tools to check the answers, thereby gaining instant gratification, or feeling good about their efforts. Many students agree with this idea with Zelda saying that “I need this pat on the back. I need it now. So, I think that it is really important.” Ulysses explained that there is “. . . a little bit of pride when I figure out something on my own, or when something clicks.” Timofey expressed the opposite view stating that he does not “. . . like using it; it irritates me. I get really frustrated that I’m missing a step. That is why I keep going back because I work, and as I work, I’m not feeling right about it. I don’t use it unless I have to.”

There were a variety of applications and websites used by the students. Initially not considered in this study was the use of YouTube videos, Khan Academy, and Googling the questions. Many students stated that this was where they began their search for assistance in completing math assignments. Quincy felt that “You have to be highly organized and use a lot of

discretion because there's a lot of stuff . . ." These websites do not provide the answers but guide learning.

Digital applications and websites used by the interviewees include Chegg, Slader, PhotoMath, Wolfram Alpha, Mathway, Desmos, and Symbolab. Chegg and Slader provide answers tied to a specific textbook. Slader is a "free source of step-by-step solutions to homework problems in popular math and science books" (Edshelf, 2017, para.1). Slader is provided free of charge, while Chegg is provided through a monthly fee or is with the rental of a textbook from Chegg. Zelda said, "I will go to Wolfram Alpha because it will give you step by steps on how to solve it. Sometimes Wolfram Alpha gives different kinds of answers at different levels, so you can't just put down an answer; you have to actually solve the equation." Two other applications are Symbolab and Wolfram Alpha, which are both step-by-step calculators. The student enters the math problem, pushes a button, and the solution to the problem is provided (Symbolab, 2017; Wolfram Alpha, n.d.). The remainder of the applications or websites gives the answers after the student inputs the questions. For PhotoMath, the student takes a picture of the problem with a smart device, which then generates a solution. For the other applications, the students use a keyboard and symbols to input the question. These applications and websites usually provide the answer to the problem the students are working.

Every participant indicated that they would continue using digital applications and websites in future math classes. Wilma felt that "It is there, and it is available. You're paying the money for it you might as well use it." Ulysses expressed the idea that these digital applications and websites are tools. "It's like my wrenches in my garage; if I didn't have it, then I wouldn't be able to do the task," Quincy stated that he has learned to enjoy math a little bit more because of the use of these tools



## **Plagiarism when Using Digital Applications and Websites**

As the Internet and digital applications continue to grow, the definition of plagiarism in mathematics requires defining (Harkins & Kubik, 2010). Plagiarism is benefiting from someone else's work without giving them credit (Perry, 2010). In a study by Perry (2010), 27% of first-year students admitted to using material from the Internet to complete assignments but did not believe this was plagiarizing. Even when students understand academic dishonesty, they still perceive a difference in what are acceptable behaviors, depending on the assignment type (Aasheim et al., 2012).

The literature review for this project found that the idea of plagiarism is extendable to the study of mathematics, where various apps and websites allow students to copy solutions (Harkins & Kubik, 2010). The students use the applications which provide answers, the student copies, and turns in as their work without giving credit to the original author (Harkins & Kubik, 2010). This action fits the definition of plagiarism, which is passing someone else's work off as your own (Plagiarism.org, 2017).

Some of the participants in the study defended their use of the digital application or website by saying that if "used properly, it is beneficial." Learning is another reason given for using these tools in completing math assignments. No one agreed outright that the use of these tools was plagiarism. Four of the interviewees said that it was not plagiarism, but it was cheating. While the others just stated it was not plagiarism. Two of the students put forth a counter-argument. They both noted that the answers to a math problem generally have only one correct answer. That would mean that there are no ownership or rights to the solution. If there is no clear ownership, then the students felt that no plagiarism could occur. Yvonne said, "Yeah, when I think of plagiarism, I think of ripping off somebody else's essay or something. Hmmm, not

necessarily a math problem, but I can see the similarities. Not necessarily in math because it's hard to say that that's unique, or somebody has ownership to that exactly because you're going for the same answer." Wilma agreed by saying, "I don't think it is plagiarism because it's not words that are being stolen. It's a problem . . . somebody writes something, and you take it and claim it as your own. In a solution, there are only so many ways to do it. It's either the right answer or the wrong answer; it's not like you stole it from somebody else. No one is specifically being given credit for the solution."

Did the student see their use of digital applications and websites as plagiarism? Most participants saw the use of these digital applications and websites as cheating but not plagiarism. Yvonne expressed the views of most of the interviewees when she said, "I definitely feel it's kind of cheating because you are given questions for even numbers that are not in the back of the book and if you can you just copy down the answer, but that doesn't help you at all because it doesn't help you understand how you go to the answer. I definitely feel like it's cheating."

There is little information available currently on plagiarism in mathematics. In research by Ma et al. (2008), students admitted to copy-and-pasting answers for a math assignment. There is little documentation as to how many students use these sites to complete their tasks, but according to a study by Eraslan (2011), 81% of 41 surveyed prospective mathematics teachers admitted they cheated on exams and written assignments in college by using crib notes, copying from others and sharing answers. The reasons given by these prospective teachers include not wanting to memorize facts for one test, wanting to ensure a good grade, not studying enough, and observing other students getting high grades by cheating and then receiving no punishment (Eraslan, 2011). The most common reason found by researchers is the neutralizing or minimizing of the action by the students (McCabe et al., 2001). Neutralizing was evident in this study as

several students believed that it is not plagiarism or cheating because they were using the sites and applications for learning with Timofey stating, “If used properly, I think it’s beneficial. I try to work on my problem until it frustrates me to the point where I’m about to break, then I’ll plug it into Symbolab and find it is usually something minor. I’m like, oh well, that was dumb, and then I learn from it. That is how I learn from it. It is a tool, and any tool can be used wrong.” Quincy echoed this sentiment when he stated that, “It can be used like any other tool, you know, I mean it can be used for some sort of nefarious purpose or used right.”

### **The Answers to the Research Questions**

RQ1: How do college students perceive the use of digital applications to complete assignments in math courses?

This study demonstrated that the use of digital applications and websites is universally among college students at this campus. There was no specific demographic which was associated with the use of these tools, how a student perceived of the use of the digital application to complete the assignment in the math course depended on the importance that the student placed on math in their degree program, or in the life. The student who placed a high value on the math used the digital applications and websites to learn the material. Students who found math to be a roadblock in achieving their degree found math felt that the use of digital application and websites was a tool to complete their math studies. Many of the students between these two extremes thought that the use of these tools helped to establish foundational skills that they were lacking. Most of the participants used digital applications and websites to check their answers and to gain self-confidence in their mathematical endeavors.

SRQ1: What reasons do college students provide for justifying the use of the Internet and digital applications in completing math assignments and tests?

The reasons for college students justifying the use of the Internet and digital applications in completing math assignments were varied. A couple of the students completed their tasks late at night or early in the morning and found that digital applications and websites offered them immediate answers to their questions. One student felt that she could not coherently form the questions that needed answering and used the digital applications and websites to discover the answers to their questions. Another student thought that he had too many questions to ask and did not want to spend too much time contacting his instructor. Several of the students felt that digital applications and websites were tools that were available and, therefore, should be used to complete their math assignments.

RQ2: How do college students perceive plagiarism in math courses ?

The participants defined the plagiarism in mathematics in several different ways. Not one of the students believed that they were plagiarizing, but instead, they were using the tools correctly for learning and checking answers. These reasonings given by students could be examples of neutralizing or minimizing their actions (McCabe et al., 2001).

SRQ2: What is the shared essence of plagiarism in math courses?

A couple of students felt that there was no plagiarizing in math courses because of the lack of uniqueness of the material. All math questions have the same correct answer, so the students felt that copy these solutions was not plagiarizing, but it could be cheating.

### **Conclusion**

This study shows that at this campus, students use digital applications and websites when completing math assignments. Their use of these tools is for many reasons, including learning, answering questions, and checking answers. All of the participants in the study will continue to use these tools for completing their math assignments.

The consensus on the question of plagiarizing in math courses was that the individual did not commit plagiarism. Some students felt that maybe they were cheating when they used digital applications and websites, but because the students were using these tools for learning, they were not plagiarizing. Other students felt that there was no possible way to plagiarize in a math course because the material is not unique to an individual, and therefore, there is not creative license associated with the solution and answer of these math questions.

## **Appendix F: Statement of Original Work**

The Concordia University Doctorate of Education Program is a collaborative community of scholar-practitioners, who seek to transform society by pursuing ethically-informed, rigorously- researched, inquiry-based projects that benefit professional, institutional, and local educational contexts. Each member of the community affirms throughout their program of study, adherence to the principles and standards outlined in the Concordia University Academic Integrity Policy. This policy states the following:

### **Statement of academic integrity.**

As a member of the Concordia University community, I will neither engage in fraudulent or unauthorized behaviors in the presentation and completion of my work, nor will I provide unauthorized assistance to others.

### **Explanations:**

#### ***What does “fraudulent” mean?***

“Fraudulent” work is any material submitted for evaluation that is falsely or improperly presented as one’s own. This includes, but is not limited to texts, graphics and other multi-media files appropriated from any source, including another individual, that are intentionally presented as all or part of a candidate’s final work without full and complete documentation.

#### ***What is “unauthorized” assistance?***

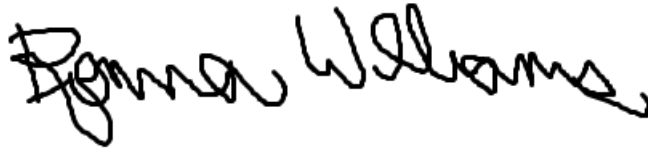
“Unauthorized assistance” refers to any support candidates solicit in the completion of their work, that has not been either explicitly specified as appropriate by the instructor, or any assistance that is understood in the class context as inappropriate. This can include, but is not limited to:

- Use of unauthorized notes or another’s work during an online test
- Use of unauthorized notes or personal assistance in an online exam setting
- Inappropriate collaboration in preparation and/or completion of a project
- Unauthorized solicitation of professional resources for the completion of the work.

### Statement of Original Work (Continued)

I attest that:

1. I have read, understood, and complied with all aspects of the Concordia University-Portland Academic Integrity Policy during the development and writing of this dissertation.
2. Where information and/or materials from outside sources has been used in the production of this dissertation, all information and/or materials from outside sources has been properly referenced and all permissions required for use of the information and/or materials have been obtained, in accordance with research standards outlined in the *Publication Manual of The American Psychological Association*.



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Digital Signature

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Ronna W. Williams

Name (Typed)

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1 April 2020

Date