TECHNOLOGY, TEXTBOOKS, AND MATHEMATICS: PERCEPTIONS OF ONLINE MATH HOMEWORK FROM TRADITIONAL HIGH SCHOOL STUDENTS ENROLLED AT PRIVATE SCHOOLS

by

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A Dissertation Submitted to the Faculty of

The College of Education

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

Florida Atlantic University

Boca Raton, FL

December 2017

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This dissertation was prepared under the direction of the candidate's dissertation advisor, Dr. Roberta K. Weber, Department of Curriculum, Culture, and Educational Inquiry, and has been approved by the members of her supervisory committee. It was submitted to the faculty of the College of Education and was accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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ACKNOWLEDGEMENTS

Dr. Roberta K. Weber, my dissertation chair, thank you for your support throughout this process. Your encouragement to take everything “day by day” helped me greatly. Dr. John Hardman, much of my methodology was influenced by the qual classes I took with you. Thank you for always making time for your students and providing helpful insight so quickly. Dr. Michelle Vaughan, thank you for serving on the committee of a student you had never met. Your understanding and encouragement throughout the process put me at ease, yet you always pushed me to make my work better. Dr. Musgrove, thank you for developing my love of technology throughout your courses. Your suggestions throughout my doctoral journey encouraged me to think outside the box.

To Dr. Kathryn A. Wolfe, I am eternally grateful for your support, encouragement, and assistance throughout this process. You gave me an example to follow, and I tried my best to emulate the grace and excellence you showed throughout your own doctoral journey. I am so grateful for your academic guidance and also for your friendship; this process would have been infinitely harder if you had not been there. Thank you. Thank you also to Dr. Christina Seamster and Dr. Alison Berger for setting excellent examples for me to follow and for answering any e-mails and texts that I sent your way.

To my doctoral cohort, thank you for understanding what I was going through and encouraging me along the way. Jillian, thank you for always being one step ahead and motivating me throughout the process. Kristen, thank you for your resolute determination; you inspired me that this could be done. Ella, thank you for being my doctoral texting buddy. From joint proposals to summer lunches, we always seemed to be at the same stage in the process, and you made the process more fun and enjoyable for me. Leigh, thank you for your dose of reality and humor. You always encouraged me to see the best-case scenario. And Tammy, thank you for the grace you showed under fire. You demonstrated true perseverance when hardships came along, and that encouraged me to be better.

To Dr. Tennies, Mr. Smith, and my Boca Christian family, thank you for encouraging my research. It was a huge blessing to know that I had the support of my administration throughout the process. The faculty and staff who asked for updates on my progress constantly encouraged me to keep pushing forward. I would also like to thank the Boca Christian Class of 2017. As eighth graders, you inspired this first-year teacher to explore online math homework, and you enthusiastically came along for the ride as we tried different variations of online and paper math homework throughout the year. I see it as only fitting that we now graduate together in 2017.

To all of my friends who supported me throughout this journey, thank you. Thank you Joanna, Erika, Vivian, Vanessa, and Valerie for understanding my crazy schedule and always supporting me along the way. You are the best

friends anyone could ask for. To Fred, Tania, Eric, and Lauren, my wonderful in-laws, thank you for your constant words of encouragement. Your excitement for me was contagious, and I am grateful for all of your support.

And to my parents and husband, I could not have done this without you. Thank you to my mom and dad for always encouraging my love for reading and education. Thank you for financing so much of my education and allowing me to pursue my dreams. To my husband, Dr. Giovanni Gutierrez, thank you for supporting me throughout the highs and lows of this process. You were always there and always told me that I could do it. I am so grateful to have you as my life partner. I love you so much. Thank you for everything.

ABSTRACT

Author:	Gisselle Gutierrez
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Institution:	Florida Atlantic University
Dissertation Advisor:	Dr. Roberta K. Weber
Degree:	Doctor of Philosophy
Year:	2017

This research study employed both quantitative and qualitative methodology to explore high school students' perceptions about online math homework and paper math homework. The purpose of this study was threefold: to understand how high school students perceive online math homework, to determine what aspects of online math homework aid and/or hinder student learning, and to improve the student learning experience with online math homework. Through quantitative analysis, the researcher noted that although not all students learned best with online math homework, nearly every student used the online tools provided when assigned online math homework. Through qualitative analysis, the researcher noted that the most commonly mentioned aid for both online math homework and paper math homework was showing your

work. The two most commonly mentioned hindrances to learning were guessing or cheating with online math homework and losing your homework with paper math homework. Participants stated that they actually have more opportunities to cheat with online math homework than with paper math homework; these results diverge from the literature, which states that online math homework helps to eliminate cheating. The data suggests that while online resources, such as examples, were a commonly mentioned aid to online math homework, many students indicated that the online resources also prevented them from truly having to think, as they could just follow the online examples step by step.

This research study determined that the majority of students did not have a strong inherent like or dislike toward either online or paper math homework. Instead, students often stated that they preferred whichever medium allowed them to earn higher grades or receive more support. Therefore, if students continue to receive the necessary support, they can continue to learn mathematical concepts through the use of both online and paper math homework.

DEDICATION

To my husband, Dr. Giovanni Gutierrez, who constantly pushes me to be a better person. I had to become a doctor because you couldn't be the only doctor in the house.

And to my parents, Patricio and Irma Fabara, your hard work and sacrifices afforded me everything that I have in life and allowed me to pursue my dreams.

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I. INTRODUCTION

New technologies are often believed to enhance learning, particularly within the field of education (Kirkwood & Prince, 2014). Technologies such as radio, television, and the Internet have all impacted student learning (Lee, 2017). As the new medium of online math homework is implemented in face-to-face, K-12 classrooms, educators must integrate online homework in creative ways to maximize students' learning gains (Koc & Liu, 2016). Educators and administrators must be aware of how to implement online math homework within face-to-face K-12 classroom in the best way possible.

It is no longer relevant to debate whether or not online homework is effective; online learning within the K-12 setting is here to stay (Simonson, Smaldino, Albright, & Zvacek, 2012). Rather, researchers need to focus on how best to design online homework in a way that enhances learning; it is crucial to be aware of what aspects of online math homework enhance learning and what value they are adding to the learners' experiences (Kirkwood & Price, 2014). Consequently, the current research study focused on what high school students enrolled in face-to-face classes perceived to be aids and/or hindrances to learning for both online math homework and paper math homework. The problem addressed in this study is that online math homework does not improve the learning experience of traditional high school students at private schools. Learning is defined as a positive change in student understanding characterized

by a richer understanding of concepts, deeper engagement, increased time on task, and improved assessment grades (Kirkwood & Price, 2014). The current research study sought to improve the learning experience of traditional high school students assigned online math homework.

Online math homework within the K-12 setting has seen tremendous growth over the past 15 years. In the 2002-2003 academic school year, a total of 317,000 K-12 students took online courses (Herold, 2017). Just over 10 years later, this number had grown by nearly 900%, with 2.7 million K-12 students enrolled in online courses during the 2014-2015 academic school year (Herold, 2017). Although K-12 teachers within face-to-face classrooms have not implemented online math homework with the same frequency as their university counterparts, online math homework is becoming more prevalent in K-12 settings, as teachers become more comfortable with technology, web-based homework programs become more accessible, and virtual schools become more mainstream (Kim, Park, & Cozart, 2014). Additionally, the Florida Department of Education (2016) now requires all high school students to complete at least one online course prior to graduation. The current research study investigated high school students' perceptions about the online math homework environment within private, brick-and-mortar schools. The aforementioned environment is unique, as students attend regular math class each school day, are taught by a physical teacher in a classroom, yet are assigned math homework that can only be accessed and completed online. The online math homework environment explored in this study can be characterized as having the following traits: (a)

students are allowed to resubmit questions, (b) students receive immediate feedback on whether their response is correct or incorrect, and (c) the website provides students with hints and examples if they don't know how to solve a problem.

The current research study focused on high school students' perceptions about what aids and/or hinders their learning with online math homework, as the attitudes and perceptions of students have a significant impact on the learning process (Haines & Torres, 2016). This impact is particularly significant when new mediums such as online math homework are introduced into a face-to-face classroom (Brooks, 2003). For this reason, the current study explored only the views of participants who were enrolled in full-time, face-to-face classes at private, brick-and-mortar high schools. One of the most distinct differences between private schools and public schools is the source of funding, with public schools receiving funding from the government and private schools receiving funding through tuition (Choy, 1997). This difference in funding can lead to differences such as private schools having greater autonomy, greater flexibility with their curriculum, a stronger sense of community, and less diverse student populations (Sakellariou, 2017). In spite of these differences, public and private school educators practice similar teaching strategies (Choy, 1997) and when controlling for student characteristics, public and private schools generally receive comparable scores on standardized tests (Wolf, 2014).

Statement of the Problem

The problem addressed in this study is that online math homework does

not improve the learning experience of traditional high school students at private schools, and concerns continue to be expressed about whether online math homework is being used effectively (Kirkwood & Price, 2014). The problem in this study applies only to traditional students who are enrolled full-time at a brick-and-mortar institution and receive full-time, face-to-face instruction and does not include students enrolled in online classes. Therefore, this study explored traditional high school students' perceptions of online math homework in an effort to improve the learning experience that results from online math homework.

Purpose of the Study

The purpose of this study was threefold: to understand how high school students perceive online math homework, to determine what aspects of online math homework aid and/or hinder student learning, and to improve the student learning experience with online math homework. To meet this goal, this study explored the perceptions of traditional, high school students enrolled at private schools regarding online math homework. Specifically, this study explored what students viewed as aids and/or hindrances to learning with both online math homework and paper math homework. The study identified aids and hindrances to learning for both online and paper math homework to allow high school teachers and administrators to maximize the benefits of the online medium while minimizing hindrances to student learning when assigning online math homework.

As the use of online math homework grows within the K-12 setting, educators must incorporate online math homework in a way that enhances

learning. Through the use of quantitative and qualitative data collection and analysis, the researcher sought to address the overarching question posed by the director of the United Kingdom's Technology-Enhanced Learning Research Programme: "How can we design technology that enhances learning?" (Kirkwood & Price, 2014). Therefore, this research study was directed by the following research questions:

1. What are the perceptions of private high school students enrolled in daily, face-to-face math classes regarding both online and paper math homework?
2. What aspects of online math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?
3. What aspects of paper math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?

Significance of the Problem

Online math homework is a relatively new area of research, particularly in the K-12 setting. Several research studies regarding the effectiveness of online math homework in higher education have been conducted, yet very few rigorous published studies have been conducted in the K-12 setting (Means, Toyama, Murphy, Bakia, & Jones, 2009). For this reason, researchers have recommended that "future research needs to focus on different populations, particularly K-12 students" (Simonson et al., 2012, p. 84). Additionally, most research has not

addressed how to improve the design of online math homework (Kim et al., 2014).

The current research study contributed to the literature by focusing on online math homework within the K-12 setting, a setting that has often been overlooked. Specifically, the current research study explored online math homework within private, K-12 schools. Unlike public schools, which are funded by the government, private schools receive funding through tuition (Choy, 1997), which allows private schools greater autonomy and flexibility when implementing new technologies, such as online math homework (Sakellariou, 2017). Online math homework is already prevalent in higher education (Guo, Palmer-Brown, Lee, & Cai, 2014), and the current research study sought to identify which aspects of online and paper math homework serve as aids and/or hindrances to learning for high school students to determine whether these findings aligned with aids and/or hindrances to learning for students at the university level. Through the identification of aids and/or hindrances to learning with online math homework, the current research study allows educators and administers within the K-12 setting to improve the design of online math homework.

Limitations and Delimitations

The current study took all possible precautionary measures to maintain credibility/reliability and dependability/validity. However, several limitations were present and had to be taken into consideration. Students' past educational backgrounds, as well as their levels of exposure to both online and paper math homework prior to the study, are variables that could have affected study results.

Since all data were self-reported, the accuracy of student responses could also have an effect. The researcher collected data through online surveys and semi-structured focus groups. In the focus groups, the opinions of others in the group could have affected or changed the opinion of fellow participants.

Limitations regarding sample size included the fact that only students in the United States attending schools within the Association of Christian Schools International (ACSI) were interviewed. The researcher selected ACSI schools because the researcher is employed by an ACSI school and has professional relationships with other ACSI schools. Due to the nature of the participants in this research study, the sample may not be representative of all populations. Future studies should aim to examine a larger number of students at both private and public schools.

This study focused on the perceptions of online math homework from high school students enrolled in face-to-face math classes at private schools. More specifically, the study focused on exploring student perceptions of online and paper math homework; perceptions regarding the actual mathematics curriculum were not sought. The study did not take into account online homework for other subjects, such as literature or the sciences.

The perceptions of elementary, middle school, or college/university students were not researched, as the study only surveyed and interviewed high school students who attended ACSI member schools and were enrolled in daily, face-to-face math classes. ACSI schools are private schools with student demographics that often differ from those found in public schools. Although

demographic data was collected and presented as part of the analysis, students' personal characteristics (e.g., age, gender, or race) were not taken into account when analyzing the data itself. Additionally, the perceptions of students who have online math homework as a result of enrollment in an online class, such as through Florida Virtual School, were not taken into account.

Definitions

ACSI School	a school that is a current member of the Association of Christian Schools International, a 501(c)(3) religious nonprofit organization
Engagement	active participation in a course to promote retention and understanding for deeper learning (iNACOL, 2011)
Learning	a positive change in student understanding characterized by a richer understanding of concepts, deeper engagement, increased time on task, and improved assessment grades (Kirkwood & Price, 2014)
NOT Learning	when students do not reflect a richer understanding of concepts, deeper engagement, increased time on task, or improved assessment grades (Kirkwood & Price, 2014)
Medium	the modality in which math homework is presented; the two mediums addressed in this study are the online medium and the paper medium
High School Student	any student in ninth to 12th grade enrolled in full-time, face-to-face classes
Online Homework	homework where answers are submitted on the computer, usually with immediate feedback provided
Paper Homework	homework where answers are submitted using paper and pencil, with feedback typically provided by the classroom teacher
Traditional Student	any student enrolled full-time at a brick-and-mortar institution receiving full-time, face-to-face instruction

Theoretical Framework

The theoretical framework for this research study builds upon ideologies for three aspects of education (see Figure 1). Instruction outlines how curriculum is taught, and the current research study builds off the humanist ideals developed in the fourth century B.C. Next, the researcher looks at how the Conditions of Learning Theory and the Mastery of Learning Theory incorporate homework as part of humanist instruction. The last component of the framework looks at a new medium for homework – online math homework—examining best practices for this new medium.

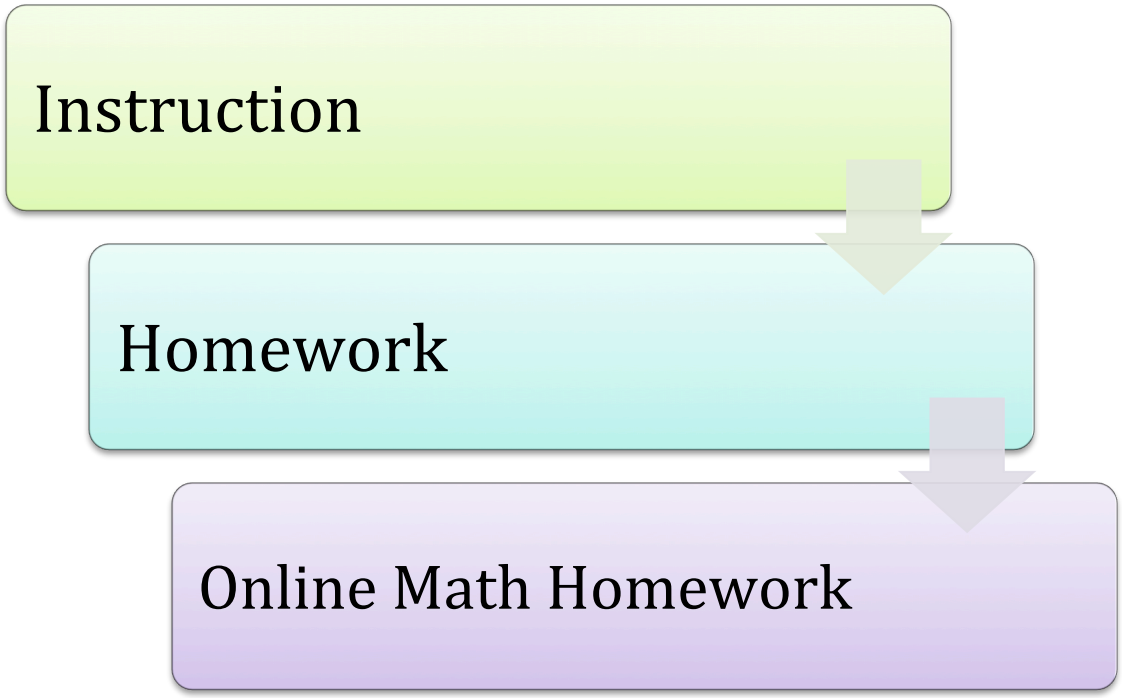


Figure 1. Theoretical framework. This figure illustrates how humanist instruction leads to homework, which in turn leads to online math homework.

Instruction

Dr. Martin Luther King Jr. (1947) wrote that the true goal of education is to teach one to not only to think critically but also to think morally. The humanist ideals of Dr. King (1947) developed in ancient Greece with Aristotle and his focus on reason. In his *Nichomachean Ethics*, Aristotle (trans. 2000) stated that knowledge is an end unto itself. Knowledge is not an instrumental good that should be sought after merely as a means to an end. Rather, Aristotle argued that knowledge and reason should be sought after for their own sake. Aristotle sought to understand the why and how of things over simply knowing the what.

Similarly, humanists in the 1800s focused on the why and how, seeing the functions of education as primarily developing the ability to think and secondarily learning content knowledge (Kliebard, 1987). Charles Eliot, who served as president of Harvard University during the late 1800s and early 1900s, summarized the humanist perspective by stating that critical thinking is necessary so that one is protected “from succumbing to the first plausible delusion or sophism he or she may encounter” (as cited in Kliebard, 1987, p. 9). Humanist ideals include the power of reason, sensitivity to beauty, and high moral character; subjects included within humanist curriculum include grammar, literature, art, math, geography, and history (Kliebard, 1987).

Homework

Instructional theorist Robert Gagné (1977) states that for knowledge to be gained, students must be allowed to practice thinking critically and developing solutions to new problems. In his Conditions of Learning theory, Gagné (1977)

outlines nine instructional steps that allow learning to occur. The last step of instruction in the Conditions of Learning Theory is “enhancing retention and transfer” (Gagné, 1977, p. 203). This step emphasizes the importance of repetition, as a “stimulus situation and its response need to repeated, or practiced, for learning to be improved and for retention to be made” (Gagné, Briggs, & Wager, 1992, p. 8). Although repetition does not improve learning or retention in all situations, there are situations – such as identifying geometric shapes – in which the need for repetition is very apparent to enhance retention and transfer (Gagné et al., 1992). Gagné et al. (1992) encouraged the use of homework for his last step of instruction and uses worksheets as an example of one way to enhance retention and transfer, as the student is able to practice newly learned skills. Gagné’s (1977) Conditions of Learning Theory also aligns with Bloom’s (1968) theory of Learning for Mastery. Bloom’s (1968) theory dictates that if proper instruction takes place, over 90% of students can master what is being taught. Bloom (1968) states that for learning to occur, it is crucial that enough time be allotted for learning. When Bloom’s (1968) philosophy is applied to Gagné’s (1977) theory, some of the time allotted for learning should be in the form of homework.

Harris Cooper, a leading expert on homework research, defines homework as “tasks assigned to students by school teachers that are meant to be carried out during noninstructional time” (as cited in Bembenutty, 2011, p. 340). Cooper states that for homework to lead to learning and mastery, homework should be meaningful and should be assigned in amounts that align

with students' stages of development and abilities (as cited in Bembenutty, 2011). Secondary to students retaining concepts through extra practice, homework benefits students by demonstrating that learning can occur during noninstructional time. This benefit can encourage students to become lifelong learners, along with promoting a sense of responsibility and time management within students (Bembenutty, 2011).

Online Math Homework

In keeping with Gagné's (1977) theory, math homework allows repetition of newly learned skills in order to enhance retention and transfer. However, the medium through which math homework is presented has seen a shift throughout the last 15 years. Online math homework has grown tremendously, and although it is more common in a university setting, high school students are now often assigned math homework online (Kim et al., 2014). Online math homework entails students viewing problems online, as well as submitting their answers to these problems online. Tallent-Runnels, Cooper, Lan, Thomas, and Busby (2005) outline seven best practices and guiding principles that should be taken into account when assigning math homework through this new online medium:

- provide helpful resources on the course site;
- let students have control over the pace at which they move;
- have copious discussions;
- provide timely feedback to students about their performance;
- provide technical support for students;

- remember that online study aids and step-by-step presentation might not make much difference in achievement;
- and evaluation can be enhanced in online courses.

The theoretical framework for this research study builds upon ideologies for three aspects of education: instruction, homework, and online math homework. The current research study relies on the humanist belief that mathematics is an important part of the curriculum. The current research study explores the subject area of mathematics, with a focus on math homework. Gagné's (1977) Conditions of Learning theory encourages homework as a way for students to practice newly learned skills, which will lead to greater retention of information that has been learned. Finally, the current research study examines the best practices for online math homework outlined by Tallent-Runnels et al. (2005) and compares them to student-identified aspects of online math homework that aid learning.

II. LITERATURE REVIEW

As with any issue in education, some researchers oppose the use of online homework, while others support it. One of the most significant hindrances observed in connection with online learning has been a point of discussion in education since the early 1900s: a lack of supervision. In early distance education courses, this problem was addressed through a supervised extension service. This service allowed a local high school to supervise students' distance learning assignments during a class period designated for this purpose (Clark, 2012). Another hindrance to learning in online math education is that students completing homework on the computer spent too much time learning how to enter mathematical notation on the computer, rather than learning the content addressed by the homework assignments (Jacobson, 2006). Some of the strongest arguments in favor of online homework include the following: online homework provides immediate feedback that enables students to better master the material by correcting their own mistakes; online homework eliminates a prevalent form of cheating by offering randomized variables in each question; and online homework allows teachers to grade daily homework for accuracy and not merely for completion (Bonham, Beichner, & Deardorff, 2001).

History of K-12 Online Education

Throughout the last two decades, the Internet has transformed education. However, the online education of today is built upon many of the distance

education practices of the past 200 years (Saba, 2013). Education was greatly impacted by the Industrial Revolution of the 19th century, and as new technologies emerged throughout the 1900s, these new technologies were used to deliver distance education (Clark, 2012). These methods ranged from print-based methods to audio, video, and web-based methods and were intended to provide access to education for nontraditional students (Peters, 2008).

Distance Education in the 1800s and 1900s

The precursor to online education was distance education, a term still used when talking about online education. The difference in terms is that while online education requires the use of a computer and Internet access, distance education does not necessarily use these tools. Distance education simply means the student and teacher are not located within the same building while learning takes place; student and teacher are at a distance, and technologies including books, radio, television, or the Internet are used to bring them together (Lee, 2017). As early as 1858, the University of London was providing distance education programs; most of these programs were targeted toward nontraditional students of that time, such as women and racial minorities (Haughey, 2010). In the United States, the University of Nebraska-Lincoln began the first, and most successful, K-12 distance-learning program in 1929 (Clark, 2012). Their program was funded through a $5,000 grant from the Carnegie Foundation. Within a short period of time, over 100 U.S. high schools had begun offering similar courses.

During that time, print-based materials, such as textbooks and handwritten letters, were the basis of distance education (Lee, 2017). However, the radio

became the first major electronic medium used in distance education during the 1920s and 1930s (Cleveland-Innes & Garrison, 2010). Radio was mostly used in supplemental instruction and not as the main form of teaching. The 1921 Ohio School of the Air was the first education radio system, but the Wisconsin School of the Air became the nation's longest running education radio system and operated from 1930 to 1975. At its peak in 1966, the Wisconsin School of the Air enrolled about 330,000 students (Clark, 2012). Educational radio systems focused on the strength of the radio to stimulate active involvement and imagination. As Clark explains, "They built opportunities for community participation through contests, festivals, and events, and forged personal connections between students and radio instructors. These approaches remain relevant for K–12 online learning today" (2012, p. 587). Educational film was first introduced in a New York public school in 1910, and educational television programming for K-12 students began in 1933. However, the use of educational television broadcast for full K-12 courses has been rare (Clark, 2012).

As more technologies developed, distance education evolved, growing quickly during the 1960s and 1970s (Lee, 2017). In 1965, Suppes, Jerman, and Groen began to experiment with computer-based learning in a fourth-grade classroom, and in the late 1970s, the telephone began to be used in K-12 distance education (as cited in Clark, 2012). The National Science Foundation (NSF) founded the NSFNET in 1985, which allowed users to communicate in real time; the NSFNET soon became known as the Internet (Simonson et al., 2012). Just as the Industrial Revolution brought about changes to traditional education,

the Internet revolutionized distance education in an even more dramatic fashion.

Online Education in the 1990s and the 21st Century

In the early 1990s, the Internet was primarily used in education for e-mail, online discussion groups, and file transfers (Simonson et al., 2012). However, the first online K-12 learning program began in 1991 (Barbour, 2012), and the first entirely online school, Florida Virtual School, opened in 1997 (Simonson et al., 2012). Despite these online learning programs, online education had yet to take off in the K-12 setting, and less than 0.001% of all K-12 students within the United States were enrolled in online classes in the 2000-2001 school year (Barbour, 2012). During the 2010-2011 school year, 10 years later, nearly 6% of K-12 students were enrolled in online classes, representing a growth of 6,000% (Barbour, 2012). A similar growth of online education can be seen in higher education, as by 2010, 90% of public universities offered online courses, and 85% of public universities stated that online education was critical to their long-term academic goals (Simonson et al., 2012).

Much of the growth of online education can be attributed to new web applications and tools that emerged in the early 2000s, promoting collaboration, networking, and sharing. These tools included online blogs, wikis, podcasts, social networks, and virtual worlds. These new tools changed both the online world in general and the online world of education and would come to be known as Web 2.0 (Simonson et al., 2012). Online education continues to grow as students gain more access to technology at home. In 1984, just prior to the birth of the Internet, only 8.2% of households in the United States had a computer

(File & Ryan, 2014). More than 10 years later, in 1997, only 18% of households reported home Internet use (File & Ryan, 2014). By the year 2013, these numbers had grown, with 84% of households owning a computer and 74% of households reporting Internet use (File & Ryan, 2014).

Additionally, the growth of online learning in education can be attributed to greater access to technology among K-12 students and teachers. The Telecommunications Act of 1996 resulted in the distribution of more than $26 billion to schools to improve schools' telecommunications infrastructure (Simonson et al., 2012). In 1994, only 35% of schools in the United States had access to the Internet (Bybee, Powell, & Trowbridge, 2008). Today, nearly 100% of schools have Internet access, and from 2012 to 2014, computer sales to K-12 schools in the United States nearly doubled, from $5.16 million to $9.10 million (Molnar, 2015). Additionally, in the year 2016, public schools within the United States had at least a 1:5 computer-to-student ratio (Herold, 2016). Scholars, such as Molnar (2015), predict that within the next year, half of all K-12 students and teachers will have 1:1 computer access.

The increase of online learning in K-12 settings is not unique to the United States and has followed a similar growth trend in other parts of the world, such as Canada (Barbour, 2012). Additionally, as postsecondary online learning grows, pressure is placed on K-12 students to experience online learning before college (Clark, 2012). As stated by Simonson et al. (2012), "online K-12 learning is growing and here to stay" (p. 68). Therefore, it is crucial that educators and administrators seek to increase students' learning gains when employing online

homework.

Best Practices for Online Math Homework

Tallent-Runnels et al. (2005) wrote an article seeking to increase faculty members' understanding of effective ways to teach online and to help faculty members make research-informed decisions regarding online course design, course management, course learning environment, and course evaluation. The article provided seven best practices for teaching online, each of those practices backed by research. The seven best practices and guiding principles identified are as follows: provide helpful resources on the course site; let students have control over the pace at which they move through the course; have copious discussions; provide timely feedback to students about their performance; provide technical support for students; online study aids and step-by-step presentation might not make much difference in achievement; and evaluation can be enhanced in online courses (Tallent-Runnels et al., 2005). Although instructors can implement best practices when using online math homework, research has shown that some aspects inherent to online math homework and paper math homework can either aid or hinder student learning.

Online Math Homework Enhances Learning

One of the greatest arguments in favor of online homework is that online homework provides immediate feedback, enabling students to better master the material by correcting their own mistakes (Bonham et al., 2001). Another aspect of online math homework viewed by many as an aid to learning is this: online homework eliminates an easy form of cheating by offering randomized variables

in each question (Bonham et al., 2001). In addition, online homework allows teachers to grade daily homework for accuracy and not merely for completion (Bonham et al., 2001).

Despite disagreements over the effectiveness of online homework, several studies have shown that online homework does lead to student learning gains. A study conducted by Burch and Kuo in 2010 compared multiple sections of a College Algebra course; one section completed online homework while another section completed homework with paper and pencil. The study, conducted over the course of a year, employed an online homework system created by Pearson Education and integrated with the course textbook. The online homework system allowed students multiple attempts at problems with both hints and examples; instant feedback was also provided for every problem (Burch & Kuo, 2010). Data such as in-class exam scores, final exam scores, and homework averages were collected from both College Algebra sections. After analysis of the data, researchers found that students who used the online homework system performed better on the exams (Burch & Kuo, 2010).

A study conducted by Mendicino, Razzaq, and Heffernan (2009) displayed positive results for the use of online homework in the elementary grades, using 28 fifth-grade students. The students were divided into two sections. The first section completed paper-and-pencil homework, followed by a review of problems in class the following day, while the second completed homework online that provided immediate feedback in the form of hints on demand and step-by-step scaffolding (Mendicino et al., 2009). The results were analyzed, indicating that

students learned significantly more when given computer feedback than when completing traditional paper-and-pencil homework (Mendicino et al., 2009).

Many studies looking into online mathematics homework seek to explore the effects of online mathematics homework. Much past research has either focused on a comparison of student performance in online and face-to-face environments or examinations of the qualities and characteristics of the online learning experience. When comparing online and face-to-face environments, researchers often try to determine whether online homework leads to an improvement in academic performance in comparison with traditional, paper homework (Kodippili & Senaratne, 2008).

Kodippili and Senaratne's (2008) study compared the aforementioned aspects of two sections of a required, undergraduate College Algebra course. The course covered topics that included equations, inequalities, and functions, and student grades were determined by performance on homework assignments, chapter tests, a final examination, and a research project. In all, 72 students participated in the research study. The study was conducted using two mathematics professors, each of whom taught two sections of College Algebra. Each professor then randomly selected one of their class sections to utilize paper homework, while the other implemented computer homework using MyMathLab. Both professors had used the online homework program in the past and were familiar with the software. The online homework program allows students three opportunities to answer a question correctly. If students answer incorrectly on the first attempt, the program provides suggestions for how to solve the math

problem. On the third incorrect attempt, the program provides the correct answer. However, students have the ability to request a similar problem until they answer correctly (Kodippili & Senaratne, 2008). The mean score for students who completed traditional, paper homework was 67.4%, while the mean score for students who completed homework using the online program was 73.7%. However, after a *t*-test, the *p*-value was not significant, and there was not enough evidence to conclude that students performed better as a result of completing online homework rather than paper homework (Kodippili & Senaratne, 2008).

While Kodippili and Senaratne's (2008) findings did not demonstrate a significant impact on students who completed online mathematics homework, the study does provide additional insight into the unseen benefits of online mathematics homework. Researchers stated that online mathematics homework allowed "faculty to spend more time with students; as homework grading is transferred to MML [MyMathLab], students can learn according to the style and pace that best suit them" (Kodippili & Senaratne, 2008, p. 931). However, the study also acknowledged its limitations and suggested that future studies be conducted with a more selective group of participants, looking into variables like age and gender, instead of a randomly assigned group. Additionally, researchers suggested that future studies use larger sample sizes and attempt to control discovered variables, such as students receiving outside tutoring help.

Paper Math Homework Enhances Learning

One of the strongest hindrances of online learning has existed since the early 1900s: a lack of supervision. In early distance education courses, this

problem was addressed through a supervised extension service (Clark, 2012). In this type of supervised correspondence study, “the local high school secures the lessons, provides periods in the regular school day for study, supervises the pupils’ work, and returns the lessons to the correspondence study center,” which prepares and grades the lessons (Clark, 2012, p. 556). Another hindrance to learning in online math education is the amount of time students completing online math homework spend learning how to enter mathematical notation on the computer, compared to the time spent learning mathematical concepts (Jacobson, 2006).

A study conducted by Duhon (2012) evaluated second graders’ math fact fluency gains across both paper and computer modalities. The purpose of the study was to determine if gains made as a result of computer-based instruction and practice would improve student performance when using traditional, paper-and-pencil assessment techniques. Additionally, the study sought to determine if paper-and-pencil practice would also result in generalized improvements on a computer assessment (Duhon, 2012).

Duhon’s (2012) study involved 32 second-grade students attending a public elementary school in the Midwest. The students were randomly assigned to either paper-and-pencil or online pre- and post-tests. Each group was then further broken down into either paper-and-pencil practice or computer practice throughout the study. The pretest served to establish an individual baseline level of performance for each participant, based on basic knowledge of math facts. The participants practiced basic math facts once a day for 20 days, and after the

20-day practice period had ended, participants completed a post-test assessment, on either computer-based or paper-and-pencil modalities matching the form of their pretest assessment (Duhon, 2012).

Pretest scores were significantly higher for students assessed using the paper-and-pencil modality, with students scoring 10 points higher than those assessed using the computerized pretest. From the group of students who were *assessed* using paper and pencil, those who *practiced* with paper and pencil made significantly higher learning gains (12 more questions correct) than those who practiced on the computer (3.5 more questions correct). From the group of students who were *assessed* with the computer format, those who *practiced* with the computer-based instruction made only slightly higher gains (13.3 more questions correct) than the students who practiced with paper and pencil (11.1 questions correct). “These results indicate that although the gains obtained through paper-and-pencil practice generalized to the computer performance, computer practice did not result in gains that generalized to the paper-and-pencil performance” (Duhon, 2012, p. 343). The results from Duhon’s (2012) study directly relate to the problem being addressed in the current study. Although learning gains may occur as a result of online math homework, those gains do not necessarily transfer to other modalities, and are therefore not true learning gains (Duhon, 2012). Those findings contrast with learning gains made through paper math homework, which do transfer to other modalities, and are therefore considered more valuable learning gains.

Challenges of Online Math Homework

Mathai and Olsen (2013) conducted a study to assess the effectiveness of online homework. The study focused on this topic because many colleges and universities have incorporated online homework within the last 20 years. “Many institutions report that their primary motivation for using software is to promote better learning in first-year courses” and that “the purpose of this tool is to enhance student engagement in the course outside the classroom” (Mathai & Olsen, 2013, p. 671). The study took place at a private military college in Vermont with roughly 2,000 undergraduate students enrolled. The study focused on two sections of students in a College Algebra course composed predominantly of freshmen. The first section, with 29 students, was assigned paper-and-pencil homework, while the second section, with 48 students, was assigned online homework through MyMathLab. The homework assignments for the two sections were very similar in both content and size, but students who completed the online homework received immediate feedback on responses, as well as step-by-step examples of how to complete each problem (Mathai & Olsen, 2013).

The mean exam score for students who had completed online homework was 71.3%, and the mean exam score for students who had completed paper homework was 66.4%. However, after analysis, the study found that there was no significant difference in the scores. This led Mathai and Olsen (2013) to conclude that homework performance alone was not a strong indicator of performance on the final exam.

One limitation of Mathai and Olsen’s (2013) study was its small sample

size. However, the researchers intentionally chose to use a small sample size to reduce the effects of other variables, such as extracurricular activities that take place in the fall semester. Another limitation was that the sample was not selected randomly and thus cannot be completely generalized. The study suggests that although there are not definitive results about the effects of online homework, it is important to realize that students learn differently. Therefore, an implication of the study is that a combination of both online and paper homework could prove to be beneficial. The results also demonstrate that students with stronger math skills improved after online homework, but students with weak math skills did not. Therefore, further studies regarding that disparity should be conducted (Mathai & Olsen, 2013).

Online homework is available for students of all ages, from elementary school to the university level, and studies concerning online mathematics homework have been conducted at the university level. One study sought to increase student participation and performance in an undergraduate math course through online homework, as Locklear (2012) investigated whether online homework was truly more effective than traditional paper homework at improving students' mastery of the course content. By utilizing data from both the online assignments and the traditional paper-and-pencil assignments, this study considered whether the students became more engaged in the course (as measured by percent of assignments attempted), whether their understanding of the subject matter improved (as measured by exam scores), the difference the assignment style made in overall course performance (as measured by final

grades), and whether students' overall feelings about the course improved (as measured by a student survey). The ultimate goal of this study was to enable students to be successful in a college-level math class (Locklear, 2012). Data for the study was collected between 2007 and 2011 and included course outcome scores, as well as perceptions related to the course, from students using the MyMathLab system of online homework (n = 174) and those who were given traditional homework assignments (n = 107). Results of two sample *t*-tests showed no difference in exam scores, overall course grades, or interest in the course; however, the number of homework attempts was statistically higher in the MyMathLab group (Locklear, 2012).

One review of the literature conducted by Tallent-Runnels,et al. (2006) found that learning in an online environment can be as effective as in traditional classrooms. However, Tallent-Runnels et al. (2006) emphasized that both methods depend on the quality of instruction. Therefore, online instructors must design courses with care, and further research must be conducted to investigate the features of online teaching that will most benefit students (Tallent-Runnels et al., 2006).

Student Perceptions of Online Math Education

Research shows that the attitude of students has a significant impact on the quality of learning with distance education (Brooks, 2003). Previous studies conducted on student perceptions of online and paper math homework have suffered from issues like discrepancies in participation rates between mediums, as in one study where only 65% of online students participated, compared to

95% of face-to-face students participating in one study (Barbour, 2012). In qualitative studies, some studies have collected data through interviews while others only used observations (Barbour, 2012). However, very few studies have enough data to be able to properly triangulate information, meaning that more data needs to be collected (Barbour 2012).

A study conducted by Jacobson (2006) that delved into student perceptions about online math education sought to explore the effectiveness of computer homework in developmental mathematics. The study examined the effects that computer homework had on course exams in comparison to the control group, where students completed traditional, paper homework, while both groups took the same course exams. The researcher also explored student perceptions of computer homework (Jacobson, 2006).

The sample in Jacobson's (2006) study consisted of four sections of a College Pre-Algebra course, the lowest level math course taught at the university where the study took place. Students are required to take this course before College Algebra if they scored below a 23 on the ACT. There were 142 students in the two experimental sections and 134 students in the two control sections. All procedures were identical in the four sections, except for whether the students were assigned computer or paper homework. Students who completed paper homework were assigned problems to complete out of the textbook. Students who completed computer homework used the textbook software and were allowed to complete problems in practice mode as many times as they wanted to before they submitted their online homework to be graded. All students took their

exams using paper and pencil (Jacobson, 2006).

The data demonstrates that although students provided positive evaluations about their computer experience with homework, their exam grades did not reflect those high opinions. Students who were assigned paper homework actually performed better on course exams than students who completed computer homework. The mean score on exams among students who completed paper homework was 73.5%, while the mean score on exams among students who completed computer homework was 68.8%. After presenting the data, Jacobson (2006) discusses student perceptions regarding learning:

> Students fail to make the best choices when managing their own instruction, students are inaccurate in assessing their own knowledge states, and of most relevance, other researchers have shown a lack of correlation between student ratings of software effectiveness and objective measures of learning. (p. 6)

Based on the results, Jacobson (2006) recommends that academic institutions not depend solely on student opinion to decide which policies and procedures to implement. Additional studies have also found student perceptions to vary according to the extent of online experience, difference in age, and the sex of the participant (del Carmen, Dobbs, & Waid, 2009).

Although Jacobson's (2006) research demonstrated that computer homework did not lead to higher exam scores, the research did not investigate whether mathematics practice on the computer can help students learn. Further research should investigate the effects of combining both paper and computer

homework. Additional research should also investigate the results of both the instructor and the students having more time to familiarize themselves with the online math software (Jacobson, 2006).

Mullen and Tallent-Runnels (2006) conducted a study to examine the differences in how students perceived online and traditional support and demands from instructors, to determine how a number of factors—including motivation, self-regulation, satisfaction, and perceptions of learning in class—related to students' outcomes. The purpose of the study was clearly stated, and the study's participants were composed of graduate students from a large university in the southwest. Most participants were predominantly Caucasian. The study clearly states the sampling plan. Students in both an online class and a traditional class were given a demographic survey to complete. Using the results of the survey, 10 students were asked to participate in interviews. The interviews asked questions to help determine whether students perceived a difference in the structure of online and traditional classrooms that influenced their motivation and self-regulation. Student responses to the interview questions were audio recorded, transcribed, and examined for consistency and variance in responses. The study did not clarify what method of coding was used (Mullen & Tallent-Runnels, 2006).

The reports of the study found that students in online classes and traditional classes perceived classroom environments differently. The most notable difference was in student perception of affective support from their instructor; affective support demonstrates to students that instructors care

through listening, encouraging students to share ideas, using personal examples, and providing humor. Students in traditional classrooms reported higher levels of affective support. The researchers also made an important design decision by choosing to mention the outlier. Only one student expressed that synchronous online discussions were a waste of time and did not provide any important information. However, the student's sentiments were so strongly expressed that the researcher devoted half a paragraph to the student's feelings and how they related to student motivation. The results indicated significant differences in students' perceptions on all variables except for self-efficacy (Mullen & Tallent-Runnels, 2006).

A study conducted by Altun (2008) had the purpose of determining the attitudes of middle school students toward online homework. The researcher administered a survey to 737 students in Turkey and covered four topics, including personal information, reasons for using online homework, attitudes toward online homework, and suggestions for online homework. A five-point Likert scale was used to measure attitudes toward online homework (Altun, 2008). The results of the study indicated that 86.7% of the students used online homework in some way, and these students had positive attitudes toward online homework. Gender, school, grade, age, computer proficiency and frequency of use, Internet use frequency, and education levels of parents appeared to have a statistically significant effect on the students' attitudes toward online homework (Altun, 2008).

Entering into a different area of mathematics, Smolira (2008) examined

student perceptions about online homework assignments within a finance class. Students from three finance classes—two undergraduate and one graduate—participated in the study. The online homework program used was Homework Manager, which uses problems from the end of course textbook chapters in an online format (Smolira, 2008). However, unlike those used in the Bonham et al. (2001) study and my own action research study, there were differences between the textbook and online versions of the homework problems. While paper homework problems from the textbook were open ended, when transferred to the online format, problems were often reworded to create fill-in-the-blank questions (Smolira, 2008).

At the end of the study, a questionnaire was administered to students in all three classes, to gauge their perceptions of the effectiveness of online homework. The results of the study showed that, overall, students preferred online homework to paper homework and felt that online homework increased their understanding of the course material (Smolira, 2008). The researcher deemed one question from the survey the most important: whether students perceived online homework assignments as helpful at improving their understanding of finance. This question is similar to the most important question in my survey, which dealt with asking students about their understanding of course concepts. The responses to this survey question in Smolira's (2008) study were extremely positive, with 84% of undergraduates stating that online homework was helpful and 88% of graduate students indicating that it was helpful. Smolira (2008) identified a potential reason for students' preference of

online homework, stating that students might have preferred the online format due to the immediate feedback provided.

Instantaneous feedback is just one of the many arguments presented by proponents of online homework. As seen in the 2011 study conducted by Drelick, Henry, Richards-Babb, and Robertson-Honecker, many instructors are also in favor of online homework due to the incredible amount of time it saves them. In this study, the researchers aimed to improve undergraduate students' retention rates by introducing online homework into the chemistry curriculum. The participants included students from four different sections of General Chemistry, all taught by the same instructor (Drelick et al., 2011).

At the end of the semester, a survey was administered to students in the four chemistry sections. Student participation was voluntary and anonymous (Drelick et al., 2011). The survey consisted of 36 Likert-type statements, four demographic questions, and four free-response questions (Drelick et al., 2011). The results of the survey used by Drelick et al. (2011) indicated that students' attitudes toward online homework were generally positive, with 86% of students stating that online homework should continue. Additionally, 84% of students viewed the online homework as worth the effort, 91% of students viewed the homework as relevant, and 83% viewed the online homework as challenging. The professor involved in the study conducted by Drelick et al. (2011) chose to continue using the method of homework students preferred the most; additionally, the professor benefitted from this method as it saved significant time otherwise spent assessing homework.

Studies have found that student perceptions often differ from faculty perceptions regarding online courses. Otter et al. (2013) conducted a study in which two separate but equivalent surveys were developed to compare student and faculty perceptions of online courses. Only faculty who had taught the same course using both traditional and online formats participated, and only students who had taken both online and traditional courses participated. Both students and faculty answers surveys; both surveys measured: (a) perceptions of online versus traditional courses; (b) perceptions of students who take online courses and students' motivations for taking online courses; (c) perceptions of faculty members who teach online courses; and (d) demographic characteristics (Otter et al., 2013).

Out of the 25 questions, responses to 12 questions showed significant differences between faculty and student perceptions as determined by a Pearson correlation analysis. The study found that students are more likely than faculty to see online courses as self-directed. Additionally, students are more likely to believe that online students must be willing to teach themselves. The students in online classes also felt more disconnected from professors and peers than the faculty believed them to be. In addition, faculty tended to see the role of the professor as more critical to the success of online courses than students did (Otter et al., 2013).

Summary of Literature Review

This review of the literature provided a basis for the research study, which aimed to understand students' perceptions of online and paper math homework.

Since the current research study implemented both quantitative and qualitative components, it was important to include literature reflecting this approach. Although none of the included research studies adhered to the convergent design used in the current study, the literature review did include both quantitative and qualitative studies. As seen in Table 1, the research and literature highlighted a variety of aspects of online math homework that contribute to student learning and growth.

Table 1

Favorable Aspects of Online Math Homework Mentioned in the Literature

Favorable aspects of online homework	Research study
immediate feedback	Bonham et al., 2001; Kodippili & Senaratne, 2008; Smolira, 2008; Mendicino et. al, 2009; Burch & Kuo, 2010; Mathai & Olsen, 2013
examples and hints	Mendicino et. al, 2009; Burch & Kuo, 2010; Mathai & Olsen, 2013
multiple attempts	Kodippili & Senaratne, 2008; Burch & Kuo, 2010
eliminates cheating	Bonham et al., 2001
graded for accuracy	Bonham et al., 2001
more faculty/student interaction	Kodippili & Senaratne, 2008

The current research study explored how students perceived the aids or hindrances to learning within both online and paper math homework. This provided the field of online mathematics education with a scholarly consideration

of the student mindset and experience of online math homework, particularly in regard to aspects of online and paper math homework that hinder student learning. The current published research centers on whether online math homework is better or worse for students than paper math homework and tends to address positive aspects about online math homework. However, there is an opportunity for research growth to focus on how to improve the learning environment when students are assigned online math homework. Additionally, there are still gaps in the literature concerning specific aspects of online and paper math homework that have either hindered student learning or not provided significant aid to student learning. Further research is needed to investigate both student- and teacher-controlled factors that can aid or hinder learning in an online math environment.

III. METHODOLOGY

The purpose of this study was threefold: to understand how high school students perceive online math homework, to determine what aspects of online math homework aid and/or hinder student learning, and to improve the student learning experience with online math homework. The study explored what aspects of online homework were viewed as aids or hindrances to improve the learning gains that occur through the medium of online math homework. The purpose of this study was not to determine which medium is best, but rather to explore what aspects of each medium can contribute to a positive, equivalent learning experience (Simonson et al., 2012, p. 64).

With this purpose in mind, this study's methodology was designed to best explore the research questions. Through the chosen methodology, the researcher sought to discover the perceptions of high school students enrolled in face-to-face math classes regarding the quality of learning with both online and paper math homework. Additionally, the methodology was meant to explore what aspects of online and paper math homework hinder or aid student learning and to use descriptive statistics in creating associations among student perceptions. Therefore, this research study was directed by the following research questions:

1. What are the perceptions of private high school students enrolled in daily, face-to-face math classes regarding both online and paper math homework?

2. What aspects of online math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?
3. What aspects of paper math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?

Study Design

This research study involved both a quantitative and a qualitative component and employed a convergent design that facilitated the use of both of these methodologies (Creswell & Plano Clark, 2011). Convergent design merges both quantitative and qualitative methodologies, with both approaches equally important to the analysis. A convergent design also allowed for the use of concurrent timing throughout the study, in which both the quantitative and qualitative elements were completed in the same stage (Creswell & Plano Clark, 2011). Both qualitative and quantitative data were collected in the same stage, and qualitative and quantitative data were analyzed simultaneously, allowing for synthesis of complementary quantitative and qualitative results, to develop a more complete understanding of the phenomenon of online math homework (Creswell & Plano Clark, 2011). The timeline that was used for data collection is illustrated in Figure 2:

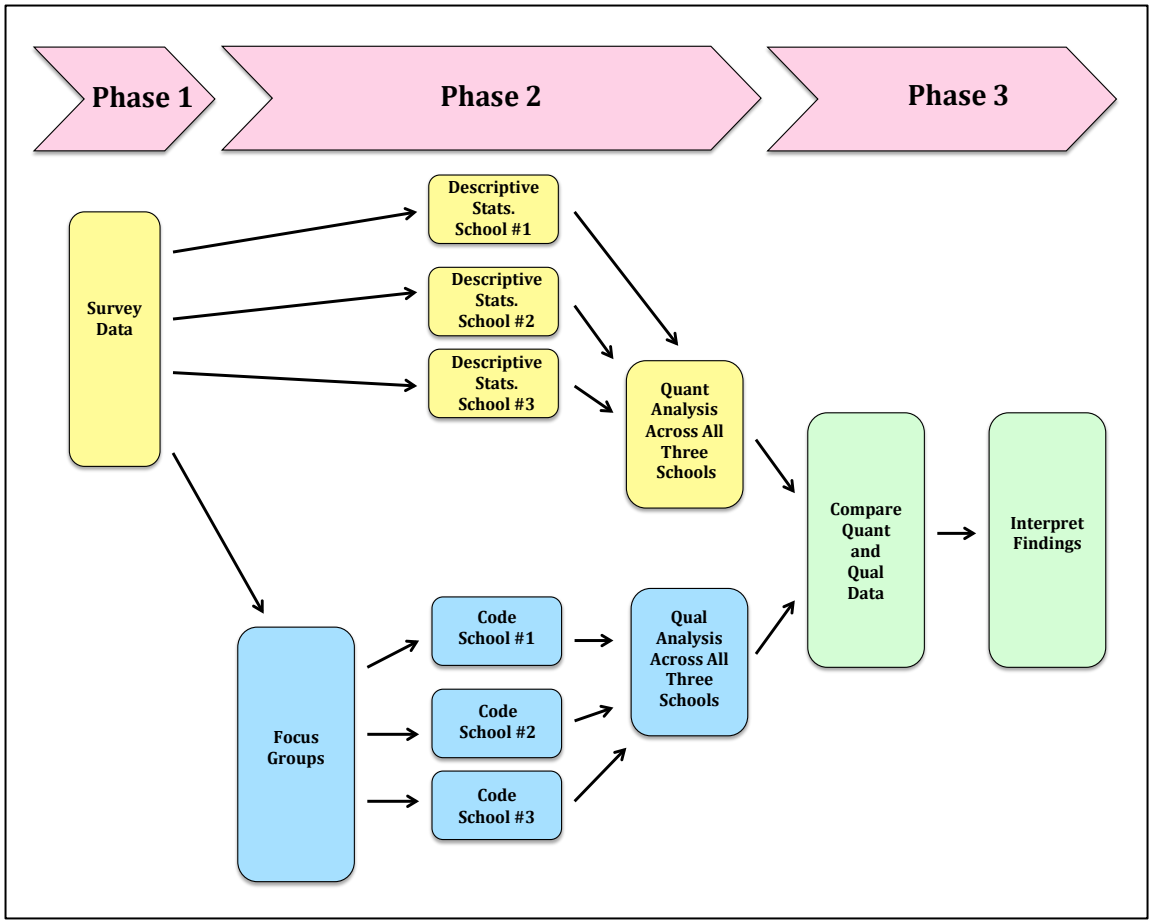


Figure 2. Parallel data collection timeline.

A convergent design supports a parallel data collection method, in which the researcher asks parallel questions in both the qualitative and quantitative instruments (Creswell & Plano Clark, 2011). In keeping with convergent design, parallel items were included on both the qualitative focus group protocol and the quantitative survey that addressed the same topic or idea. Table 2 delineates how the survey and focus group protocols employed parallel questions that addressed the same topic but were presented in quantitative and qualitative instruments, respectively:

Table 2

Parallel Quantitative and Qualitative Items

Research question	Relevant survey item	Relevant focus group protocol item
What are the perceptions of private high school students enrolled in daily, face-to-face math classes regarding both online and paper math homework?	12, 13, 14, 17, 18, 19, 20, 22, 29, 30	11, 12, 13, 14, 15
What aspects of online math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?	10, 15, 16, 21, 25, 26, 31, 32	1, 2, 3, 4, 5
What aspects of paper math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?	11, 17, 23, 24, 33, 34	6, 7, 8, 9, 10

Subjects

The participants for this study consisted of high school students enrolled full-time in face-to-face classes at schools in the United States that belong to the Association of Christian Schools International (ACSI). ACSI is a Christian educational organization founded in 1978 whose goal is to advance excellence in Christian education. The vision of ACSI is to develop schools that contribute to the public good through effective teaching and learning that is biblically sound, academically rigorous, socially engaged, and culturally relevant (ACSI, 2017). ACSI has nearly 24,000 member schools in more than 100 countries. A total of 3,000 ACSI member schools (K-12) are located in the United States (ACSI, 2017).

Quantitative Subjects

The participants for the quantitative component of this study consisted of 64 high school students from three ACSI schools in the southeastern United States. The researcher chose to survey students at ACSI schools because the researcher worked at an ACSI school and had professional relationships with other ACSI schools. The participants were chosen through non-probability sampling, and the researcher did not rely on randomization to select participants (Creswell & Plano Clark, 2011). In order for participants to be able to answer all questions in the survey, students must have had both online and paper math homework while in high school. Therefore, randomization was not possible for this study. The type of non-probability sampling used was purposive sampling, in which members of a particular group were purposefully sought after (Creswell & Plano Clark, 2011). The only participants asked to complete the survey were those who had been confirmed by their teachers to meet the following criteria: they were students in ninth to 12th grade, enrolled full-time in face-to-face classes, and had been assigned both online and paper math homework within three years of the beginning of the study.

Qualitative Participants

The participants for the qualitative component of this study consisted of 14 high school students from two ACSI schools in south Florida. The researcher was scheduled to conduct three focus groups, one at each of the three research sites. However, the researcher was only able to conduct a focus group at the first and third sites. When the researcher administered the survey to students at the

second site, several students indicated their willingness to participate in a focus group and provided their contact information (Survey item 8). However, despite the researcher making several attempts to contact these students via email, none of the students at the second research site responded. Therefore, after consulting with her faculty advisor, the researcher was obligated to proceed with the study with only two focus groups.

The students who participated in the focus groups were selected from the pool of 64 students who participated in the quantitative survey. The qualitative portion of this study collected data from two focus groups, each group consisting of seven high school students from the same ACSI school. The participants were chosen through criterion sampling. All participants had to meet the following criteria: be a ninth through 12th student enrolled full-time in face-to-face classes and have been assigned online math homework within the past three years, as well as paper math homework within the past three years. Personal characteristics of the participants, such as gender or race, were not taken into account when selecting participants.

Procedures

The researcher proposed this research study on January 9, 2017. After the researcher's dissertation was approved, the researcher made changes to the study based on suggestions by the dissertation committee (See Appendix B for Timeline of Study). In February 2017, the researcher attended a Christian Schools Conference. During the conference, the researcher met with faculty and administrators from ACSI schools and discussed the possibility of conducting

research at their respective institutions.

During the spring of 2017, the researcher contacted the administrators at each of the three research sites and confirmed participation in the study (See Appendices H, I, & J). Additionally, administrators at all three research sites provided the researcher with a faculty liaison with whom the researcher would correspond in the future. The researcher submitted her research proposal to the IRB, and the IRB granted the study research approval on March 23, 2017 (See Appendix C). The IRB did not require the researcher to make any adjustments to obtain approval.

Following IRB approval, the researcher contacted the faculty liaisons at each of the three research sites to coordinate the process of obtaining parental consent forms from students, as well as to schedule visits for administering surveys and conducting focus groups. At the beginning of the week during which the researcher was scheduled to administer the survey at each research site, the researcher contacted the faculty liaison to confirm the date and the distribution of parental consent forms. The researcher then traveled to each research site, administering the survey at all three sites. All surveys were administered during the last week of April 2017 or the first week of May 2017.

Upon receiving survey data from all three research sites indicating which students were willing to participate in focus groups, the researcher contacted those willing students via e-mail, thanking them for their participation and asking which of two dates and times would work best for the focus group. Both focus groups were scheduled for afternoons in May 2017, and once the researcher had

conducted the focus group at the last site, data collection officially ended.

Quantitative Approach

This research study employed descriptive statistics as the quantitative methodology used to analyze data. To gain an understanding of students' perceptions regarding online math homework, descriptive statistics were conducted for each individual ACSI school. Through analysis of patterns and frequencies in students' responses, the study identified students' perceptions of online and paper math homework. Once each school had been analyzed individually, the data was also analyzed across all three schools to determine whether tendencies in student attitudes toward the aids and hindrances of online math homework extended across all three schools.

Survey

The survey contains a total of 25 items, not including the demographic questions. The first 21 survey items were adapted from both Koc and Liu's (2016) *An Investigation of Graduate Students' Help-Seeking Experiences, Preferences, and Attitudes in Online Learning* and Nam and Zellner's (2010) *The Relative Effects of Positive Interdependence and Group Processing on Student Achievement and Attitude in Online Cooperative Learning.* The researcher obtained permission from Koc, Liu, Nam, and Zellner to adapt the survey in order for the items to be better suited for high school students and their perceptions of online and paper math homework (See Appendices D, E, & F for Letters of Agreement). The last four survey items were open-ended questions in which students typed responses into a comment box.

Koc and Liu (2016) surveyed a total of 26 graduate students who had taken at least one online course. Koc and Liu's (2016) survey focused specifically on student attitudes toward seeking help with online homework. The current research study took a broader approach toward online math homework by asking about high school students' perceptions about online math homework in general, as well as perceptions of what aspects of online math homework aid or hinder learning. Nam and Zellner (2010) surveyed 144 undergraduate students who were enrolled in an online course at the time of the study. Nam and Zellner's (2010) survey focused specifically on student attitudes toward cooperative learning in online environments. Although the current research study did not specifically address cooperative learning, several of the survey items from Nam and Zellner's (2010) study addressed student perceptions about online homework in general.

The researcher made every attempt to keep survey items as close to the original wording as possible. Some changes were necessary to make survey items appropriate for the Likert-type scale used in this study and to make survey items easier to read and understand for high school students. When verbiage had to be changed, the researcher made every effort to preserve the original spirit of each survey item. See Figures 3 and 4 for examples of how survey items from the Koc and Liu (2016) instrument and the Nam and Zellner (2010) instrument were adapted for this research study.

Koc & Liu (2016)	Adapted for this Study
To what extent do you feel that online classes are structured to provide help for students when they have questions about the subject matter content? (Item 18)	Online math homework provides me with resources that help me solve my problems. (Item 10)

Figure 3. Example of adapted survey item from Koc and Liu (2016).

Nam & Zellner (2010)	Adapted for this Study
I prefer online learning activities to face to face learning activities. (Item 9)	I would rather have online math homework than paper math homework. (Item 12)

Figure 4. Example of adapted survey item from Nam and Zellner (2010).

Although the items from the Koc and Liu (2016) instrument employed a three-point scale, the Likert scale found in the Nam and Zellner (2010) instrument was used for 21 of the 25 survey items in this study. The Likert scale was used to maintain continuity throughout the survey. The researcher also added a column to the Likert scale to provide students with the ability to decline response. The six response options for the survey items were: Strongly Disagree (1), Disagree (2), Somewhat Disagree (3), Somewhat Agree (4), Agree (5), Strongly Agree (6), and "I prefer not to answer" (7).

Validity and Reliability

Validity is the extent to which survey responses reflect reality (Nolte, Shauver, & Chung, 2014). Having valid instruments in this study allowed the participants' responses regarding online math homework to reflect how the participants actually thought and felt (Nolte et al., 2014). To ensure validity and reliability, the survey was distributed to a panel of five experts who each had experience with online education. The researcher received responses from four of the five panelists. All four members of the panel held a doctorate degree, had

conducted research in the field of online education, and had experience with online homework.

Hauge et al. (2015) established that survey validity can be developed through input provided by content experts in the field. Creswell and Plano Clark (2011) agree that quantitative validity can be established from external experts alone. The panel of experts increased validity by providing informed feedback about the survey regarding issues, such as the type of questions, the technical quality of questions, the topic coverage of questions, and whether participants' responses to the survey questions would truly reflect how the participants think and feel regarding online math homework. Several panel members expressed that participants should have an opportunity to discuss aids and hindrances to online and paper math homework outside of a Likert-type question, leading the researcher to include four open-ended survey items.

Data Collection

The researcher employed a convergent design throughout data collection, allowing the researcher to merge both the quantitative and qualitative methodologies used in this study (Creswell & Plano Clark, 2011). Using a convergent design throughout the study also allowed for the use of concurrent timing in data collection, in which both the quantitative and qualitative components were completed in the same stage (Creswell & Plano Clark, 2011).

Sites and Participants. The participants for the quantitative component of this study consisted of 64 high school students coming from three ACSI schools in the United States. Although all three are K-12 schools, this research study only

looked at high school students' perceptions. The high school populations (grades 9-12) at each of the three research sites were: 135 high school students, 622 high school students, and 112 high school students (ACSI, 2017). Since data were collected from 64 high school students out of a total of 869 high school students, this current research study had a sample size equivalent to 7.4% of the total high school student populations. It is important to note that many students in the population did not qualify for this research study, as they did not meet the three criteria. Having 64 out of 869 total students in the population adhered to the sample size range needed to be within the 95% confidence level, as outlined by Dillman (2007). The 95% confidence level indicates that the researcher can be 95% confident that other students would have responded the same way, had they been surveyed.

Sampling Plan. The study collected quantitative data through an online survey. The participants were chosen through non-probability sampling, and the researcher did not rely on randomization to select participants (Creswell & Plano Clark, 2011). In order for participants to be able to answer all questions in the survey, students must have been assigned both online and paper math homework while in high school. Therefore, randomization was not possible for this study. The type of non-probability sampling used was purposive sampling, in which members of a particular group were purposefully sought after (Creswell & Plano Clark, 2011). The only participants asked to complete my survey were those who had been confirmed by their teachers to meet the following criteria: students in grades 9-12, enrolled full-time in face-to-face classes, who had been

assigned online math homework within the past three years, and had been assigned paper math homework within the past three years. The researcher also employed convenience sampling, as all participants attended three ACSI schools within one geographic area. The researcher selected students at ACSI schools to participate in the study, because the researcher was employed at an ACSI school and had professional relationship with principals at other ACSI schools.

Administering the Survey. After receiving a Letter of Cooperation from each ACSI school principal and securing IRB approval, the researcher contacted the administrator-approved faculty liaison at each of the three ACSI schools. Once parental consent forms had been completed and returned, the researcher administered the online survey to students at each research site. The survey provided the quantitative data needed for the study and also allowed students to volunteer their participation for the qualitative portion of the study.

Administering the survey was the first part of data collection. The survey was administered to students who were already enrolled in face-to-face math courses at one of the three ACSI schools. The researcher provided the faculty liaison at each of the three research sites with paper and digital copies of the recruitment flyer, as well as paper and digital copies of the parental consent forms. The faculty liaison then distributed the parent consent form and the recruitment flyer both as a hard copy to students and via e-mail to both students and parents. Once the parental consent forms had been signed and returned, the researcher traveled to each research site to administer the survey. The researcher distributed the link for the online survey to students at each research

site. Students completed the survey during their normally scheduled math class while the researcher was on their school campus. This timing provided participants with an opportunity to ask the researcher any questions they had about the research study prior to taking the survey. The scheduling also allowed the researcher to be available for troubleshooting, although issues did not arise at any of the three sites.

The researcher informed students at all three sites that their participation in the study was completely voluntary and that their decision whether to participate would not affect their relationship with their classroom teacher, the researcher, or Florida Atlantic University. Once students completed the survey, the results were automatically sent to the researcher. The survey included demographic items where participants self-identified information such as their gender, grade level in school, and average math grades. These items provided the researcher with more insight as to the participants.

Data Analysis

Data collected from the 25-item survey was analyzed using descriptive statistics such as frequencies, means, modes, percentages, and standard deviation. These analyses allowed the researcher to identify patterns and visualize what the data were showing (Creswell & Plano Clark, 2011). The researcher examined descriptive statistics for each individual ACSI school and also analyzed the descriptive statistics across all three ACSI schools to determine whether tendencies extended across the research sites. The analysis provided insight into students' views about online and paper math homework, as

well as insight into students' levels of agreement with items that pertained to online and paper math homework and their perceptions of the two mediums.

Qualitative Approach

The methodology for the qualitative portion of this research study followed the phenomenological approach outlined by Creswell (2013). This was done to explore high school student perceptions about the quality of learning in online and paper math homework. A phenomenology is an explanatory study that explores how individuals make sense of a certain phenomenon (Creswell, 2013). The current research study sought to explore how high school students enrolled full-time in face-to-face math classes made sense of online math homework.

In keeping with Creswell's (2013) phenomenological approach, the researcher studied individuals with shared experiences. The researcher collected data by conducting semi-structured focus groups with these individuals. Once all focus groups had been conducted, the researcher transcribed the audio recording of each focus group and began coding. Codes, categories, and themes that best captured and described the "essence" of the experience were developed (Creswell, 2013, p. 79).

For the first level of coding, the researcher used descriptive coding, enabling the researcher to use a word or phrase to summarize the basic topic of a passage. For the second level of coding, the researcher employed pattern coding. Once both levels of coding were complete, the researcher had a list of 20 codes (Appendix N). Upon completion of the second level of coding, the researcher further analyzed and organized the codes. The researcher began by

grouping the codes into the following six categories: (a) student-controlled factors, (b) teacher-controlled factors, (c) online factors, (d) paper factors, (e) positive emotions, and (f) negative emotions. The researcher analyzed the codes separately for each site and documented the frequency of each code for each focus group. The researcher was able to triangulate the data by comparing the codes found in each focus group, ensuring that each code was found in both focus groups. Out of 20 total codes, only five codes did not appear in each focus group transcript: Personalized, Accountability, Cheating, Grading, and Don't Know What to Do.

Once the researcher had completed the two levels of coding and organized the codes into categories, the researcher identified three themes from the data: aids to learning, hindrances to learning, and emotional response (see Figure 23). These three themes provided a basis for understanding high school students' perceptions about online and paper math homework, as well as their experiences with online and paper math homework. Additionally, through these themes, the researcher was able to view aspects of online and paper math homework that students perceived as aids or hindrances to their learning.

Sites and Participants

The participants for the qualitative component of this study consisted of 14 high school students from two of the previously noted ACSI schools in the southeastern United States. The researcher was scheduled to conduct three focus groups, one at each of the three research sites. However, the researcher was only able to conduct a focus group at the first and third sites. When the

researcher administered the survey to students at the second site, several students indicated their willingness to participate in a focus group and provided their contact information (Survey item 8). However, despite the researcher making several attempts at contacting these students via email, none of the students at the second research site responded. Therefore, after consulting with her faculty advisor, the researcher was obligated to proceed with the study with only two focus groups.

Focus group participants were selected from the pool of 64 students who participated in the quantitative survey. At the beginning of the survey, participants were asked to include their name and e-mail address if they are willing to participate in a focus group. As with the survey participants, focus group participants were chosen through criterion sampling, and all participants were required to meet the following criteria: be a student in grades 9-12, enrolled full-time in face-to-face classes, having been assigned both online and paper math homework within the past three years. The researcher chose a relatively homogenous sample (the participants of each focus group attended the same school and met all three criteria) to minimize the variables. Additionally, homogenous focus groups “allow for more free-flowing conversations among participants” and “facilitate analyses that examine differences in perspectives within groups” (Morgan, 1997, p. 35). Personal characteristics of the participants, such as gender or race, were not taken into account when selecting focus group participants. All participants who showed up at the focus group’s scheduled date and time with a signed parental consent form were allowed to participate.

The participants in one focus group were a mix of ninth and 10th grade students, while the participants in the second focus group were all 12th grade students. The unique characteristics of the Christian campus culture found at ACSI schools led many of the students in focus groups to have stronger relationships and a stronger sense of community than average high school students would have had (Wolfe, 2016). This allowed the participants to "converse more readily" (Morgan, 1997, p. 37).

To gain access to the participants, the researcher contacted the administrator-approved faculty liaison at each of the three ACSI schools; each faculty liaison was also one of the high school math teachers at each of the respective research sites. After signed parental consent forms had been turned in, the researcher administered the online survey to students at each research site. The survey allowed students to volunteer as participants for the focus groups.

Once participants had volunteered for the focus groups, all participants who volunteered were contacted by the researcher via e-mail and asked if they would be willing to take part in a focus group. Upon the participant's willingness to move forward with the study, the researcher provided the participant with the time, date, and location of the appropriate focus group. The focus groups were all conducted in a classroom at the home school of the participants, which helped provide comfort and convenience for the participants. Each participant signed a consent form, stating willingness to participate in the study. A parent/guardian of each participant also signed a consent form, allowing the student to participate in

the survey and/or focus group.

Focus Groups

Once students had participated in the 25-item survey, the researcher conducted semi-structured focus groups to allow students an opportunity to share, hear, and experience different aspects of online and paper math homework in a group setting. The semi-structured nature of the focus groups allowed the topics of conversation to vary from group to group (Morgan, 1997). The researcher aimed for each focus group to consist of three to five high school students from the same ACSI school. Morgan (1997) recommends over-recruiting by 20% to cover participants who do not show up. Therefore, the researcher contacted all students who volunteered for the focus group.

Data Collection

Qualitative studies can be a helpful tool when determining whether or not web-based homework is effective in learning. In keeping with a qualitative phenomenology, data for this study were collected through focus groups. The focus groups occurred after school, as this time was convenient to the participants. Additionally, each focus group took place on the school campus where the participants were enrolled. The focus groups were semi-structured, because too much structure can limit the data collected; less structure is good for focus groups when studies are exploratory, as this current research study was (Morgan, 1997).

The purpose of this study was threefold: to understand how high school students perceive online math homework, to determine what aspects of online

math homework aid and/or hinder student learning, and to improve the student learning experience with online math homework. The researcher did not have predetermined beliefs about the aids or hindrances that students would address prior to conducting the focus groups. Therefore, a less-structured focus group allowed the participants to “pursue what interested them” and “speak for themselves” (Morgan, 1997, p. 40). Each focus group was scheduled for 90 minutes, but participants were told that the discussion would last 2 hours to leave a cushion for latecomers or early leavers (Morgan, 1997).

The researcher met with one focus group per day and moderated each focus group. As moderator, the researcher allowed the conversation topics to flow according to what interested the students. However, the focus group protocol allowed the researcher to keep the students focused on the research topic and provided probes to help the researcher dig deeper into a certain topic. Creation of the focus group protocol for the current research study was guided by Al-Asfour and Bryant’s (2011) interview protocol for their qualitative study examining the perceptions of students taking an online course. After the focus groups had been conducted, the researcher transcribed each focus group. The researcher then provided all 14 focus group participants with a transcribed copy of their portions of the focus group for member-checking. None of the participants indicated that there was something in the focus group transcript they wanted to change.

Qualitative Data Analysis

The researcher used qualitative methodology to analyze the data collected

from the focus groups. Data collected during the focus groups was transcribed verbatim, with permission from the participants. The researcher also made every attempt to eliminate researcher bias and establish credibility and trustworthiness.

Researcher Bias

To analyze the data in the best way possible, the researcher then attempted to "remove, or at least become aware of prejudices, viewpoints or assumptions regarding the phenomenon under investigation" (Merriam, 2009, p. 199). To deal with any pre-existing prejudices about online homework, the researcher conducted blind coding. Miles, Huberman, and Saldaña (2014) describe blind coding as coding in which the codes are not specified beforehand. The researcher conducted blind coding in this study to discover the codes along the way (Miles et al., 2014). Additionally, the researcher waited until all focus group data had been collected before completing any qualitative analysis. This was done to prevent the researcher from being influenced by the topics mentioned in one focus group and subconsciously bringing up those topics in the next focus group.

In phenomenological study, the focus should always remain on the participants' experiences (Merriam, 2009), and the researcher kept this in mind throughout the coding process. Along with blind coding, the researcher simultaneously coded the data using descriptive coding to assign labels to data and use a word or short phrase to summarize the basic topic of a passage (Miles et al., 2014). For example, each of the following focus group passages was coded as Online Tools:

- “If your teacher’s not there and you're confused about something [the online homework] has a tab there [to help].”
- “If you’re doing it by yourself then the computer [helps you learn more] cause it has more tools to help you.”
- “I liked what Jordan said. If you get something wrong [the online math homework] has tools for you to do it.”

Once codes had been assigned, the researcher developed mutually exclusive categories that were responsive to the purpose of the research.

Credibility and Trustworthiness

Credibility was established though peer examination, member-checking, and triangulation. Miles et al. (2014) recommend that the researcher triangulate among data sources to determine if generally converging conclusions emerge. Therefore, the researcher triangulated the qualitative data collected from the focus groups by coding the qualitative data from each site and then ensuring that all themes and categories were represented in the focus group transcripts for each site. The researcher also employed member-checking throughout the study by inviting the participants to discuss or redact their portion of the focus group’s written transcript. The researcher provided all 14 focus group participants with a transcribed copy of their portions of the focus group for member-checking. None of the participants indicated that there was something in the focus group transcript that they wanted to redact or change.

To increase credibility and trustworthiness, the researcher also employed inter-rater reliability and peer review. After the researcher had analyzed all the

focus group data individually, the researcher asked an objective third party to serve as a peer reviewer. The peer reviewer analyzed and coded the qualitative data to ensure there was agreement between the researcher and the peer reviewer regarding codes and consistency. The peer reviewer for this research study was one of the researcher's former colleagues, who holds a Ph.D. within the field of education and has a qualitative analysis background.

After individually developing codes, categories, and themes from the focus group data, the researcher created a comprehensive list of categories along with examples and quotes for each category. To train the rater, the researcher provided the rater with the list of categories and discussed the examples. Once the rater expressed understanding of the categories, the researcher provided the rater with a selection of qualitative data to code. Once the rater had coded 21 of the 43 pages of focus group transcripts, the researcher reviewed the rater's findings. The rater coded 117 of 151 total codes in the same manner as the researcher, leading to a 77% accuracy rate between researcher and rater. The researcher discussed the inconsistent items with the rater and found that the majority of disagreements related to the rater confusing the teenage participants' use of the word "like." The rater often coded conversational uses of the word "like" as participants showing positive emotions when they were not. For example, the rater confused the following focus group excerpt as a verb showing positive emotion, when the student was simply using the adverb "like" informally as part of his everyday vocabulary: "With online there's usually, like, if you get it wrong you can, like, it'll take you through the entire problem." After the

researcher and rater discussed the use of the word “like,” the rater went back and recoded. The second round of coding led the rater and researcher to have 91% accuracy, with the rater coding 137 out of the 151 codes in the same manner as the researcher.

Finally, the researcher kept an audit trail of the methods, procedures, and decision points made throughout the study. The researcher conducted two documented focus groups using a focus group protocol. Each focus group was audio recorded with permission from the participants and their parents/guardians. The researcher also took field notes on the mannerisms and nonverbal behaviors of the interviewees for deeper reflection and insights. The field notes assisted the researcher when transcribing the focus groups. The focus group recordings and transcripts were stored via written transcription on the researcher’s personal computer drive and in the cloud via Google Drive.

Final Analysis

The purpose of a convergent design is to merge both the quantitative and qualitative methodologies used in the study (Creswell & Plano Clark, 2011). Therefore, the final analysis in this study occurred after both the quantitative and qualitative analyses. The researcher synthesized the complementary quantitative and qualitative results to develop a more complete understanding of the phenomenon of online math homework (Creswell & Plano Clark, 2011).

IV. RESULTS

The current research study explored the perceptions that high school students enrolled full-time in face-to-face classes at private schools have in regard to online and traditional paper math homework. The focus of the research study was to explore what aspects of online homework are viewed as aids or hindrances to improve the learning gains that occur through the medium of online math homework. The purpose of this study was threefold: to understand how high school students perceive online math homework, to determine what aspects of online math homework aid and/or hinder student learning, and to improve the student learning experience with online math homework. Consequently, this research study was directed by the following research questions:

1. What are the perceptions of private high school students enrolled in daily, face-to-face math classes regarding both online and paper math homework?
2. What aspects of online math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?
3. What aspects of paper math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?

Methodology

The researcher employed a convergent design to answer the three research questions and better understand high school students' opinions about online math homework. The research study involved both a quantitative and qualitative component, and a convergent design facilitated the use of both of these methodologies (Creswell & Plano Clark, 2011). The convergent design allowed the researcher to give the quantitative and qualitative components equal importance in the study. Additionally, the use of a convergent design allowed the researcher to use concurrent timing throughout the study; thus, both the quantitative and qualitative data collection processes were completed in the same stage (Creswell & Plano Clark, 2011). This approach allowed the researcher both to administer the survey and conduct focus groups over the span of a few days without waiting on data analysis from either source (Creswell & Plano Clark, 2011). To answer the three research questions in the best manner possible, the researcher also incorporated parallel data collection, in which questions that cover the same topics are asked in both the qualitative and quantitative data collection phases. The use of convergent design along with parallel data collection allowed for synthesis of complementary quantitative and qualitative results and the development of a more complete understanding of the phenomenon of online math homework (Creswell & Plano Clark, 2011).

A key component of the convergent and parallel design methodology is the use of two different data sources (Creswell & Plano Clark, 2011). To collect data from two separate sources, the researcher administered a survey for

quantitative data and conducted a focus group for qualitative data. Through both the survey and the focus group, high school students were able to express their perceptions about online math homework. Quantitative data collected from the surveys allowed the researcher to note trends and frequencies in how students perceive online math homework, while the focus groups allowed the students to emphasize the aids and hindrances involved with online math homework.

The quantitative component of this research study involved a survey composed of demographic questions along with a Likert-type matrix. The Likert-type survey items were adapted from Koc and Liu's (2016) *An Investigation of Graduate Students' Help-Seeking Experiences, Preferences, and Attitudes in Online Learning* and Nam and Zellner's (2010) *The Relative Effects of Positive Interdependence and Group Processing on Student Achievement and Attitude in Online Cooperative Learning*. Additionally, the researchers created some of the Likert-type items. The survey allowed students to express their overall sentiments toward online and paper math homework while also stating any aids or hindrances toward learning seen in either medium. Students had the opportunity to enter their contact information within the survey if they were interested in participating in a focus group. The researcher led two student-centered focus groups. The focus group setting allowed students to express personal views and opinions about online math homework while also hearing the views and opinions of others. Students were often surprised to see both similarities and differences between their own experiences with online math homework and those of the other students.

Description of Research Sites

This research study focused on the perceptions of high school students enrolled in private schools regarding online and paper math homework. The researcher also made it a requirement that the private schools be members of the Association of Christian Schools International (ACSI). The researcher decided upon these criteria to ensure access to students, as the researcher works at an ACSI school and has professional relationships with ACSI schools. As members of ACSI, all three research sites held similar educational and religious philosophies. However, the three sites still provided variation in size of the study body, demographics, and other features.

Description of Participants

After the three ACSI schools agreed to be research sites, a school administrator from each site provided the researcher with a faculty member liaison to facilitate data collection at that site. The faculty liaison at each site assisted the researcher in identifying participants for the study. The researcher selected participants through criterion sampling. All participants were required to meet the following criteria: be ninth to 12th grade students enrolled full-time in face-to-face classes (Survey item 1); have been assigned online math homework within the past three years (Survey item 2); and have been assigned paper math homework within the past three years (Survey item 3). The researcher chose a relatively homogenous sample (the participants of each focus group attend the same school and meet all three criteria) to minimize variables. Additionally, the homogenous focus groups allowed for more “free-flowing conversations among

participants" and facilitated analyses that examined "differences in perspectives within groups" (Morgan, 1997, p. 35). Although demographic questions were included in the survey, personal characteristics of the participants, such as gender or race, were not taken into account when selecting participants. Students who met the criteria and indicated their desire to participate in a focus group (Survey item 7) received an email message from the researcher providing two dates, times, and locations for focus groups on their school campus. Only students who met all the criteria and completed the survey were eligible for the focus groups, as having the same participants complete both the quantitative and qualitative components of the study allowed for comparison during the analysis (Creswell & Plano Clark, 2011).

Quantitative Findings

After collecting survey results from participants at all three research sites, the researcher began to analyze the data. The first form of analysis conducted by the researcher was descriptive statistics for each school individually based upon what students described as aids and hindrances to learning with online and paper math homework. The researcher studied that data for patterns and frequencies to identify commonalities, as well as outliers. The researcher summarized the data by stating the frequencies, means, and standard deviations of the students' perceptions about those aids and hindrances (see each section). The researcher also examined the data for students' level of agreement with statements about online and paper math homework. The researcher completed the quantitative data analysis by analyzing the data in a comparison across all

three ACSI research sites.

Results for Research Site 1

Research Site 1 (RS1) is a small, private, K-12 school with a total of 541 enrolled students; 135 of those students are enrolled as high school students (ACSI, 2017). The researcher received a total of 24 survey responses, which represents 21% of the high school student body. However, of the 24 surveys, six were disqualified because they did not meet one of the delimitations for the study (had not been assigned online math homework within the past three years). Additionally, one incomplete survey did not provide any information beyond consent. Therefore, the researcher received 17 usable survey responses, which represents 13% of the high school student body.

Demographics. From the 17 survey participants, four were female (24%), and 13 were male (76%). All participants were either freshmen or sophomores with 10 participants in ninth grade (59%) and seven participants being in 10th grade (41%). Nearly every survey participant self-identified as either Caucasian or Hispanic. One participant chose to not identify demographically, and one participant selected “Other,” choosing to type in “latino” instead of identifying with one of the provided categories. Figure 5 illustrates the demographic categories with which participants most closely identified.

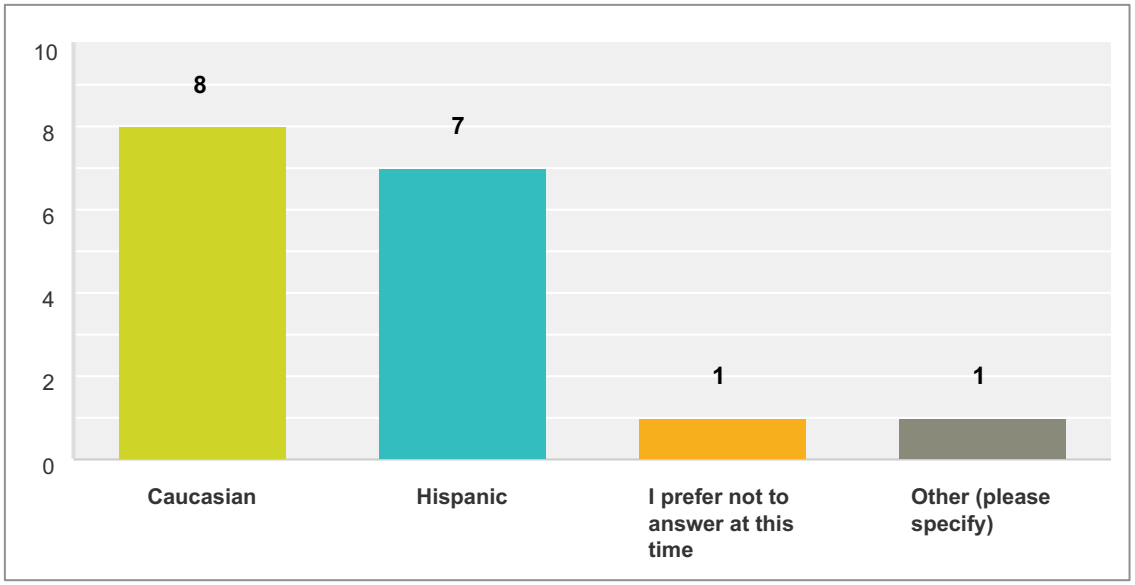


Figure 5. Demographic associations of students at RS1.

No students surveyed at RS1 identified as African American, Asian, Caribbean Islander, Hawaiian/Pacific Islander, Indian, or Native American. Students also provided insight into their levels of achievement in mathematics by self-reporting the types of grades they most commonly earned in their high school math classes, as seen in Figure 6.

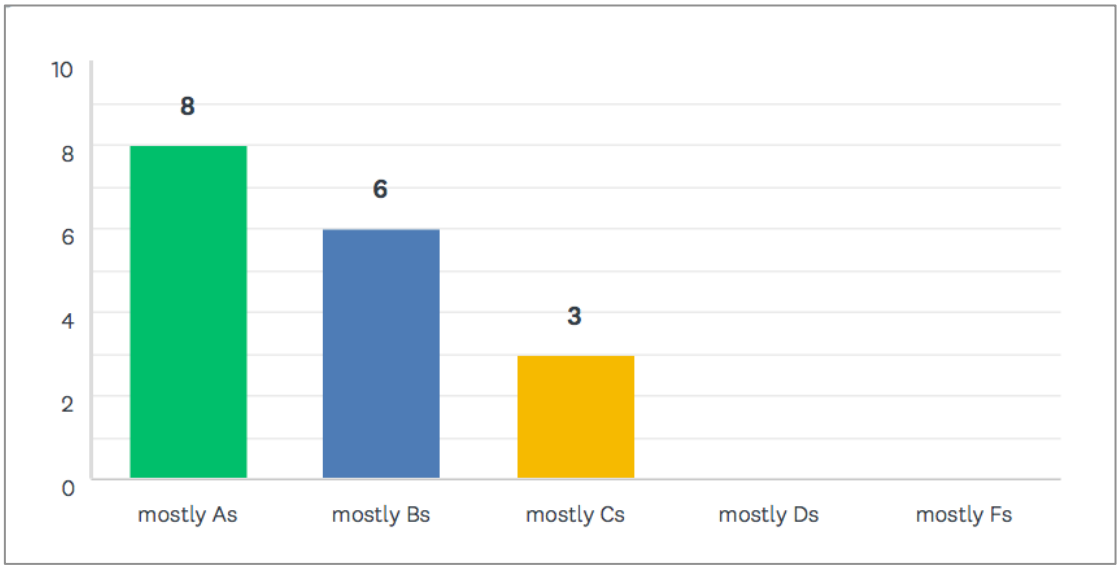


Figure 6. RS1 students' self-reported math grades.

Survey items 10 through 30, Likert-type. After the demographic information, students completed 21 Likert-type survey items that asked participants to “Select the option that best describes how you feel.” Participants were able to select from the following levels of agreement for each of the 21 items, with corresponding value: Strongly Disagree (1), Disagree (2), Somewhat Disagree (3), Somewhat Agree (4), Agree (5), Strongly Agree (6), and “I prefer not to answer” (7). Almost every student responded to single Likert-type item. Only two students selected “I prefer not to answer” for any of the items. One participant selected “I prefer not to answer” for three unique items, while another participant selected “I prefer not to answer” for two unique items. For these five items, the researcher analyzed the data by deleting any value of 7.0 from the calculations (“I prefer not to answer”) and determining the average for the item based on 16 available responses. Therefore, all averages fell between 1.0 and 6.0, as seen in Table 3. Averages below 3.50 indicate that participants disagreed with the statement, while averages above 3.50 indicate that participants agreed with the statement. Once the average had been determined for each item, the researcher also calculated the standard deviation for each Likert-type item. A lower standard deviation, such as 0.95, indicates that most of the participants’ responses were close to the average. A higher standard deviation, such as 1.71, indicates that participants’ responses were more varied for that item.

Table 3

RS1 Averages and Standard Deviations for Survey Items 10-30

Likert-type survey item	Average	Standard deviation
10	4.18	1.04
11	4.18	1.25
12	3.00	1.53
13	3.18	0.98
14	3.94	1.06
15	4.29	1.23
16*	2.81	1.07
17*	2.81	0.95
18	4.35	1.71
19	4.18	1.46
20*	3.19	1.24
21*	3.50	1.66
22	4.59	1.24
23	2.65	1.08
24*	4.63	1.36
25	3.00	1.24
26	4.24	1.21
27	3.65	1.13
28	3.35	1.45
29	4.47	1.61
30	2.94	1.26

* denotes an item where one of the participant responses was “I prefer not to answer.”

Survey items were randomly presented to students so as not to influence their responses. Survey items 10, 15, 16, 21, 25, and 26 all addressed student perceptions about the aids and hindrances to learning with online math homework. Averages and standard deviations for the aforementioned items can be seen in Table 4.

Table 4

RS1 Averages and Standard Deviations for Survey Items Related to Student Perceptions about the Aids and Hindrances to Learning with Online Math Homework

Likert-type survey item	Average	Standard deviation
10	4.18	1.04
15	4.29	1.23
16*	2.81	1.07
21*	3.50	1.66
25	3.00	1.24
26	4.24	1.21

* denotes an item where one of the participant responses was “I prefer not to answer.”

Item 16 was parallel in content to Item 10 but structured with reverse scoring, as was Item 15 with Item 21. While discussing online resources, 71% (n = 17) of participants agreed with Item 10, which states, “Online math homework provides me with resources that help me solve my homework problems.” Once again, 71% (n = 17) of participants agreed with Item 15 that stated, “When completing online math homework, I use the online resources provided.” In Item 26, almost every student (76%; n = 17) agreed with the statement, “There are things about online math homework that help me learn how to do math.” However, in Item 25, 41% of

students (n = 17) agreed that “There are things about online math homework that prevent me from learning how to do math.”

Survey items 11, 17, 23, and 24 all addressed student perceptions about the aids and hindrances to learning with paper math homework. Item 17 paralleled Item 11 but with reverse scoring as did Items 23 and 24. As shown in Table 5, the reverse scoring confirms the results with a high average for Item 11 (agreement) and a low average for Item 17 (disagreement). The same results can be seen for Items 24 and 24 with Item 23 having a low average (disagreement) and Item 24 having a high average (agreement).

Table 5

RS1 Averages and Standard Deviations for Survey Items Related to Student Perceptions about the Aids and Hindrances to Learning with Paper Math Homework

Likert-type survey Item	Average	Standard deviation
11	4.18	1.25
17*	2.81	0.95
23	2.65	1.08
24*	4.63	1.36

* denotes an item where one of the participant responses was “I prefer not to answer.”

For Item 11, 65% (n = 17) of participants agreed that “Paper math homework provides me with resources to help solve my homework problems.” This was further reinforced by participants’ responses to Item 24 where 81% (n = 16) of participants agreed that “There are things about paper math homework that help me learn how to do math.”

The next series of survey items (13, 14, 19, 20, 22) addressed students' perceptions as to whether they learned with online and paper math homework and students' perceptions of their grades after having been assigned online and paper math homework.

Table 6

RS1 Averages and Standard Deviations for Survey Items Related to Students' Perceptions of Learning Gains

Likert-type survey item	Average	Standard deviation
13	3.18	0.98
14	3.94	1.06
19	4.18	1.46
20	3.19*	1.24
22	4.59	1.24

* denotes an item where one of the participant responses was "I prefer not to answer."

Item 19 had one of the strongest senses of agreement (average = 4.18) but also had one of the largest standard deviations, at 1.46, as seen in Table 6. Item 19 was one of the few survey items in which each response option (Strongly Agree, Somewhat Agree, etc.) was selected by at least one participant. Figure 7 shows the student responses to the statement, "I earn higher test grades after I have paper math homework." Although the responses were varied, 76% (n = 17) of students agreed with the statement.

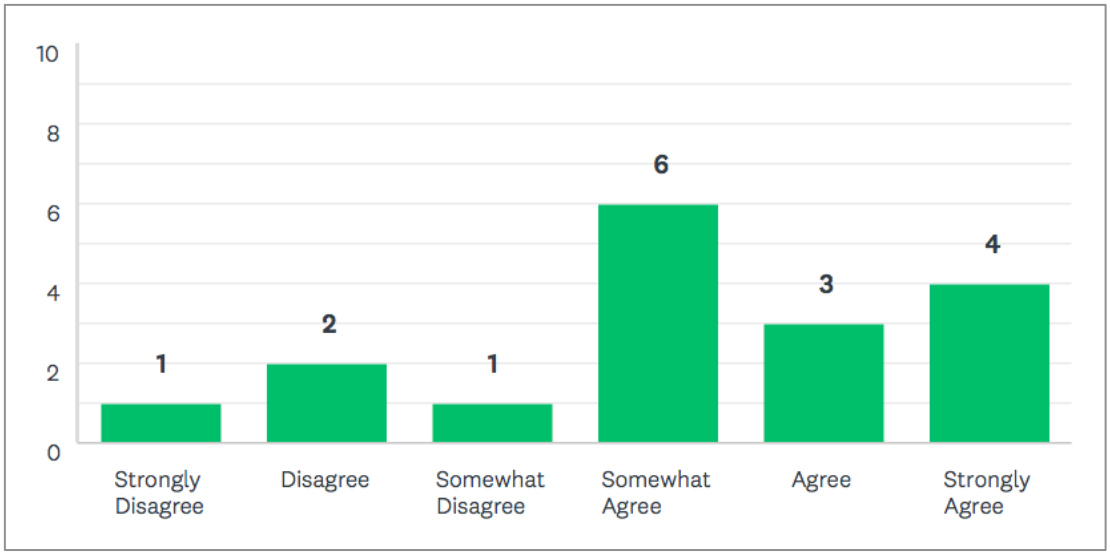


Figure 7. RS1 students' responses to Item 19: "I earn higher test grades after I have paper math homework."

By contrast, in response to Item 13, nearly all students (87%; n = 17) *disagreed* with the statement, “I earn higher test grades after I have online math homework,” as seen in Figure 8.

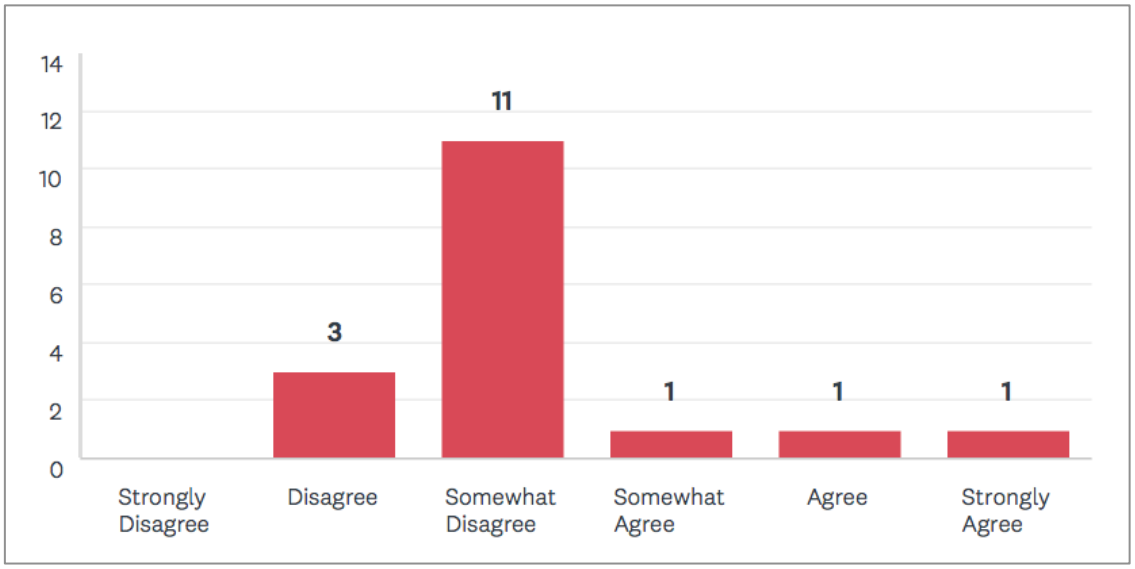


Figure 8. RS1 students' responses to Item 13: "I earn higher test grades after I have online math homework."

Item 20 paralleled Item 14 but was worded in such a way that scoring was reversed. Students’ views were split down the middle for Item 14, with eight

students indicating they disagreed and nine students (n = 17) indicating they agreed to the statement, “I think that online math homework helps me learn how to do math.” However, the degrees of agreement are important to note, as seen in Figure 9. Of the students who disagreed, all eight selected “Somewhat Disagree” while of the students who agreed, two felt so passionately about the matter that they selected “Strongly Agree.”

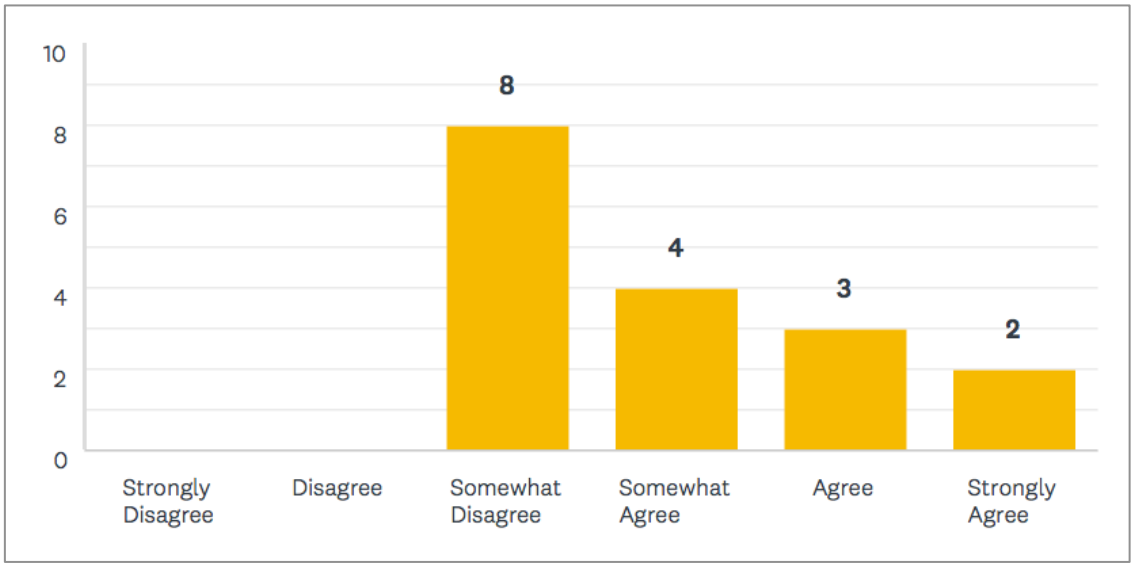


Figure 9. RS1 students' responses to Item 14: "I think that online math homework helps me learn how to do math."

The final item in this cluster was Item 22, which stated, “I think that paper math homework is useful for my learning.” The majority of students (76%; n = 17) agreed with this statement.

The last six Likert-type items referenced students’ preferences regarding online math homework and paper math homework. Unlike other survey items that combined opinion with fact (i.e., “I earn higher test grades after I have online math homework” or “Online math homework provides me with resources”), Items 12, 17, 18, 29, and 30 relied purely on students’ perceptions. That distinction led

these six items to have very high values for standard deviation, as shown in Table 7. Item 18 paralleled Item 12 but with reverse scoring. Items 27 and 28 also paralleled each other, as did Items 29 and 30.

Table 7

RS1 Averages and Standard Deviations for Survey Items Related to Students' Preferences Regarding Online and Paper Math Homework

Likert-type survey item	Average	Standard deviation
12	3.00	1.53
18	4.35	1.71
27	3.65	1.13
28	3.35	1.45
29	4.47	1.61
30	2.94	1.26

Item 18 showed that 71% (n = 17) of students agreed with the statement, "I would rather have paper math homework than online math homework." This item was the most polarizing in the survey, as seen in Figure 10, and resulted in the largest standard deviation, with six students selecting "Strongly Agree," while two students selected "Strongly Disagree."

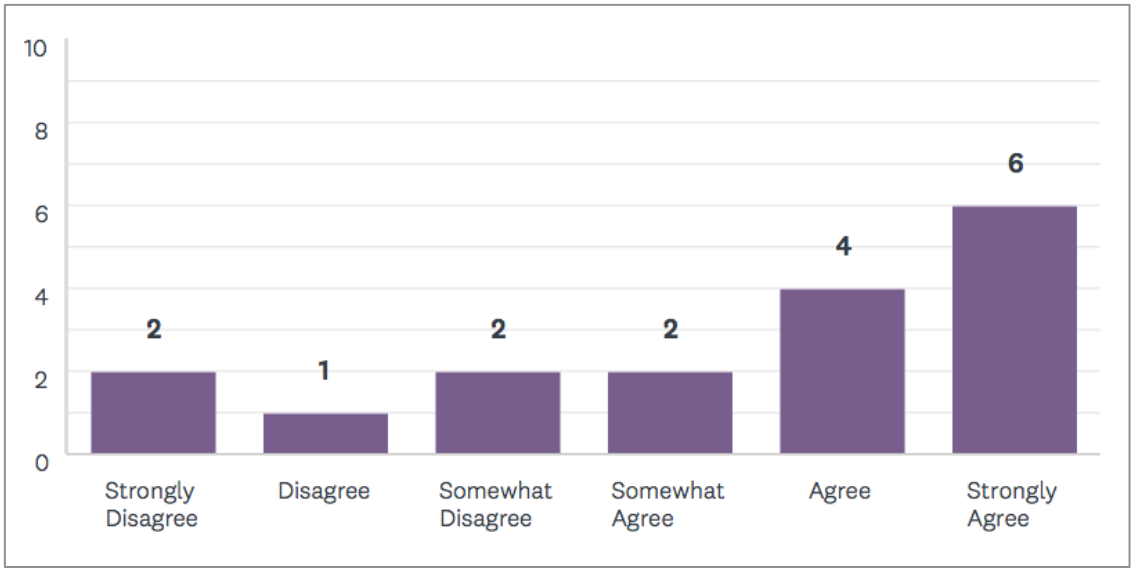


Figure 10. RS1 students' responses to Item 18: "I would rather have paper math homework than online math homework."

Items 27 and 28 showed that students were split down the middle in their opinions regarding online math homework. In Item 27, eight students (n = 17) agreed, and nine students disagreed that “Online math homework is more good than bad.” In Item 28, nine students (n = 17) disagreed, and eight students agreed that “Online homework is more bad than good.” Items 29 and 30 showed that students had a more unified, positive opinion toward paper math homework. In Item 29, 82% (n = 17) of students agreed that “Paper homework is more good than bad,” a majority that was confirmed in Item 30.

Aids and hindrances to learning, open-ended. The last four questions in the survey were free-response questions, allowing students to type in what they viewed as aids and hindrances to learning for both online and paper math homework. When asked to “Describe anything about online math homework that helps you learn” in Item 31, students responded with comments such as:

- “step by step examples of how to solve the problem”

- “the tools…help me understand…if the teacher isn’t around to help me”
- “easily accessible”
- “The resources provided help me if I do not find the correct answer the first time, because I can see how to do the problem and see where I went wrong”
- “being able to search up a topic that I missed or failed to take good notes on”
- “it won’t get lost”
- “it lets you retry if you get it wrong the first time until you get it right”
- “the resources, such as an online calculator”

Students commonly responded to what aspect of online math homework aids learning by citing the online examples, with this phrase being submitted by 47% (n = 17) of students. In response to Item 32, which read, “Describe anything about online math homework that prevents you from learning,” students wrote:

- “I don’t have a teacher to help me understand it in other ways”
- “no where to write work down”
- “going on games and watch[ing] videos”
- “multiple choice options cause me to just guess instead of working out the problem”
- “lessons are generic”
- “my home lacks an internet connection”
- “staring at a screen for too long can give headaches”

The most commonly mentioned hindrances to learning with online math

homework were the lack of teacher help, mentioned by 24% (n = 17) of students, and not being able to show their work, also mentioned by 24% of students.

When asked in Item 33 to "Describe anything about paper math homework that helps you learn," students' responses included:

- "examples in the book"
- "showing your work on the page [and] working it out yourself"
- "I learn better when I write it down"
- "I can focus more, rather than getting distracted by other online activities"
- "it's easier to ask for help with paper math homework"
- "I am able to ask questions when my teacher is present"

Nearly every response to what aids learning with paper math homework centered on two issues: help from the classroom teacher, or another person physically present; and showing their work. Out of 17 students, 65% mentioned showing their work as an aid to learning with paper math homework, while 18% (n = 17) brought up receiving help from their classroom teacher.

The final question of the survey, Item 34, asked students to "Describe anything about paper math homework that prevents you from learning." Students responded with phrases such as:

- "there are not as many ways to see where I went wrong because there are not the resources like I would have online"
- "no examples"
- "paper homework can get lost or torn"
- "my handwriting is awful"

- “can’t see the answers till the next day”

However, the most common response to what hinders learning with paper math homework was one word: “nothing.” Out of the 17 students, 47% stated that there is nothing about paper math homework that hinders their learning.

Results for Research Site 2

Research Site 2 (RS2), the largest school in this study, is a private, K-12 school with a total of 1,739 enrolled students; 622 of those students are enrolled as high school students (ACSI, 2017). The researcher received a total of 29 survey responses, which represents 5% of the high school student body. However, of the 29 surveys, the researcher disqualified two that were incomplete and did not provide any information beyond consent, delimitations, or demographics. Thus, 27 usable survey responses were left, which represents 3% of the high school student body at Research Site 2.

Demographics. Out of 27 survey participants, 17 were females (63%) and 10 were males (37%). All participants were 12th grade students in an Advanced Statistics course. The majority of participants self-identified as Caucasian, with Hispanic being the second most commonly selected demographic category. Additionally, two students categorized themselves as African Americans, and one student self-identified as Asian. One selected “Other,” choosing to type in “Hispanic, Caucasian, Asian” instead of identifying with one of the provided categories. Figure 11 illustrates the demographic categories participants chose when self-identifying.

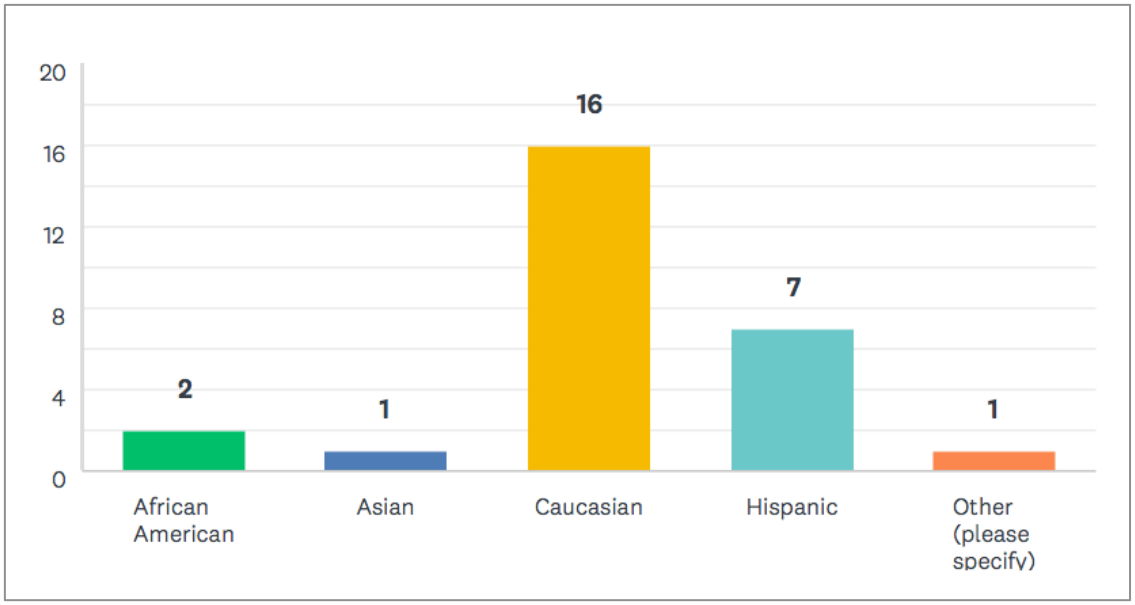


Figure 11. Demographic associations of RS2 students.

There were no students at RS2 who identified as African American (born in Africa), Caribbean Islander, Hawaiian/Pacific Islander, Indian, or Native American. Students also provided insight into their levels of achievement in mathematics by self-reporting the grades they most commonly earned their high school math classes (see Figure 12).

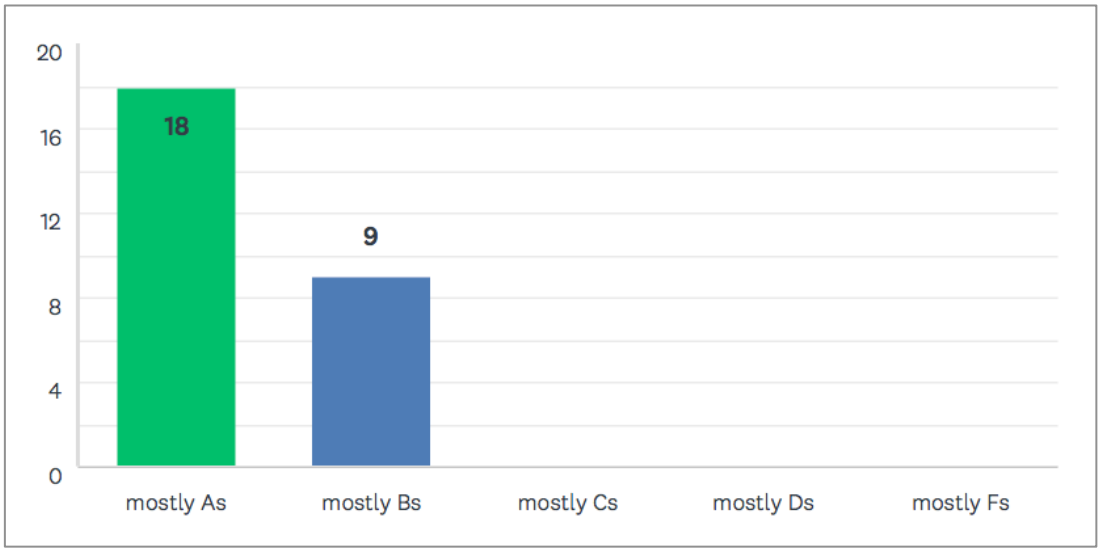


Figure 12. RS2 students' self-reported math grades.

Survey items 10 through 30, Likert-type. After the demographic information, students completed 21 Likert-type survey items that asked participants to “Select the option that best describes how you feel.” Participants were able to select from the following levels of agreement for each of the 21 items with corresponding value: Strongly Disagree (1), Disagree (2), Somewhat Disagree (3), Somewhat Agree (4), Agree (5), Strongly Agree (6), and “I prefer not to answer” (7). The vast majority of students responded to every Likert-type item. Only two survey items recorded a response of “I prefer not to answer,” from one student each. For these two items, the researcher analyzed the data by deleting any value of 7.0 from the calculations (“I prefer not to answer”) and determining the average for the item based on 26 available responses. Therefore, all averages fell between 1.0 and 6.0. Averages below 3.50 indicate that participants disagreed with the statement, while averages above 3.50 indicate that participants agreed with the statement, as shown in Table 8. Once the average had been determined for each item, the researcher also calculated the standard deviation for each Likert-type item. A lower standard deviation, such as 0.83, indicates that most of the participants’ responses were close to the average. A higher standard deviation, such as 1.54, indicates that participants’ responses were more varied for that item.

Table 8

RS2 Averages and Standard Deviations for Survey Items 10-30

Likert-type survey item	Average	Standard deviation
10	4.96	1.00
11	3.59	1.52
12	3.93	1.54
13	3.96	1.37
14	4.11	1.31
15*	5.19	0.83
16	2.30	1.30
17	3.85	1.38
18	3.37	1.57
19	4.00	1.39
20*	2.54	1.22
21	2.30	1.38
22	4.41	1.25
23	2.96	1.50
24	4.41	1.23
25	3.56	1.29
26	4.74	0.84
27	4.26	1.26
28	3.00	1.33
29	4.11	1.31
30	2.85	1.24

* denotes an item where one of the participant responses was “I prefer not to answer”

Survey items were randomly presented to students so as not to influence their responses. Survey items 10, 15, 16, 21, 25, and 26 all addressed student perceptions about the aids and hindrances to learning with online math homework.

Table 9

RS2 Averages and Standard Deviations for Survey Items Related to Student Perceptions about the Aids and Hindrances to Learning with Online Math Homework

Likert-type survey item	Average	Standard deviation
10	4.96	1.00
15*	5.19	0.83
16	2.30	1.30
21	2.30	1.38
25	3.56	1.29
26	4.74	0.84

* denotes an item where one of the participant responses was “I prefer not to answer”

Item 16 was parallel in content to Item 10 but structured with reverse scoring, as was Item 15 with Item 21. While discussing online resources, 93% (n = 27) of participants agreed with Item 10, which stated, “Online math homework provides me with resources that help me solve my homework problems.” Nine of those students selected “Strongly Agree.” In an even stronger majority, all but one student surveyed agreed with Item 15, which stated, “When completing online math homework, I use the online resources provided” (see Table 9). Eleven students selected “Strongly Agree” for Item 15. The strong majority held for Item 26, as 96% of students (n = 27) agreed with the statement, “There are things

about online math homework that help me learn how to do math." However, in Item 25, 52% of students (n = 27) also agreed with the statement "There are things about online math homework that prevent me from learning how to do math."

Survey items 11, 17, 23, and 24 all addressed student perceptions about the aids and hindrances to learning with paper math homework. Item 17 paralleled Item 11 but with reverse scoring, as explained earlier, as did Items 23 and 24.

Table 10

RS2 Averages and Standard Deviations for Survey Items Related to Student Perceptions about the Aids and Hindrances to Learning with Paper Math Homework

Likert-type survey item	Average	Standard deviation
11	3.59	1.52
17	3.85	1.38
23	2.96	1.50
24	4.41	1.23

For Item 11, 52% (n = 27) of participants agreed that "Paper math homework provides me with resources to help solve my homework problems." A split roughly down the middle of this kind explains why the averages for Items 11 and 17 were so similar, despite being structured with reverse scoring (see Table 10).

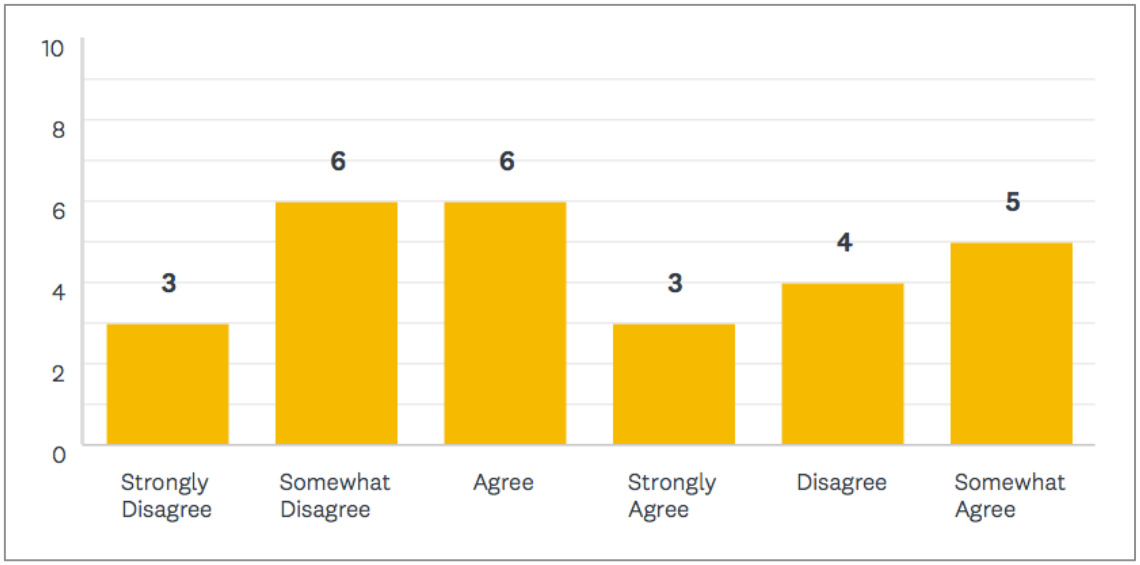


Figure 13. RS2 students' responses to Item 11: "Paper math homework provides me with resources to help solve my homework problems."

Although nearly half the participants believed that paper math homework does not provide resources to help solve homework problems (see Figure 13), participants' responses to Item 24 demonstrate that 85% of participants (n =27) *do* agree with the statement that "There are things about paper math homework that help me learn how to do math" (see Figure 14).

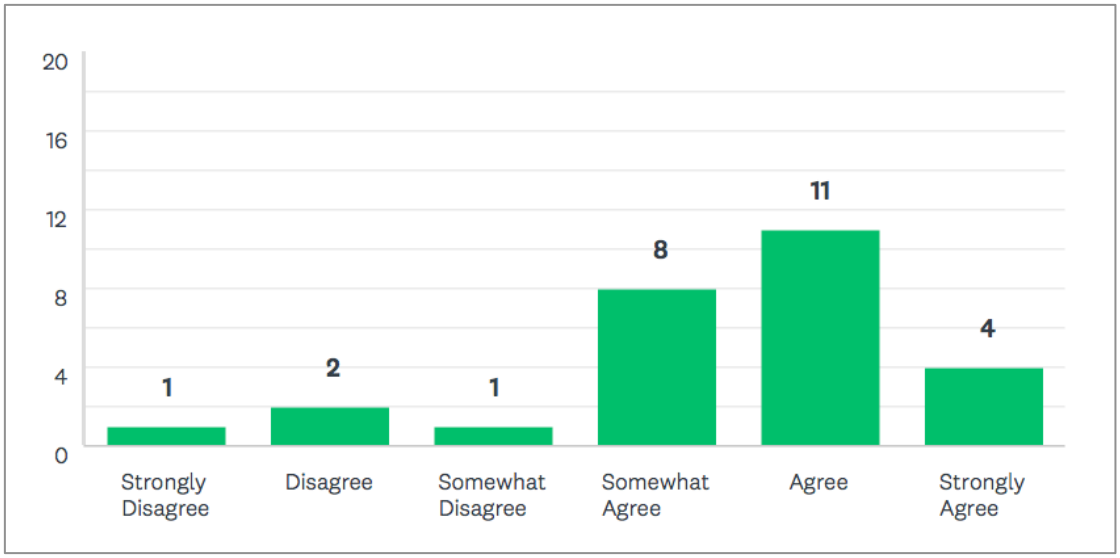


Figure 14. RS2 students' responses to Item 24: "There are things about paper math homework that help me learn how to do math."

The next series of survey items (13, 14, 19, 20, 22) addressed students' perceptions regarding whether they learned with online and paper math homework, as well as students' perceptions of their grades after having been assigned online and paper math homework.

Table 11

RS2 Averages and Standard Deviations for Survey Items Related to Students' Perceptions Regarding Learning Gains with Online and Paper Math Homework

Likert-type Survey Item	Average	Standard deviation
13	3.96	1.37
14	4.11	1.31
19	4.00	1.39
20*	2.54	1.22
22	4.41	1.25

* denotes an item where one of the participant responses was "I prefer not to answer"

Items 13 and 19 had very similar averages, with students agreeing with both "I

earn higher test grades after I have online math homework" in Item 13 and "I earn higher test grades after I have paper math homework" in Item 19. Item 20 paralleled Item 14 but with reverse scoring. As shown in Table 11, the reverse scoring confirmed the results with a high average for Item 14 (agreement) and a low average for Item 20 (disagreement). For Item 14, 74% (n = 27) of students agreed that "online math homework helps me learn how to do math." The reverse scoring in Item 20 confirmed these results. The final item in this cluster, Item 22, stated, "I think that paper math homework is useful for my learning." Although the majority of students (85%; n = 27) agreed with this statement, two students strongly disagreed and did not believe that paper math homework was useful for their learning (see Figure 15).

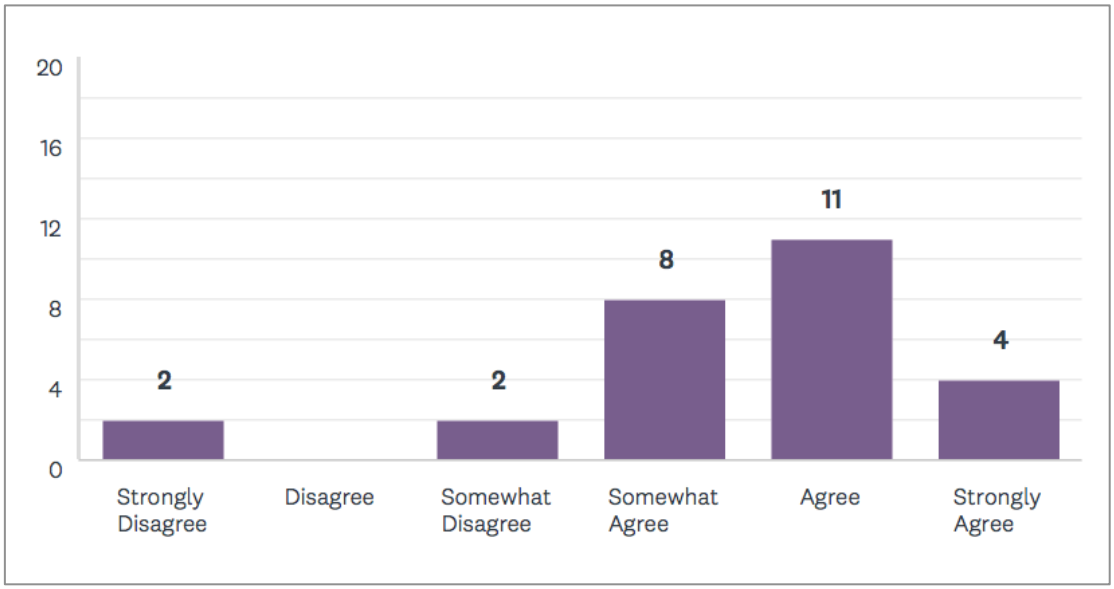


Figure 15. RS2 students' responses to Item 22: "I think that paper math homework is useful for my learning."

The last six Likert-type items referenced students' preferences regarding online math homework and paper math homework. Item 18 paralleled Item 12 but with reverse scoring. Items 27 and 28 also paralleled each other with reverse

scoring, as did Items 29 and 30.

Table 12

RS2 Averages and Standard Deviations for Survey Items Related to Students' Preferences Regarding Online and Paper Math Homework

Likert-type survey item	Average	Standard deviation
12	3.93	1.54
18	3.37	1.57
27	4.26	1.26
28	3.00	1.33
29	4.11	1.31
30	2.85	1.24

Item 18 was the most polarizing in the survey and resulted in the largest standard deviation (see Table 12). Three students selected "Strongly Agree," four students selected "Strongly Disagree," and every option in between was also selected by at least four students. The final results showed a split in responses nearly down the middle, with 48% (n = 27) of students agreeing with the statement, "I would rather have paper math homework than online math homework" (see Figure 16).

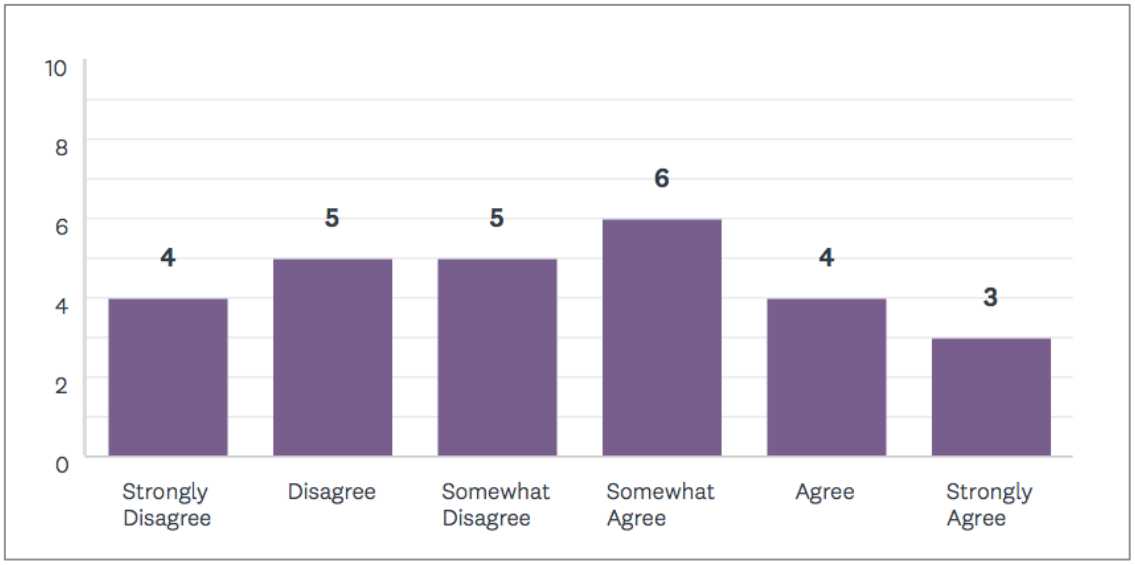


Figure 16. RS2 students' responses to Item 18: "I would rather have paper math homework than online math homework."

Responses to Items 27 and 28 showed that students had a more unified, positive opinion toward online math homework. In Item 27, 78% of students agreed that "Online math homework is more good than bad," a majority that was confirmed in Item 28. Just as students thought positively of online math homework, they also thought positively of paper math homework. Almost an identical percentage of students, 74%, agreed that "Paper math homework is more good than bad." This majority was also confirmed in Item 30 through reverse scoring.

Aids and hindrances to learning, open-ended. The last four questions in the survey were free-response questions, allowing students to type in what they viewed as aids and hindrances to learning for both online and paper math homework. When asked to "Describe anything about online math homework that helps you learn" in Item 31, students responded with comments such as:

- "the examples"
- "resources such as videos and examples [are] readily available"

- “multiple tries on a problem to eventually reach the correct answer”
- “the online textbook”
- “the immediate response as to whether I got it right or wrong”

The most common response to what aspect of online math homework aids learning was the online examples; 74% (n = 27) of students submitted this phrase. In response to Item 32, which read, “Describe anything about online math homework that prevents you from learning,” students wrote:

- “the setting doesn't prepare me for a test”
- “it prevents you from showing your work so you can’t look back on your homework and understand what you did”
- “teacher not present”
- “being able to Google the answers”
- “technical errors”
- “it’s a lot easier to cheat”
- “Typing numbers doesn’t help me remember, but writing does”
- “Sometimes when I have the right answer, it will say I’m wrong because of a rounding mistake”
- “I don’t have to remember anything because I can just use the resources”

The responses to Item 32 varied, but several answers made multiple appearances. The two most commonly mentioned hindrances with online math homework were that too much step-by-step direction and not being able to write things down prevented students from fully understanding the concept; 33% of students described these as a hindrance. The idea of being able to cheat or

guess was also commonly cited (19%; n = 27) by participants as an aspect of online math homework that hinders learning

When asked in Item 33 to “Describe anything about paper math homework that helps you learn,” students’ responses included:

- “you can look back on your work”
- “nothing, I’ve struggled with paper homework in the past”
- “the more you write it, the more you remember”
- “I just feel more comfortable reading a piece of paper instead of an electronic screen. It’s very distracting and easy to get off track.”
- “the test is always paper so it replicates the test”
- “I have to figure out the question, only using the basic examples in the book, and even though it is more of a challenge I learn more through it when I have to work it out.”

The majority of responses about what aspects of paper math homework aided students’ learning centered on help showing work. Out of 27 students, 74% mentioned showing their work as an aid to learning and comprehending the topic.

The final question of the survey, Item 34, asked students to “Describe anything about paper math homework that prevents you from learning.” Students responded with phrases such as:

- “nothing”
- “not many resources available”
- “my hand hurts and it proves to be much more tedious than online homework”

- “Not knowing if my answer is wrong as soon as I finish the problem. I may continue to do other problems wrong if I don’t know my first answer is wrong.”
- “I don’t like hand-writing all of my problems so I am less inclined to actually do it”

Several responses appeared multiple times, but the two most common responses cited “nothing” or noted a lack of resources. Out of the 27 students, 26% stated that there is nothing about paper math homework that hinders their learning. A lack of resources was also mentioned by 26% of students as a hindrance to learning with paper math homework. The second most common response was the lack of immediate feedback on whether a question was right or wrong, mentioned by 15% of students.

Results for Research Site 3

Research Site 3 (RS3), the smallest school in this study, is a small, private, K-12 school with a total of 396 enrolled students; 112 of those students are enrolled as high school students (ACSI, 2017). Due to the researcher’s use of criterion sampling, not all of the 112 high school students qualified for the survey. After speaking with the faculty liaison at Research Site 3, the researcher administered the survey in person to the students who qualified and who had turned in a signed parental consent form. The researcher received a total of 20 survey responses, all 20 complete and usable. These 20 responses were equivalent to 18% of the high school student population.

Demographics. From the 20 survey participants, 50% were female and 50% were male. All participants were high school seniors in 12th grade. Research Site 3 had the most diverse population of participants. The majority of the participants, 40%, identified as Hispanic, while 25% identified as Caucasian, and 20% identified as African American. Two participants selected "Other," with one participant identifying as "Mulatto" and the other typing in the word "Mixed." Figure 17 illustrates the demographic categories students chose when self-identifying.

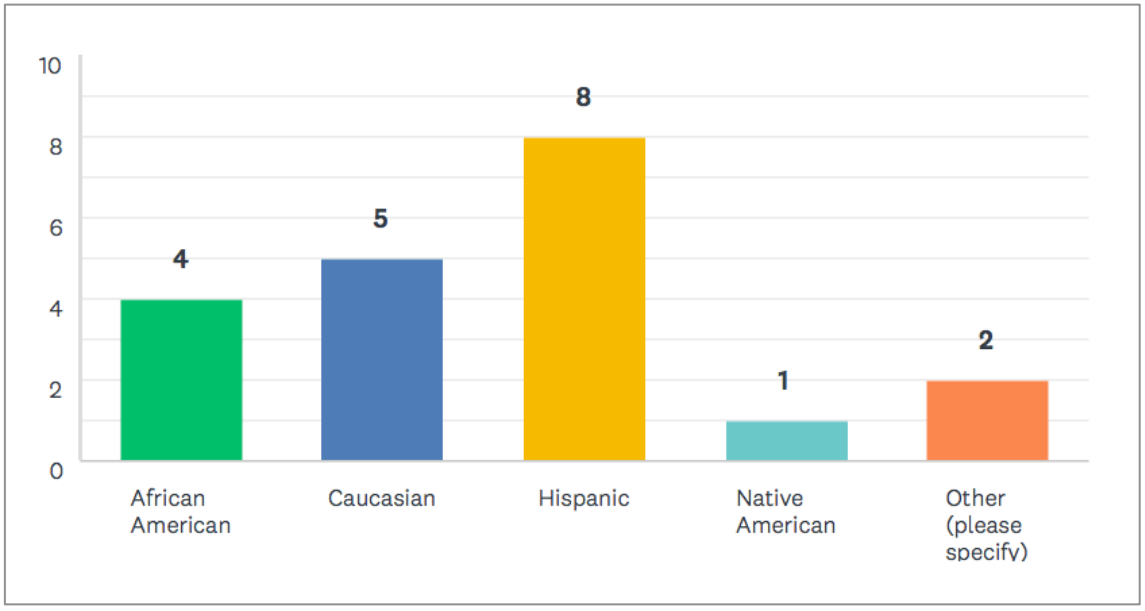


Figure 17. Demographic associations of RS3 students.

No students at RS3 identified as Caribbean Islander, Hawaiian/Pacific Islander, or Indian. Students also provided insight into their levels of achievement in mathematics, by self-reporting grades they most commonly earned in their high school math classes (see Figure 18).

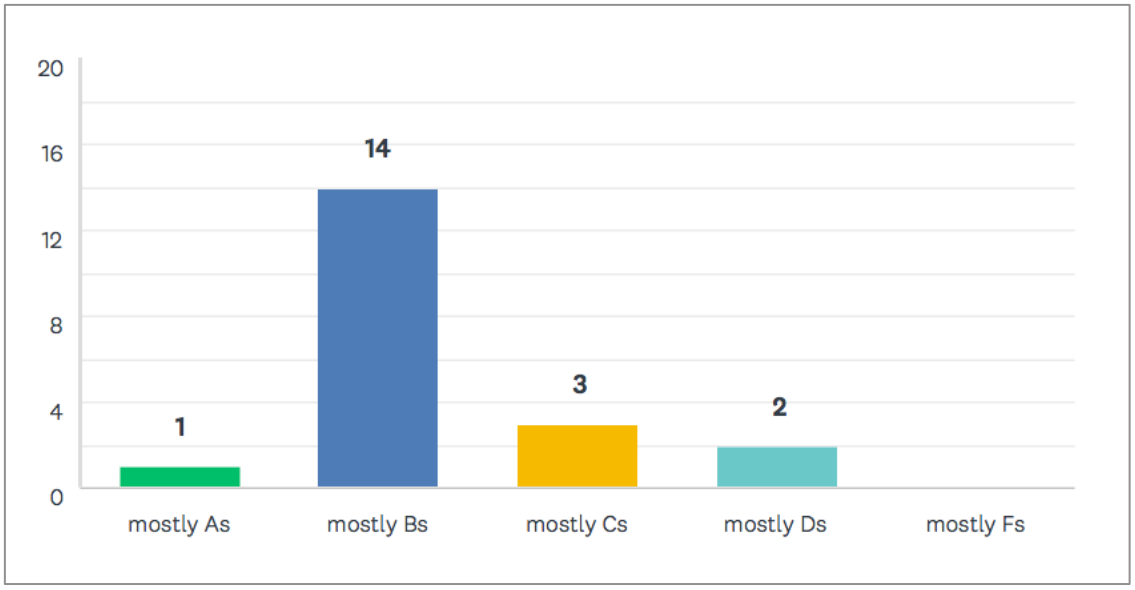


Figure 18. RS3 students' self-reported math grades.

Survey items 10 through 30, Likert-type. After the demographic information, students completed 21 Likert-type survey items that directed participants to “Select the option that best describes how you feel.” Participants were able to select from the following levels of agreement for each of the 21 items with corresponding value: Strongly Disagree (1), Disagree (2), Somewhat Disagree (3), Somewhat Agree (4), Agree (5), Strongly Agree (6), and “I prefer not to answer” (7). The vast majority of students responded to every Likert-type item. Only two survey items recorded a response of “I prefer not to answer,” from one student each. For these two items, the researcher analyzed the data by deleting any value of 7.0 from the calculations (“I prefer not to answer”) and determining the average for the item based on 26 available responses. Therefore, all averages fell between 1.0 and 6.0. Averages below 3.50 indicate that participants disagreed with the statement while averages above 3.50 indicate that participants agreed with the statement. Once the average had been

determined for each item, the researcher also calculated the standard deviation for each Likert-type item (see Table 13). A lower standard deviation, such as 0.83, indicates that most of the participants' responses were close to the average. A higher standard deviation, such as 1.54, indicates that participants' responses were more varied for that item.

Table 13

RS3 Averages and Standard Deviations for Survey Items 10-30

Likert-type survey item	Average	Standard deviation
10	4.80	0.93
11	4.00	1.26
12	4.05	1.66
13	4.55	1.12
14	4.75	1.13
15	5.25	0.54
16*	2.79	0.95
17	3.50	1.16
18	3.25	1.34
19	3.60	1.59
20	2.50	1.02
21*	2.58	1.18
22	4.55	0.97
23	3.35	1.24
24	4.55	0.92
25	3.65	1.01
26	5.00	0.77
27	4.50	1.16
28	2.65	1.11
29	3.85	1.06
30	3.20	1.17

* denotes an item where one of the participant responses was “I prefer not to answer”

Survey items were randomly presented to students so as not to influence their responses. Survey items 10, 15, 16, 21, 25, and 26 addressed student perceptions about the aids and hindrances to learning with online math homework. These items focused on the presence of aids and hindrances within an online homework environment and used a Likert-type scale. The averages and standard deviations for these survey items can be seen in Table 14. In later items, students were asked to list the specific aids and hindrances.

Table 14

RS3 Averages and Standard Deviations for Survey Items Related to Student Perceptions about the Aids and Hindrances to Learning with Online Math Homework

Likert-type survey Item	Average	Standard deviation
10	4.80	0.93
15	5.25	0.54
16*	2.79	0.95
21*	2.58	1.18
25	3.65	1.01
26	5.00	0.77

* denotes an item where one of the participant responses was “I prefer not to answer”

Item 16 paralleled Item 10 structured in such a way that scoring was reversed, as did Items 15 and 21. While discussing online resources, all but one participant (n = 20) agreed with Item 10,which stated, “Online math homework provides me with resources that help me solve my homework problems.” Additionally, 100% of participants (n = 20) agreed with Item 15 that stated, “When completing online math homework, I use the online resources provided” (see Figure 19).

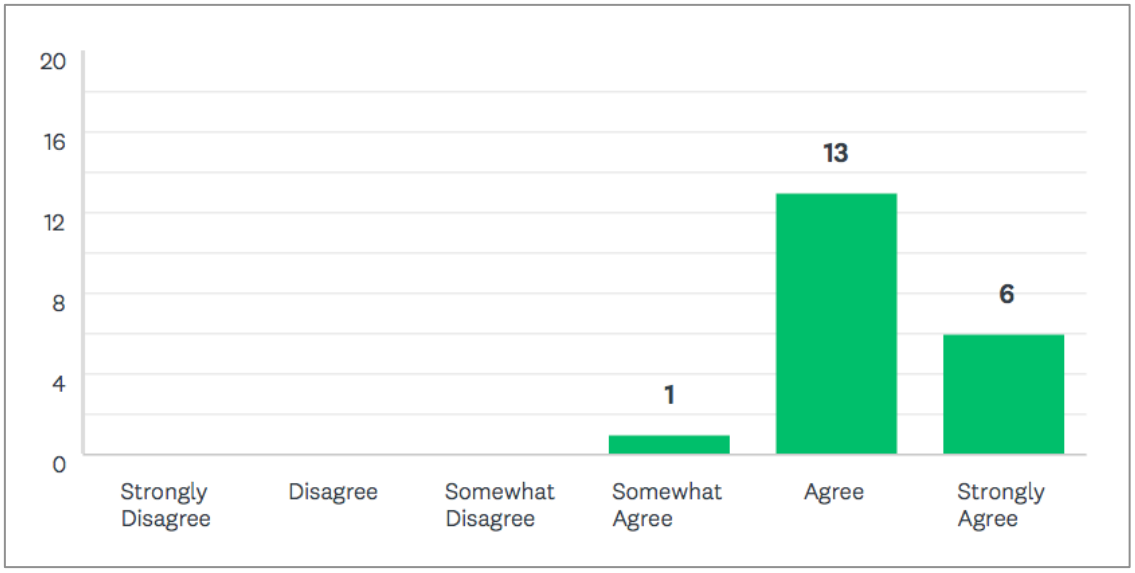


Figure 19. RS3 students' responses to Item 15: "When completing online math homework, I use the online resources provided."

In Item 26, all but one student agreed with the statement, “There are things about online math homework that help me learn how to do math.” However, in Item 25, 60% of students (n = 20) agreed that “There are things about online math homework that prevent me from learning how to do math.”

Survey items 11, 17, 23, and 24 addressed student perceptions about the aids and hindrances to learning with paper math homework. Item 17 paralleled Item 11 but with reverse scoring, as did Items 23 and 24. As shown in Table 15, the reverse scoring confirms the results, with the average for Item 11 showing agreement and a neutral average for Item 17 showing neither agreement nor disagreement. Similar results can be seen for Items 23 and 24, with Item 23 having a low average (disagreement) and Item 24 having a high average (agreement).

Table 15

RS3 Averages and Standard Deviations for Survey Items Related to Student Perceptions about the Aids and Hindrances to Learning with Paper Math Homework

Likert-type survey item	Average	Standard deviation
11	4.00	1.26
17	3.50	1.16
23	3.35	1.24
24	4.55	0.92

* denotes an item where one of the participant responses was “I prefer not to answer”

For Item 11, 60% (n = 20) of participants agreed that “Paper math homework provides me with resources to help solve my homework problems.” This result was further reinforced by participants’ responses to Item 24, where 65% (n = 16) of participants agreed that “There are things about paper math homework that help me learn how to do math.”

The next series of survey items (13, 14, 19, 20, 22) addressed students’ perceptions of whether they learned from online and paper math homework, as well as and students’ perceptions regarding their grades after having been assigned online and paper math homework (see Table 16).

Table 16

RS3 Averages and Standard Deviations for Survey Items Related to Students' Perceptions about Learning Gains with Online and Paper Math Homework

Likert-type survey item	Average	Standard deviation
13	4.55	1.12
14	4.75	1.13
19	3.60	1.59
20	2.50	1.02
22	4.55	0.97

The vast majority of students, 85% (n = 20), agreed with Item 13, which stated, "I earn higher test grades after I have online math homework." A slightly smaller majority, 60%, agreed with the statement in Item 19: "I earn higher test grades after I have paper math homework." Item 20 paralleled Item 14, but was structured for reverse scoring. Out of 20 students, 85% agreed with Item 14, which read, "I think that online math homework helps me learn how to do math" (see Figure 20). This outcome was mirrored by the reverse scoring in Item 20, where 85% of students *disagreeing* with the statement, "I do not think that online math homework helps me learn how to do math" (see Figure 21).

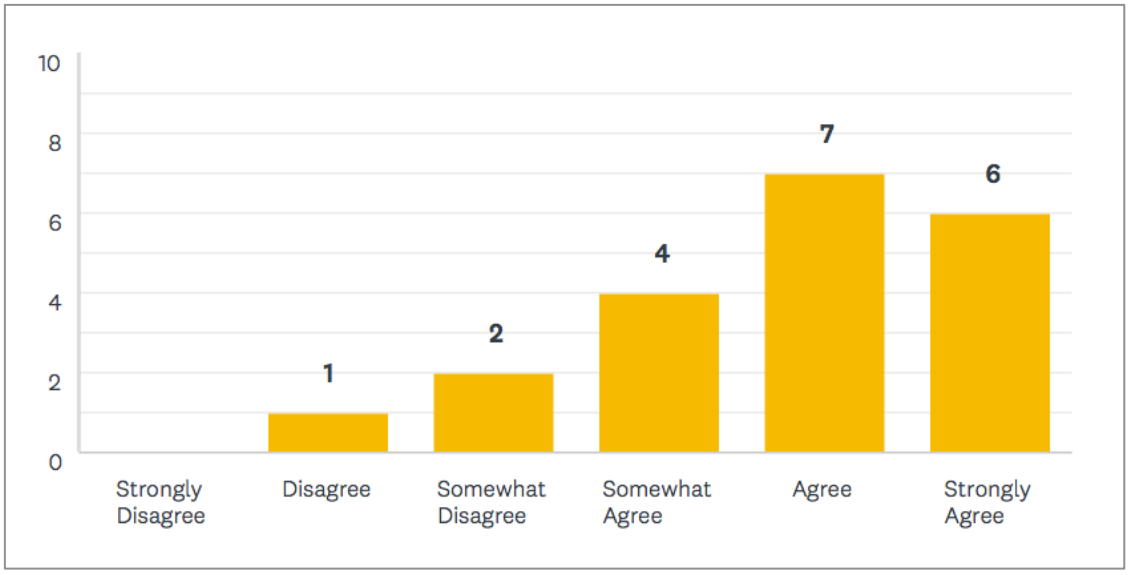


Figure 20. RS3 students' responses to Item 14: "I think that online math homework helps me learn how to do math."

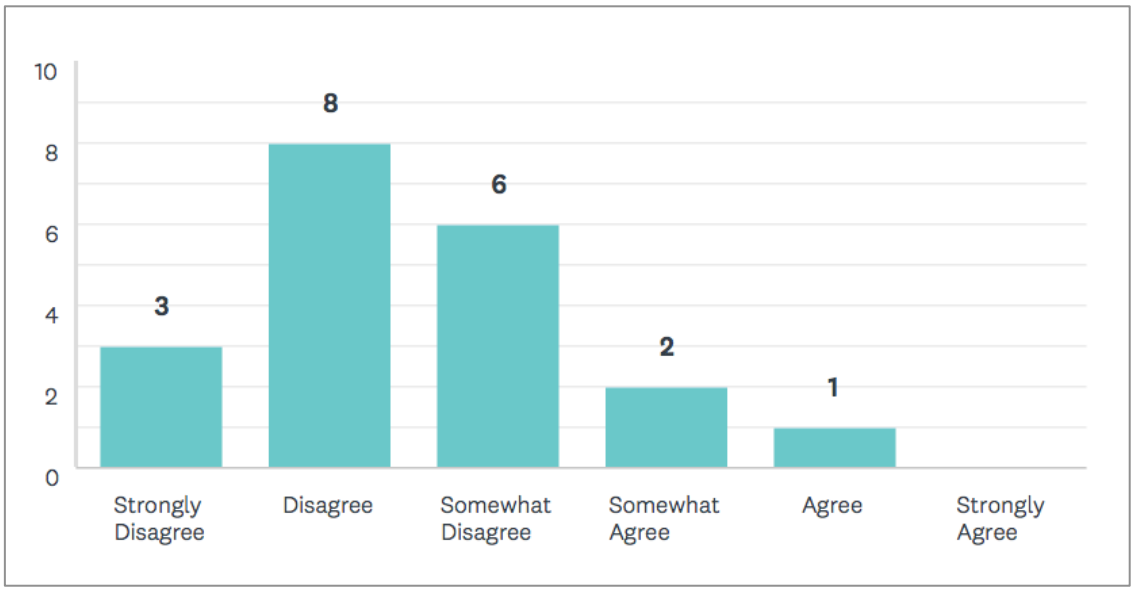


Figure 21. RS3 students' responses to Item 20: "I do not think that online math homework helps me learn how to do math."

Item 22, the final item in this cluster, stated, “I think that paper math homework is useful for my learning.” The large majority of students (85%; n = 17) agreed with this statement.

The last six Likert-type items referenced students’ preferences regarding

online math homework and paper math homework. Unlike other survey items that combined opinion with fact (i.e., “I earn higher test grades after I have online math homework” or “Online math homework provides me with resources”), Items 12, 18, 17, 18, 29, and 30 relied purely on students’ perceptions. This distinction led these six items to have larger values for standard deviation (see Table 17). Item 18 paralleled Item 12 but with reverse scoring. Items 27 and 28 also paralleled each other, as did Items 29 and 30.

Table 17

RS3 Averages and Standard Deviations for Survey Items Related to Students’ Preferences Regarding Online and Paper Math Homework

Likert-type survey item	Average	Standard deviation
12	4.05	1.66
18	3.25	1.34
27	4.50	1.16
28	2.65	1.11
29	3.85	1.06
30	3.20	1.17

Responses to Items 12 and 18 showed that students were divided in their preferences toward paper or online math homework. For Item 18, 10 students agreed with the statement, “I would rather have paper math homework than online math homework,” while 10 students disagreed with the statement (see Figure 22).

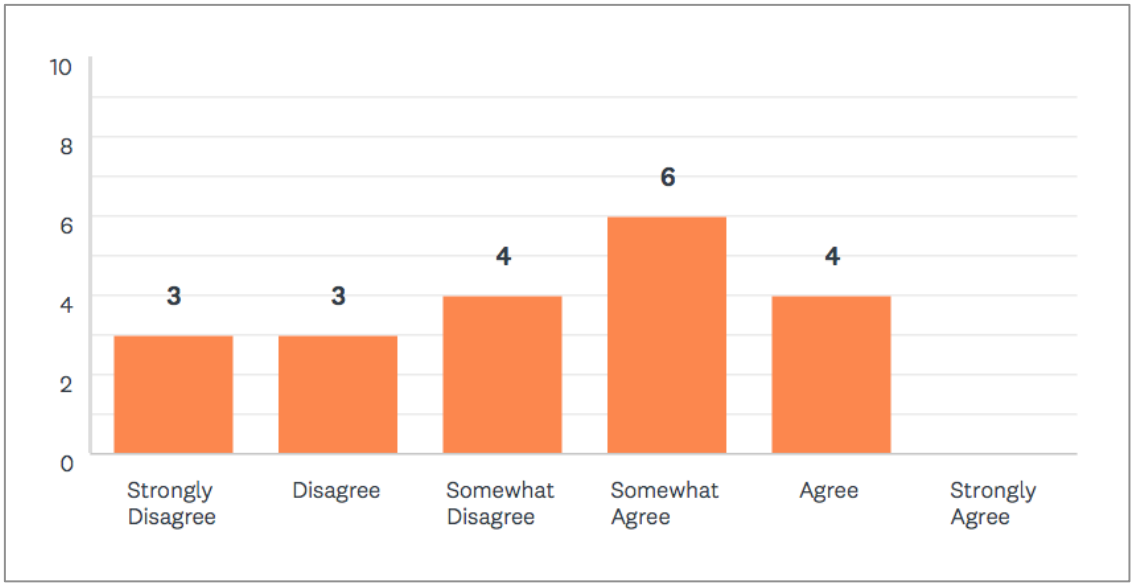


Figure 22. RS3 students' responses to Item 18: "I would rather have paper math homework than online math homework."

Items 27 and 28 showed that most students had a positive view of online math homework. In Item 27, 80% of students (n = 20) agreed that “Online math homework is more good than bad.” Responses to Items 29 and 30 showed that students also had a positive view of paper math homework. In Item 29, 70% (n = 20) of students agreed that “Paper homework is more good than bad,” a majority that was confirmed in Item 30.

Aids and hindrances to learning, open-ended. The last four questions in the survey were free-response questions that allowed students to type in what they viewed as aids and hindrances to learning for both online and paper math homework. When asked to “Describe anything about online math homework that helps you learn” in Item 31, students responded with comments such as:

- “the step by step instructions”
- “it tells me right away if I got the question right or wrong”
- “the View and Example and Help Me Do This [tools]”

- “the fact that the math website provides me with examples on how to solve the problem really helps”
- “Google”

The most common response when asked what aspects of online math homework aid learning was online resources; 70% of students mentioned them as an aid to learning. Out of the 20 participants, 35% percent mentioned examples, 40% mentioned step-by-step instructions/explanations of how to solve a problem, and 25% mentioned immediate feedback on whether their answer was right or wrong.

In response to Item 32, which read, “Describe anything about online math homework that prevents you from learning,” students wrote:

- “Sometimes the way my teacher teachers a lesson is different from how it is [online] so sometimes I struggle with that … and it confuses me”
- “not having someone I can ask a question [to]”
- “this may be due to my computer, but crashes, freezes, lagging, and sometimes glitches”
- “I can just guess to get the right answer”
- “Google”

Although answers to this question varied, some of the most common responses mentioned that online homework was different from what was taught in class and that being able to guess the answer inhibited learning.

When asked in Item 33 to “Describe anything about paper math homework that helps you learn,” students’ responses included:

- “Having paper and textbook side by side helps me to focus more because

they are so close together. As opposed to online work where I have to shift between my desk and the computer monitor."

- "seeing how I worked out the problem"
- "I learn better by writing things down, it cements it into my brain"
- "nothing because [the teacher] takes time grading and it's just more work for our teacher"
- "it is exactly how it was taught to me"
- "the ability to try the problems completely on my own"

Many of the participants' responses regarding what aids learning with paper math homework centered on the opportunity to show their work. Out of 20 students, 55% mentioned showing their work as an aid to learning with paper math homework.

The final question of the survey, Item 34, asked students to "Describe anything about paper math homework that prevents you from learning." Students responded with phrases such as:

- "I can very easily … do the question incorrectly. An online assignment tells me when I give the wrong answer."
- "It's very time consuming and tedious"
- "I have nothing to correct me"
- "Maybe there aren't more resources with paper homework, but I still prefer it"
- "nothing distracts me"
- "there is not anything that prevents me from learning"

Many of the participants' responses (25%, n = 20) were related to a lack of feedback as to whether their question was right or wrong. Additionally, out of the 20 students, 30% stated that nothing about paper math homework hinders their learning.

Qualitative Analysis

The researcher used focus groups for the qualitative component of this study. While the researcher planned for three focus groups, one at each of the three research sites, only those at the first and third sites were conducted. When the researcher administered the survey to students at the second site, several students indicated their willingness to participate in a focus group and provided their contact information (Survey item 8). However, despite the researcher making several attempts to contact these students via e-mail, none of the students at the second research site responded. Therefore, after consulting with her faculty advisor, the researcher was obligated to proceed with the study using only two focus groups. Table 18 provides background information on each of the focus group participants.

Table 18

Focus Group Participants

Name	Research site	Grade	Years with online math homework (6th – 12th)	Years with paper math homework (6th – 12th)
Charles	1	9	2	4
Albert	1	9	2	4
Isaac	1	9	2	4
Pierre	1	10	1	4
Henri	1	10	1	4
Blaise	1	10	2	5
Marjorie	1	10	2	3
Carl	3	12	2	2
Leonhard	3	12	2	2
Alan	3	12	2	2
Mary	3	12	2	2
Ada	3	12	2	2
Sophie	3	12	2	2
Emmy	3	12	2	2

Once all focus groups were conducted, the researcher transcribed the audio recordings and began coding. The researcher used descriptive coding for the first level of coding -- enabling the researcher to use a word or phrase to summarize the basic topic of a passage -- and pattern coding for the second level. After coding, the researcher had a list of 20 codes (Appendix N).

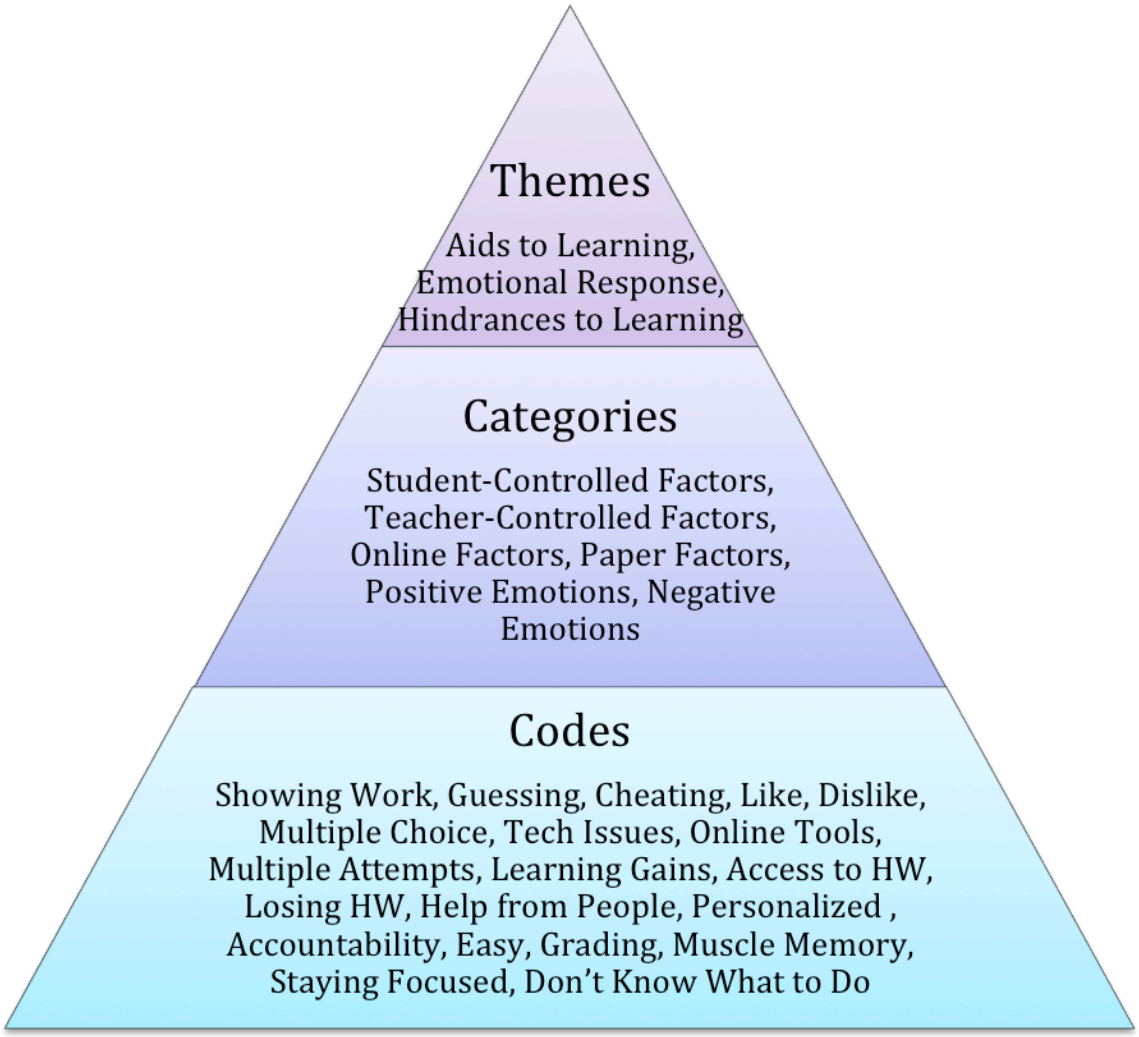


Figure 23. Qualitative codes, categories, and themes.

Upon completion of the second level of coding, the researcher further analyzed and organized the codes. The researcher began by grouping the codes into the following six categories: student-controlled factors, teacher-controlled factors, online factors, paper factors, positive emotions, and negative emotions. The researcher analyzed the codes separately for each site and documented the frequency of each code for each focus group. The researcher was able to triangulate the data by comparing the codes found in each focus group, ensuring that each code was found in both focus groups. Out of the total 20 codes, only

five codes did not appear in both focus group transcripts: Personalized, Accountability, Cheating, Grading, and Don't Know What to Do. These codes were grouped into their appropriate category and theme. Figures 24, 25, and 26 demonstrate which specific codes collapsed into which categories and which categories combined to create each of the three themes: Aids to Learning, Emotional Response, and Hindrances to Learning.

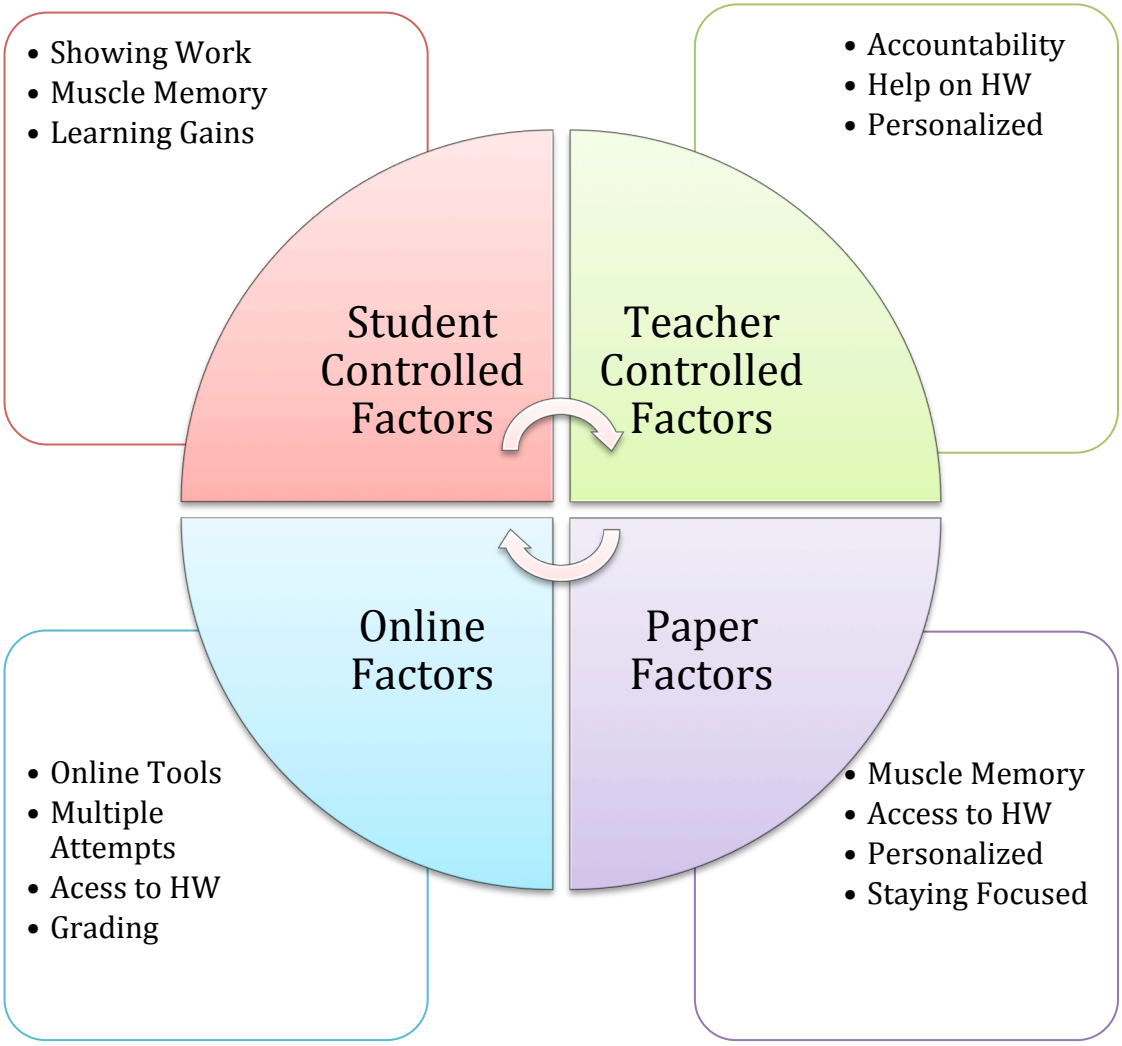


Figure 24. Categories and codes for the theme Aids to Learning.

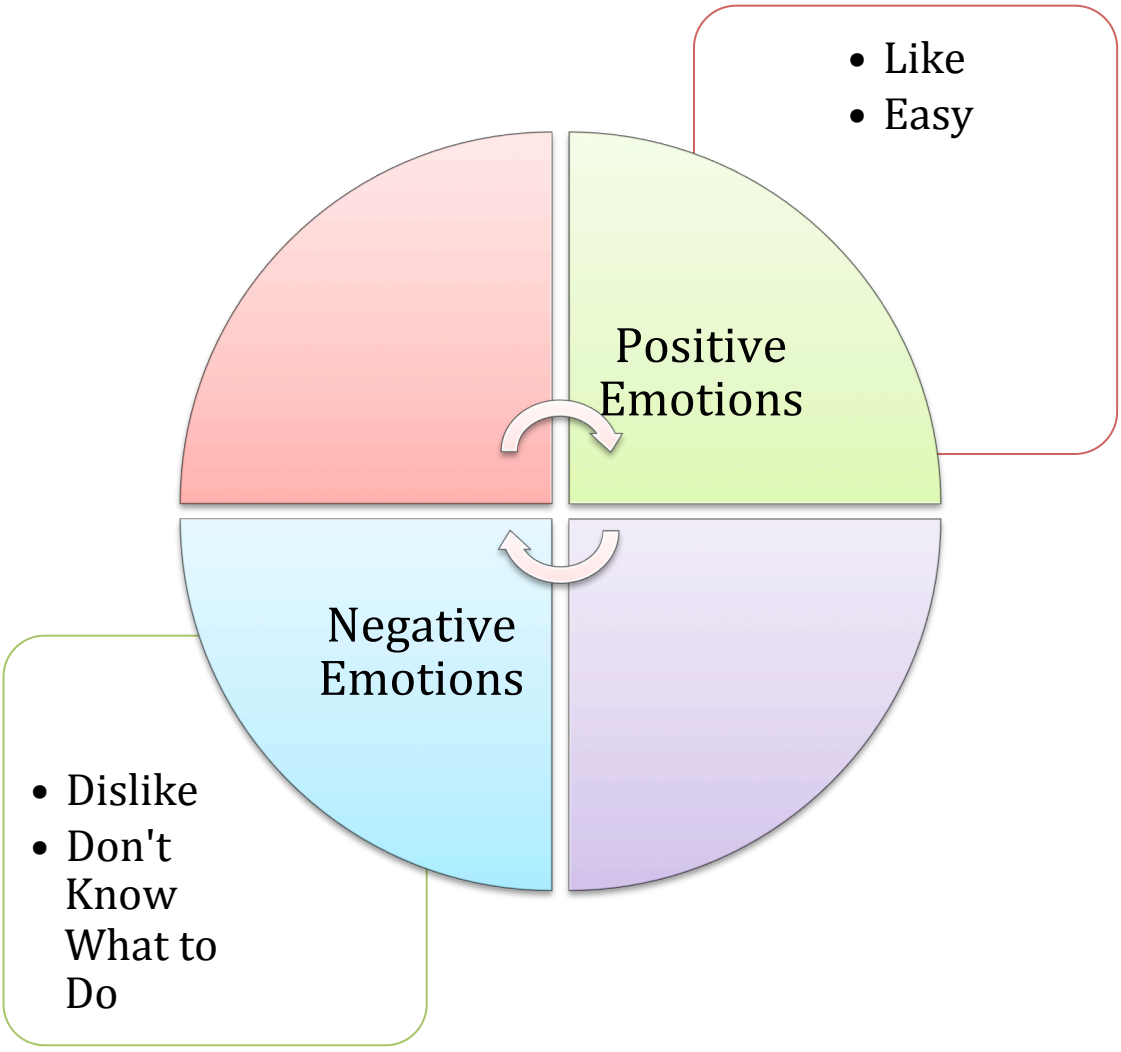


Figure 25. Categories and codes for the theme Emotional Response.

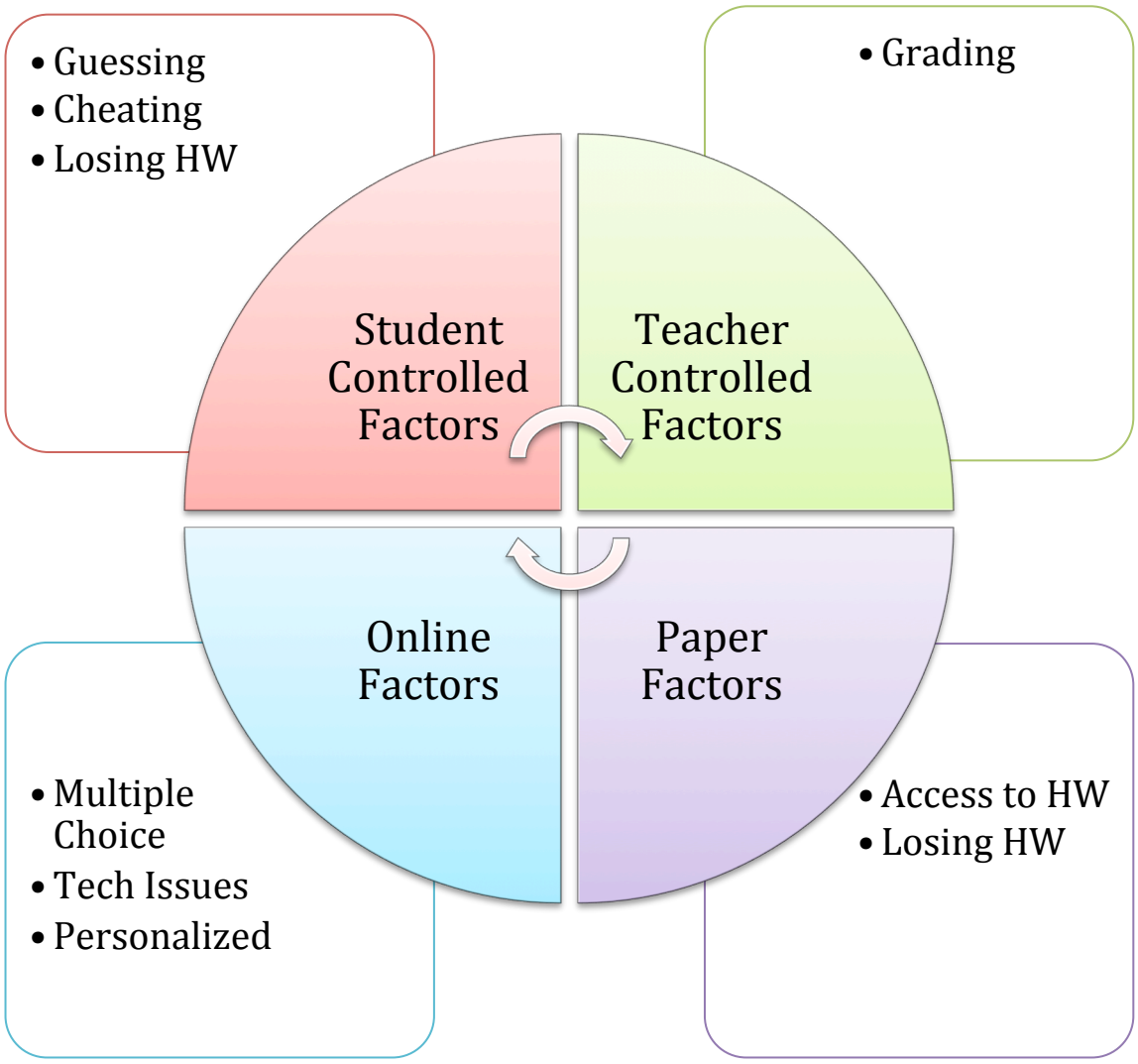


Figure 26. Categories and codes for the theme Hindrances to Learning.

Qualitative Findings

Once the researcher had completed the two levels of coding and organized the codes into categories, the researcher identified three themes from the data: aids to learning, hindrances to learning, and emotional response (see Figure 23). These three themes provided a basis for understanding high school students' perceptions about online and paper math homework, as well as their experiences with online and paper math homework. Additionally, through these themes, the researcher was able to view aspects of online and paper math

homework that students perceived as aids or hindrances to their learning.

Aids to learning. At each research site, the participants discussed aspects of both online and paper math homework that aid learning. The specific aspects participants mentioned as aids to their own learning were related to either the “human factor” of paper homework or inherent aspects of the mediums of online and paper homework. The aids to learning fell into four sub-categories. Student-controlled factors and teacher-controlled factors fell under the human factors, while online factors and paper factors fell under aspects of the mediums.

The most commonly mentioned aid to learning across any sub-category fell under student-controlled factors: writing things down and showing your work when you do math homework. Although one participant mentioned that he doesn't like showing work, he agreed with participants from both sites that writing down your work is helpful when trying to learn math. Several participants offered suggestions about why writing down work is helpful to learning. These reasons included the following: you can look at your work and see your step-by-step progress; you can see if you did anything wrong; and it’s easier for the teacher to help you if you write things down. However, the most common response as to why showing your work aids learning was intangible, something students were not able to put into words. Carl captured the essence of other participants’ responses when he said that paper helps him to learn more: “How do I explain this? When I write the problem, it sticks in my head.” Isaac stated that “doing the problems over and over again by hand kind of develops muscle memory, and it gets easier to do the problems.” This sentiment was echoed by Charles when he

said that “when you’re writing it down, it’s copied in your head, and then you know how to do it for next time, and for the test you pretty much remember what you wrote.” Participants also listed teacher-controlled factors, such as providing face-to-face help for math problems and accountability to complete your work in class as human factors that aid learning.

Online and paper math homework are presented in two different mediums. As a result, participants founds that different aspects of each aid learning. The most commonly mentioned inherent aspect of a medium to aid learning was the online help provided by online math homework. As Leonhard said, “It’ll tell you what you got wrong, and then you can go and see the steps.” Many students also brought up the fact that online help and online tools are available at any time, even when your teacher might not be available. Blaise stated, “If you get a question wrong, you can just look back in the [online] lesson and see how to do it instead of waiting the next day for your teacher.” Many participants mentioned that online tools—such as examples, immediate grading, and being allowed multiple attempts—assisted their learning.

Having access to lessons and homework was a final trait many participants mentioned as crucial to their learning. However, this access meant different things to each participant. Most students found online homework easier to access, as evidenced by the comments “you can go to any computer to find it,” “online, it’s always there,” “you can do it wherever you want,” and “you can do it anywhere.” However, Emmy and Sophie, two students at site three, said paper homework was more accessible than online homework. Emmy reasoned that

paper homework is “portable, so if you’re around someone you can say ‘Hey, can you help me with this?’” Additional aspects of paper homework participants said aid learning included the ability to stay more focused.

Hindrances to learning. As with aids to learning, participants at each research site discussed aspects of online and paper math homework that hinder their learning. These hindrances were organized into categories that mirrored the aids to learning categories: human factors and aspects of the medium. The sub-categories for hindrances to learning also paralleled the sub-categories for aids to learning: student-controlled factors, teacher-controlled factors, online factors, and paper factors.

While most participants at both sites were in general agreement about the aids to learning, participants at each site focused on very different hindrances to learning. The major hindrances to learning, as viewed by the participants at site one, included guessing or cheating with online homework and losing paper homework. Meanwhile, participants at site three found that technology issues were the biggest hindrance to learning with online homework, while the time it took to receive grades and feedback was the biggest hindrance to learning with paper homework.

The focus group participants at site one were forthcoming, stating that almost all of them had guessed at some time while completing online math homework, and several had cheated on online math homework. Several students mentioned the idea of not learning because they could just guess and check, since most online homework problems are multiple choice. Although it is possible

to guess on paper homework as well, as Marjorie stated, “If you’re trying to guess on [paper], you have to have an exact answer, and it could be completely off, whereas online it’s easier to guess.” Isaac agreed with Marjorie and said that with “online math homework, I can just sort of guess because it shows the options, and you just click on one of them that you think might be right.” Pierre, a participant at site one, was very reserved throughout the focus group. However, he was most vocal when discussing guessing or cheating with online math homework, and he mentioned that he “usually cheats” when he is assigned online math homework. Marjorie and Charles both confirmed how easy it is to cheat with online math homework, although they did not admit to cheating themselves.

Another hindrance participants at site one mentioned was a lack of personalization related to online math homework. Participants at site three did not mention a lack of personalization during their focus group. At site one, Isaac specifically said something that stops him from learning through online math homework is that “the lessons aren’t personalized.” Charles and Albert agreed, with both stating that with online math homework, it’s just “the same for everyone.”

While participants at site one focused on guessing and cheating as hindrances to online math homework, participants at site three found technological issues and tardiness in receiving homework grades as major hindrances to learning for online and paper math homework, respectively. As the group discussed hindrances to online homework, Leonhard stated the following:

> there’s the technological issues, where you didn't put the comma, or there were too many spaces or something, so it’ll mark you wrong. Or like how some questions will have the plus or minus and then you write both the other way – small technical errors.

Although Emmy was soft-spoken and reserved throughout the focus group, she vociferously chimed in with, “That happens all the time!” Mary also added, “Oh my goodness, I hate how you have to type in the number, and you type in the right number, but you left a space or something, and it’ll tell you that [the answer] is wrong.” Alan spoke up to agree with his fellow classmates regarding “all the technical issues.” Participants at site one also found technological issues a hindrance to learning with online math homework. Charles and Henri both mentioned that the completion of online math homework depends on good, working Wi-Fi, with Henri saying that, “online you need Wi-Fi to work, and if the Wi-Fi is down or the computer is out of battery, and you don't have a charger, then there’s no way to do [online math homework].”

The major hindrance for students at site three in regard to learning with paper homework was the amount of time it took to receive feedback and grades. Mary was the most vocal about her frustration with “having to wait for [the teacher] to grade it.” When asked if she learns from paper homework, Mary sarcastically responded, “After you get it back, like a week later.” Mary also expressed that sometimes she will complete her paper math homework and think, “Man this is right! And then you get it back and it’s like an F!” Leonhard also brought up the fact that with online grades “you know instantly, versus paper

homework, you have to wait for the teacher to give you back your work."

Another hindrance to learning with paper homework discussed at both sites is the lack of access to homework or the fact that paper homework could be lost. Several students bemoaned the fact that, to complete paper homework, "you have to carry [your book] everywhere" and that "the book is heavy." Ada even stated, "I mean you could take it, but I don't want to take my textbook home." Organization is key when paper homework is assigned, and as Charles said, "if you forget your binder that day or you're just not an organized person, then it's troublesome. … Paper has always been really easy [to lose]. Kind of haphazard." Henri and Mary agreed that paper is very easy to lose, with Pierre adding that losing paper homework is "pretty much my struggle" when it comes to learning with paper math homework. Not having access to homework will naturally prevent students from learning, and students mentioned the problems that could arise if they forgot their textbook or homework at school. Leonhard discussed times when he had "forgotten my paper work" and he couldn't do his homework, while Emmy expressed that there had been "times where I forgot my homework and I was like, 'Oh crap.'" Only one student at either site mentioned lack of access as a hindrance to online math homework, when Leonhard stated, "if you don't have access to a computer either at home or at school, then you're screwed."

Emotional response. Participants at both sites had passionate responses while discussing both paper and online math homework. This directed the researcher to combine the categories of positive emotions and negative emotions

under the theme emotional response. At site one, participants expressed only positive emotions toward paper math homework and only negative emotions toward online math homework. This distinction does not mean that all comments made toward paper and online homework were positive and negative, respectively, but that rather that all comments conveying feeling and emotions fell into these two categories. Participants said paper math homework was “better” and “pretty good,” while reserving much stronger negative phrases for online math homework. For example, Henri said, “I actually don't like it,” Pierre commented that “It sucks,” and Charles said “It’s kind of infuriating.”

The participants at site three showed a little more balance in their emotional responses to paper and online math homework, although, as with participants at site one, most positive emotions were directed toward paper math homework, while most negative emotions were directed toward online math homework. Participants at site three made comments, such as “I like paper homework better” and “I like it.” One conversation in particular captured strong emotions from Ada:

Ada: I love paper homework.

Mary: Wow. That’s a strong word.

Ada: It is a strong word! I love it.

Carl: Same.

But not all participants at site three had positive emotional reactions toward paper math homework. Mary described paper math homework as “annoying” and stated, “I hate it.” Mary also expressed negative emotions toward online math

homework, saying that it “drives me CRAZY!” and “is so annoying.” The majority of participants at site three, however, expressed negative emotions only toward online math homework. Ada described online homework as “very stressful,” going on to say that “because we have a time frame [to complete online homework], that’s even more stressful.” Alan did not speak much during the focus group, but when he did, it was usually an emotional reaction to online math homework. He expressed several times throughout the focus group that he is “not a big fan of online [math homework].”

Merging Quantitative and Qualitative Findings

To merge the quantitative and qualitative data and provide a greater understanding about the phenomenon of online math homework, the researcher adhered to a convergent design and conducted a side-by-side comparison of the data. The researcher compared the three themes, which emerged in the qualitative analysis, to the quantitative data. The researcher created a frequency table noting how many times each code appeared in the qualitative data (see Appendix N) and compared this to the quantitative data, allowing the researcher to examine the data together and determine how the two data forms related to each other. The researcher made sure to note topics on which the two forms of data supported each other and topics on which the two forms of data opposed each other.

Aids to Learning

The qualitative findings indicated that aids to student learning with online math homework are vastly different from aids to student learning with paper math

homework. Therefore, the researcher focused on comparing survey Items 31 and 33 with the following qualitative codes: Showing Work, Online Tools, Multiple Attempts, Access to HW, Help on HW, Personalized, Accountability, Grading, Muscle Memory, and Staying Focused. Survey Items 31 and 33 asked students to describe any aspects about online and paper math homework, respectively, which aided their learning. The results are displayed in Tables 19 and 20, with one table comparing findings for aids to learning with online math homework and the other table comparing findings for aids to learning with paper math homework.

Table 19

Comparing Frequencies of Online Aids to Learning

Code	Quantitative frequencies n = 64	Qualitative frequencies n = 14
Online Tools	46	25
Multiple Attempts	2	12
Access to HW	6	22
Grading	8	12

Table 20

Comparing Frequencies of Paper Aids to Learning

Code	Quantitative frequencies n = 64	Qualitative frequencies n = 14
Showing Work	27	35
Access to HW	6	22
Help on HW	2	13
Personalized	0	4
Accountability	1	3
Muscle Memory	16	25
Staying Focused	4	2

In both the qualitative and quantitative findings, participants mentioned online tools most often when discussing what aids their learning when completing online math homework. Being given multiple attempts at a problem, having easy access to the homework, and being provided with immediate feedback were mentioned more often in the focus groups than in the surveys. This difference is most likely because in the focus groups, participants' responses often addressed topics brought up by other students. Since the surveys were completed individually, each participant wrote down only what he or she believed were aids to learning without outside influence. In regard to aids to learning with paper math homework, the two most common responses were showing work and muscle memory. These two codes are similar but uniquely distinguished from one another. When students mention showing work, it refers to students being able to

see steps to a problem and showing their work on paper. The code muscle memory was used when students specifically mentioned something innate about paper that allows them to retain more information.

Hindrances to Learning

As with aids to learning, the qualitative findings indicated that hindrances to student learning with online math homework are vastly different from hindrances to student learning with paper math homework. Therefore, the researcher focused on comparing survey Items 32 and 34 with the following qualitative codes: Guessing, Cheating, Losing HW, Grading, Multiple Choice, Tech Issues, Personalization, and Access to HW. Survey Items 32 and 34 asked students to describe any aspects about online and paper math homework, respectively, which prevented them from learning. The results are displayed in Tables 21 and 22, with one table comparing findings for aids to learning with online math homework and the other table comparing findings for aids to learning with paper math homework.

Table 21

Comparing Frequencies of Online Hindrances to Learning

Code	Quantitative frequencies n = 64	Qualitative frequencies n = 14
Guessing	4	11
Cheating	5	6
Multiple Choice	3	4
Tech Issues	7	10
[Lack of] Personalization	1	3

Table 22

Comparing Frequencies of Paper Hindrances to Learning

Code	Quantitative frequencies n = 64	Qualitative frequencies n = 14
Losing HW	1	7
Grading	12	5
[Lack of] Access to HW	0	13

The qualitative and quantitative frequencies regarding hindrances to online and paper math homework varied. Although guessing, cheating, and technological issues were mentioned as the three most common hindrances to learning with online math homework, the quantitative data showed technology issues as the most common response, while guessing was the most common response in the qualitative data. Technology issues remained a common response in the qualitative data, however, having only one fewer mention than

guessing. The data shows that in regard to discussing hindrances about online math homework, students were much more likely to think of hindrances in the focus group setting than they were in the individual survey. Even though the focus groups had a total of 14 participants, compared to the 64 participants in the survey, every code was mentioned more often in the focus groups than in the survey. The results for hindrances to learning with paper homework varied as well. While only one participant out of 64 mentioned losing homework as a hindrance in the survey, this code was mentioned as a hindrance seven times in the focus groups, demonstrating that although students might not have thought of the hindrance individually, they agreed with other members of the focus group when the topic was brought up. Additionally, having a longer period of time to think about these issues might have prompted more students to remember losing homework as a hindrance of learning with paper math homework. Similarly, not a single student who took the survey mentioned a lack of access to homework or the textbook as a hindrance to learning with paper homework. However, a lack of access to paper homework was the most commonly mentioned hindrance in the focus groups.

Emotional Response

The qualitative findings indicated that students often had strong emotional responses to either online or paper math homework. For comparison of the qualitative and quantitative data, the researcher focused on comparing four survey items with the qualitative codes of Like and Dislike. When referring to the codes Like and Dislike, the researcher only coded instances where a participant

explicitly and verbally indicated that he or she had positive or negative emotion toward either online or paper math homework. For example, “I actually don’t like it” would be coded under Dislike, but “It is tedious” would not be coded under Dislike. Survey Items 12 and 27 displayed participants’ emotions toward online math homework, while Survey Items 18 and 29 showed participants’ emotions toward paper math homework. The results are displayed in Tables 23 and 24, with one table comparing participants’ emotional responses to online math homework and the other table comparing findings for emotional responses to paper math homework.

Table 23

Comparing Frequencies of Emotional Responses to Online Math Homework

Code	Quantitative frequency n = 64	Qualitative frequency n = 14
Like	80	0
Dislike	48	10

Table 24

Comparing Frequencies of Emotional Responses to Paper Math Homework

Code	Quantitative frequency n = 64	Qualitative frequency n = 14
Like	83	13
Dislike	45	2

Emotional responses to both online and paper math homework were much more frequent in the surveys than in the focus groups. This is largely due to the fact

that four survey items specifically addressed emotional responses toward the mediums, while the focus groups were purposefully less structured to allow participants to address topics as they desired. It is interesting to note that in the quantitative data, *both* online and paper math homework had a significantly higher number of Likes than Dislikes. However, in the focus groups, not one student expressed that they liked online math homework, while 10 students (n =14) expressed that they did *not* like online math homework. In contrast, 13 out of 14 students in the focus groups expressed that they like paper homework, while two students indicated that they dislike paper homework. (This would mean that at least one student stated that they both like and dislike paper math homework.)

Summary

The current research study sought to investigate students' perceptions about online and paper math homework. The researcher administered a survey to students at three ACSI schools and analyzed the data through descriptive statistics. Through this analysis, the researcher was able to determine the patterns and frequencies in the students' responses. Through the quantitative analysis, the researcher noted that although not all students learned best with online math homework, nearly every student used the online tools provided when assigned online math homework. Once the surveys had been administered, the researcher conducted a focus group at two of the three ACSI schools to further investigate students' perceptions about online and paper math homework. Unfortunately, students at Research Site 2 did not respond to recruitment e-mails

and did not participate in a focus group. The researcher coded the focus group transcripts, first analyzing themes for each individual school, and then comparing similarities across all schools. Through qualitative analysis, the researcher noted that the most commonly mentioned aid to learning math was showing your work, while the two most commonly mentioned hindrances to learning were guessing or cheating with online math homework and losing your homework with paper math homework.

The survey data showed that students viewed a wide range of items as aids and hindrances to their learning regarding both online and paper math homework. These aids and hindrances for online math homework ranged from being given examples online to being able to cheat with online math homework. Aids and hindrances for paper math homework included items like as being able to show work on paper but not receiving immediate feedback on whether that work is correct. The focus group discussions mirrored many of the aids and hindrances mentioned during the surveys, but the group setting allowed students who did not think of certain aids and hindrances individually to agree or disagree with other students who mentioned specific issues.

V. DISCUSSION, IMPLICATIONS, RECOMMENDATIONS

The current study explored high school students' perceptions about online and paper math homework, along with identifying what aspects of online or paper math homework students viewed as aids or hindrances to their learning. While online math homework is not as prevalent in high schools as it is at the university level, that prevalence has grown significantly within the last 15 years. Through a convergent parallel design, the researcher employed both qualitative and quantitative methodologies. The quantitative data collection consisted of a survey, which allowed students the opportunity to share their attitudes toward each medium. Survey participants volunteered to participate in focus groups, which gave students further opportunity to discuss their perceptions of online and paper math homework. Students were able to provide an in-depth explanation of their views and experiences with online and paper math homework and the aspects of each that aid and/or hinder their learning.

Discussion

1. What are the perceptions of private high school students enrolled in daily, face-to-face math classes regarding both online and paper math homework?

This research study was conducted to understand students' perceptions about online and paper math homework. Figures 27 and 28 provide a representation of the surveyed students' beliefs about both online and paper

math homework. The data showed that 72% of students (n = 64) believed online math homework to be “more good than bad.” A slightly larger majority of students (75%; n = 64) believed paper math homework to be “more good than bad.”

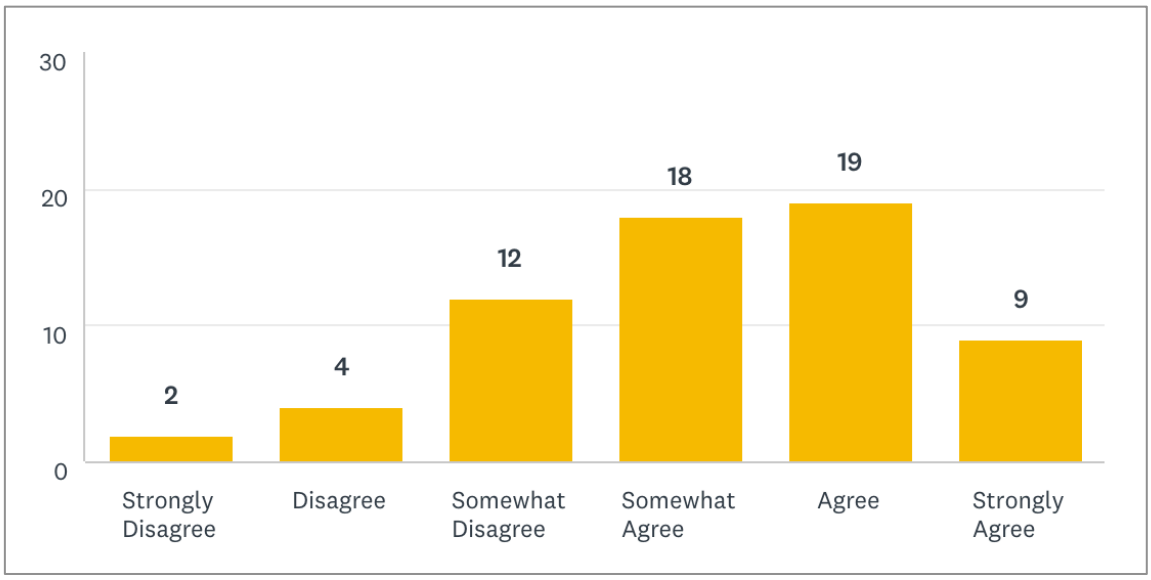


Figure 27. All participants' responses to Item 27: "Online math homework is more good than bad."

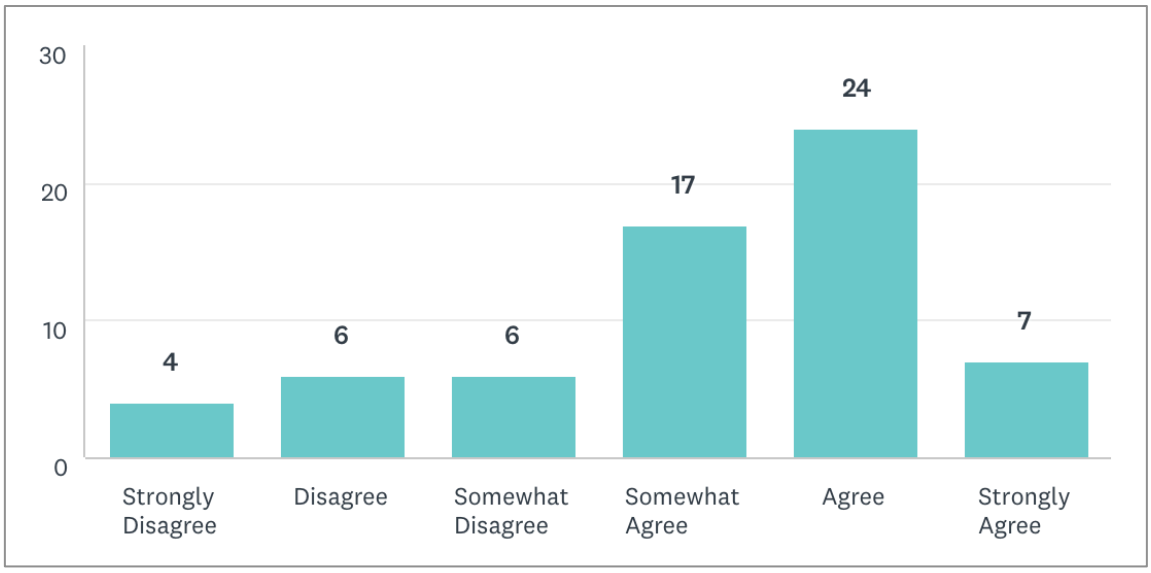


Figure 28. All participants' responses to Item 29: "Paper math homework is more good than bad."

Table 25

Focus Group Participants' Initial Reactions to Online Math Homework

Name	Positive reactions	Negative reactions
Charles		It's kind of infuriating.
Albert	I find it easy.	
Isaac*		
Pierre		It sucks.
Henri		I actually don't like it.
Blaise		[Paper homework] is easier.
Marjorie		You can just guess.
Mary	I think it's pretty cool.	
Ada		I find it very stressful.
Emmy	It's helped me a lot.	
Sophie		I like paper HW better.
Carl*		
Leonhard	I like the ease of [it].	
Alan		I'm not a big fan of online.

* denotes student who chose to not respond

Table 25 shows the focus group participants' responses when the researcher asked, "What is it like to have online math homework?" This question opened up the topic of online math homework to the focus group, allowing the researcher to witness participants' gut reactions to online math homework. Out of

the 14 focus group participants, two participants chose not to respond to this question. Therefore, out of the remaining 12 focus group participants, two-thirds of the participants' first reactions toward online math homework were negative, with descriptors of online math homework ranging from "infuriating" to "stressful." A total of four students had an initial positive reaction toward online math homework, with eight students displaying an initial negative reaction toward online math homework.

Table 26 shows the focus group participants' responses when the researcher asked, "Tell me what it's like to have paper homework." Out of the 14 focus group participants, three participants chose not to respond to this question. Therefore, out of the remaining 11 focus group participants, 82% of the participants' first reactions toward paper math homework were positive, with descriptions of paper math homework including, "It's pretty good." Nine students had an initial positive reaction to paper math homework, and only two students had an initial negative reaction to paper math homework. These numbers are nearly opposite to students' reactions to online math homework, which had eight negative reactions and four positive reactions.

Table 26

Focus Group Participants' Initial Reactions to Paper Math Homework

Name	Positive reactions	Negative reactions
Charles	Faster.	
Albert*		
Isaac*		
Pierre	It's pretty good.	
Henri	It’s better.	
Blaise*		
Marjorie	You can write stuff down.	
Mary		Annoying.
Ada	I love paper homework.	
Emmy	I like that it’s portable.	
Sophie	I like it.	
Carl		I agree [that it’s annoying].
Leonhard	I like the ability to work out the problem.	
Alan	I like it.	

* denotes student who chose to not respond

Throughout the survey and focus groups, students often expressed both positive and negative emotions toward online and paper math homework, demonstrating that although a student may have a preference for one medium, having positive feelings toward online math homework is not mutually exclusive from having positive feelings toward paper math homework. The two most

passionate declarations came from Charles and Ada, with Charles expressing his disdain for online math homework by deeming it “infuriating” and Ada expressing her affection for paper math homework as seen in the following exchange:

Ada: I love paper homework.

Mary: Wow. That is a strong word.

Ada: It is a strong word! I love it.

Although Mary questioned Ada’s use of the word “love” for paper math homework, Ada defended her position by reiterating that she does indeed feel that strongly about paper math homework.

In conclusion, initial gut reactions showed that students have a much more positive opinion of paper math homework than of online math homework. Analysis of the survey data echoed this result, as students who viewed paper math homework as good slightly outnumbered the students who viewed online math homework as good. However, analyzing the rest of the focus group discussions and the survey data showed that most of the 64 total participants in this research study view both online and paper math homework in a positive light.

2. What aspects of online math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?

This research study aimed at understanding students’ perceptions about what aspects of online math homework aid and/or hinder their learning. The vast majority of students, 91% (n = 64), indicated that aspects of online math homework do directly aid learning (see Figure 29).

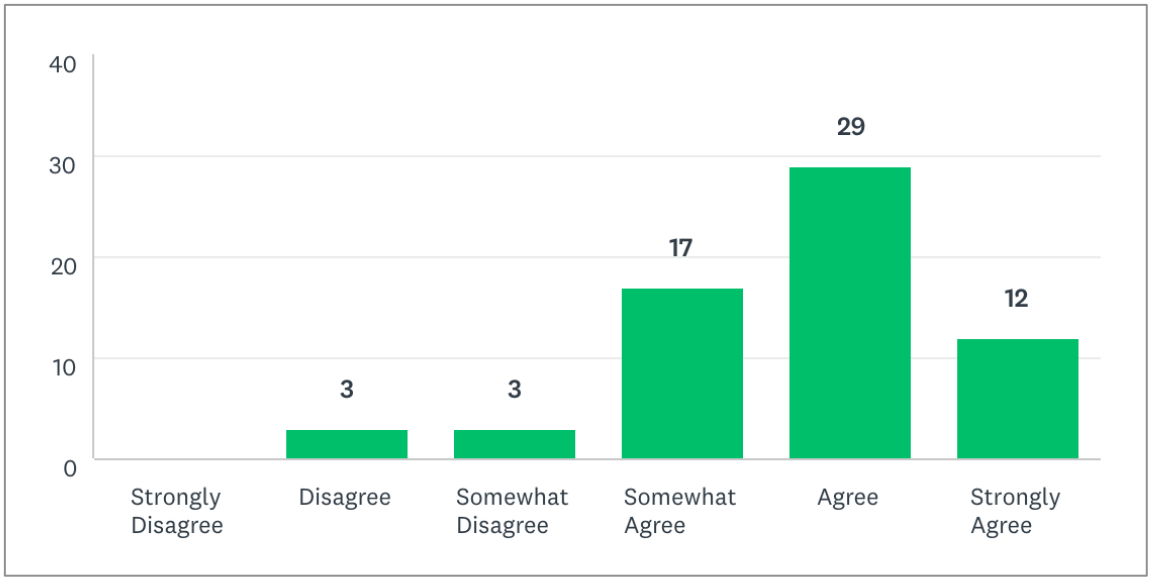


Figure 23. All participants' responses to Item 26: "There are things about online math homework that help me learn how to do math."

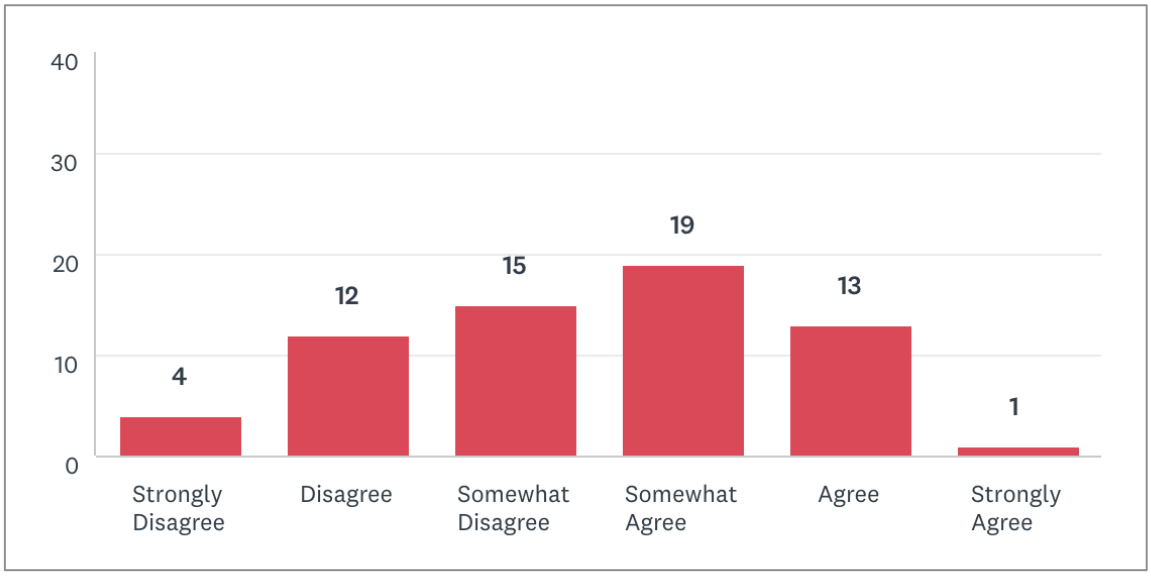


Figure 30. All participants' responses to Item 25: "There are things about online homework that prevent me from learning how to do math."

However, 52% of students also stated that there are specific aspects of online math homework that prevent learning (see Figure 30), demonstrating that although the overwhelming majority of students agree that the resources available with online math homework do help them learn, half of those same

students also view online math homework as something that can prevent them from learning.

Figure 31. Student-generated list of aids and hindrances of online math homework.

Figure 31 details specific aids and hindrances to learning with online math homework identified by participants in either the survey or focus groups. Sophie embodied the mixed emotions that many students demonstrated toward online homework when she said, “I like paper homework better, but one thing I like about online homework is the steps. They tell the examples and stuff, and you can see if you get it right or wrong.”

Another student, Emmy, emphasized the positive impact that online math homework had on her math grade:

> Honestly, it's helped my grade a lot, because last year, in Geometry, I had paper work, and like I'd turn it in or whatever, and then I'd get all these wrong answers, and I got bad grades on my homework. This year, I've gotten good grades because of Math XL [online homework program] telling me that it's wrong and showing me how to do it.

Mary agreed with Emmy and described online math homework in the following manner:

> It's pretty cool 'cause, like, when you do it, it'll say you got the wrong thing and then you can go through that little corner and see how to do it. The steps. And if you get it wrong, you can just redo it and just get the right answers. So, yeah. I just redo it all the time. Like, I get a 20%. Yeah, and I just improve my score and do it all over again.

As shown in Figure 32, nearly every item mentioned in the literature as a positive

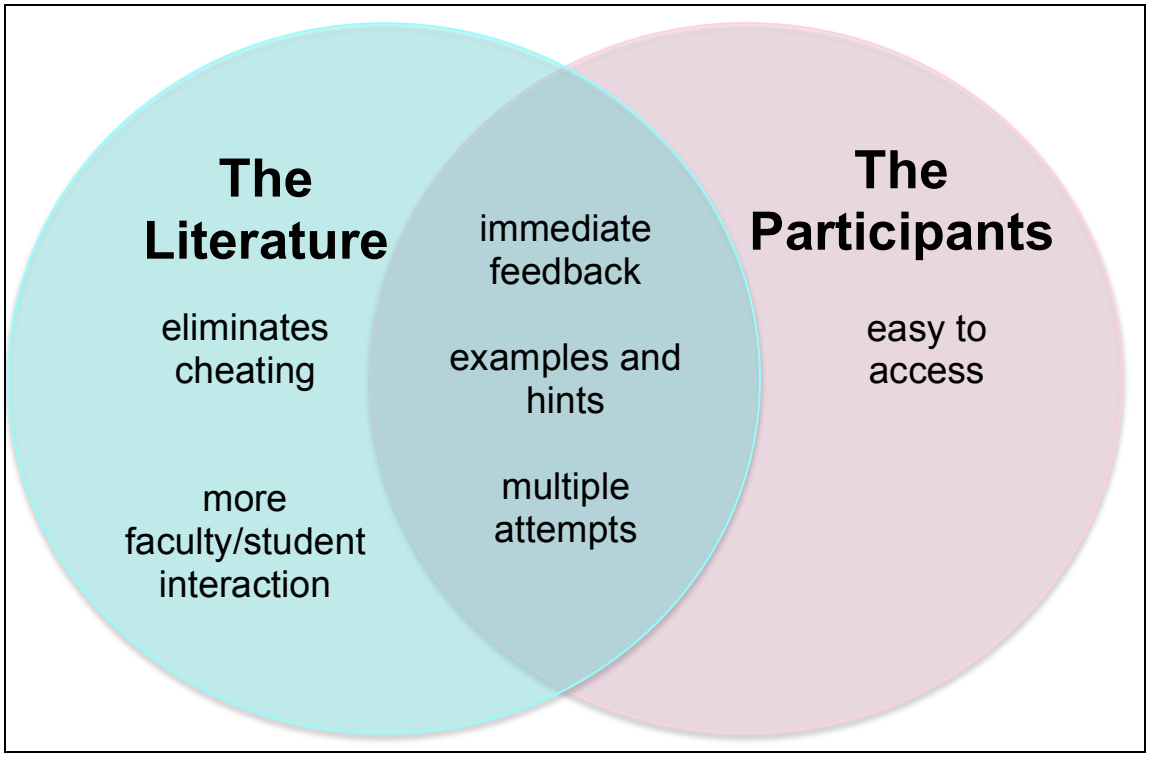


Figure 32. Comparison between aspects of online math homework that aid learning found in the literature and identified by participants.

aspect of online math homework was mentioned in this current research study as an aid to learning with online math homework. The notable exceptions were "eliminates cheating" and "more faculty/student interaction." Participants of the current research study stated that online math homework actually provides them with greater avenues to cheat. Additionally, participants mentioned that online math homework often results in less faculty/student interaction, which negatively impacts their learning.

The current research study added to the literature by finding that “easy to access” was a commonly mentioned student aid to learning with online math homework.

In addition to speaking about the favorable aspects of online math homework, students also spoke passionately about the hindrances to learning with online math homework. Several students described their frustration with the manner in which answers are input into online math homework and small technical errors in the process:

> Mary: Oh my goodness I hate how, like, you have to type in the number, and you type in the right number, but, like, you left a space in the front or something, and it’ll tell you it’s wrong.
>
> (laughter from others)
>
> Carl: Yeah!
>
> Mary: That drives me CRAZY!
>
> Emmy: That happens all the time!
>
> Mary: Or, like, they don't know the right answer, so you put in the answer that you think, and the answer was like 0.00, and I’m just like what? That lesson that we had the other time, I’m just like, this is so annoying. I was getting so mad.

Several students also mentioned that online math homework provided them with an easy outlet to guess or not really learn the material. Emmy explained:

> When I do the example ‘cause I want to get the problem right, it’ll tell me how to do it, and I don't fully understand how they got to that answer. I’m

just like, whatever, I just want to get the problem done. So I wouldn't say that I fully retain too much on Math XL [online math program].

Additionally, several students specifically mentioned that the multiple-choice format of online math homework hinders them from learning. Alan echoed Emmy's statements about not really learning because, "I just guess for them."

In conclusion, nearly all students surveyed agreed that some aspects of online math homework help them learn. However, half of those same students also stated that certain aspects of online math homework prevent them from learning. Therefore, although more students describe online math homework as an aid to learning, citing aspects of online learning, such as immediate feedback and online examples, a large percentage of students still describe online math homework as preventing them from learning due to certain aspects of online math homework, such as distractions that occur more easily and multiple-choice questions that facilitate cheating or guessing.

3. What aspects of paper math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?

The current research study also explores high school students' perceptions about the aids and/or hindrances to learning with paper math homework. As seen in Figure 33, 82% (n = 64) of students surveyed agreed that some aspects of paper math homework aid their learning. This percentage was not as high as the 91% of students who believed online math homework provided aids to learning, but it was still quite a high percentage.

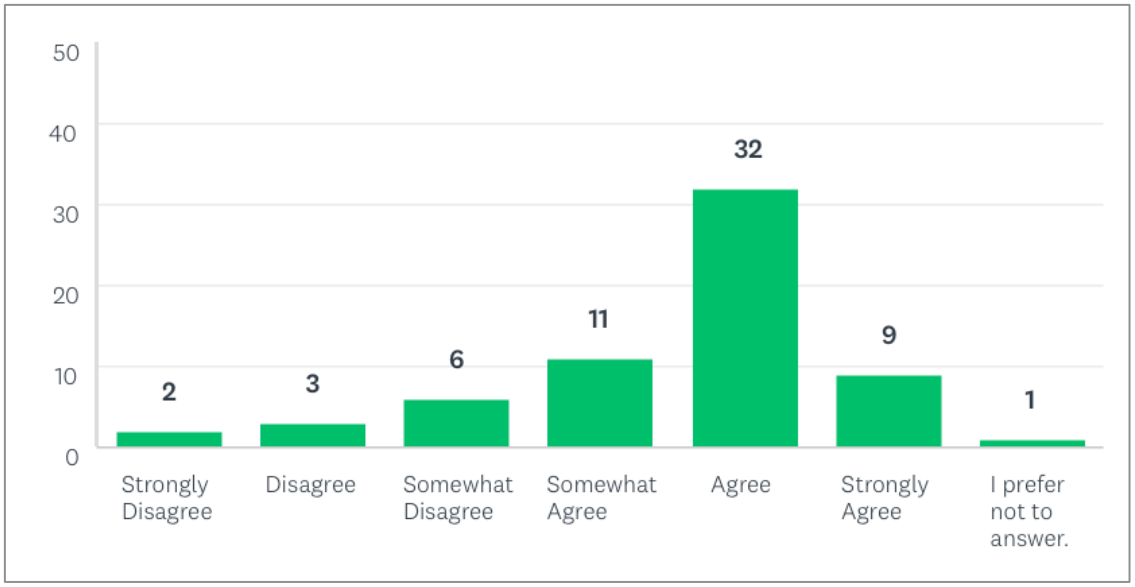


Figure 33. All participants' responses to Item 24: "There are things about paper math homework that help me learn to do math."

In contrast, Figure 34 shows that only 30% of students surveyed believed that aspects about paper math homework specifically hindered them from learning. This percentage had a much larger disparity against online math homework, as 52% of students stated that specific aspects of online math homework prevent learning.

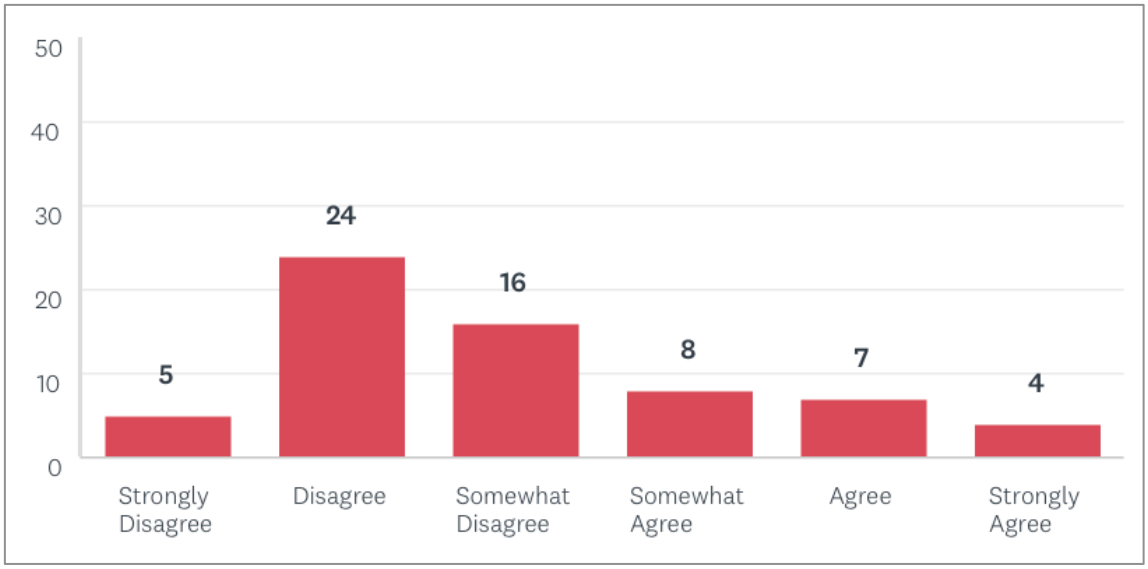


Figure 24. All participants' responses to Item 23: "There are things about paper math homework that prevent me from learning how to do math."

Figure 35 details specific aids and hindrances to learning with paper math homework that participants identified in either the survey or focus groups.

Figure 35. Student-generated list of aids and hindrances of paper math homework.

As seen in the chart, a variety of aids to learning were mentioned in regard to paper math homework. Charles summarized the sentiments expressed by many students when he said:

> When you see something online and it tells you how to do it, usually I still don't know how to do it. I still don't understand it even if it tells me, like, how to do it. But if I can write it down and then see how the formula works and how it goes in action, it usually just clicks.

Henri and Isaac echoed Charles' statement, with Henri commenting that paper

math homework allows you to “see the progress” and “show your ideas,” which in turn enables the classroom teacher to know how to help you if you did something wrong. Isaac added that he learns more from “paper [math homework] because writing it down and doing the problems over and over again by hand kind of develops, like, muscle memory, and it gets easier to do the problems.” Additionally, Carl stated that he preferred “paper because it … How do I explain this? ... when I write the problem, it sticks in my head.” These student perceptions about the importance of showing work with math homework align with Gagné’s (1977) Conditions of Learning Theory, as Gagné asserts that repetition is necessary in order to enhance retention and transfer of information (Gagné et al., 1992).

Several students noted one aid of learning with paper math homework was that paper allowed them to focus more on the task at hand. Leonhard stated that he learned more from “paper, because I actually have to – like I actually focus and think about the work, instead of just plugging it in on the computer.” Ada agreed with Leonhard’s assessment and noted that, “I don't know why, I don't know if it's the computer screen or something – I don't know why, but when it’s in textbook form you just focus more. At least for me. I don't know why.” Carl chimed in to agree by saying, “Same,” and Alan also agreed with his “fellow classmate Leonhard,” stating that paper math homework helps him learn because “it’s easier to focus with the textbook there, writing down the answers and the problems.”

Students also spoke about the hindrances to learning with paper math

homework; many students mentioned losing their paper homework or having to carry around their heavy math textbooks as hindrances to learning. Leonhard stated that “there’s been times I’ve forgotten my paper work and been like, where’s my book, and I can’t do it. But with online [homework], I know I can go online and do it.” Henri and Pierre agreed, with Henri proclaiming that “It’s easy to lose it!” and Pierre adding, “That’s pretty much my struggle right there.” Charles also mentioned that that “if you forget your binder that day or you’re just not an organized person, then it [paper math homework] is troublesome.”

The other major hindrance to learning with paper math homework was the lack of immediate feedback. Mary bemoaned that she feels like she learns from paper math homework “after you get it back like a week later.” Mary went on to add that the amount of time that passes while she awaits feedback on her work often stops her from learning with paper math homework because “you do it and you’re like – man this is right! And then you get it back and it’s like an F!” Tallent-Runnels et al. (2005) stated the importance of providing timely feedback to students about their performance, and as seen throughout the focus group discussion, it continues to be a best practice that is highly valued by students as an aid to their learning.

In conclusion, the data showed that students believe more aspects of online math homework aid learning than those of paper math homework. However, students also believed more aspects of online math homework work to hinder learning than those of paper math homework. When asked which medium allows him to learn more, Albert summarized the differences in mediums by

expressing that it “depends. If you're doing it with the teacher there, paper’s better because you can go through it with them, and they can show you how to do it. But if you’re doing it by yourself, then the computer because it has, like, more tools to help you.”

Implications and Recommendations

The purpose of this research study was threefold: to better understand how high school students perceive online math homework, to determine what aspects of online math homework aid and/or hinder student learning, and to improve the student learning experience with online math homework. While this study provided data regarding students’ perceptions about online and paper math homework, only students from three research sites could participate. Therefore, it is important to note the limitations of this study. However, based on the available quantitative and qualitative data, the researcher noted implications for high schools, specifically ACSI schools, and provided recommendations for future research in the area of online math homework.

Implications for ACSI Schools

The Association of Christian Schools International (ACSI) is a diverse organization, with more than 3,000 ACSI schools in the United States and more than 20,000 ACSI schools internationally. Although ACSI prides itself on academic rigor, there are philosophical differences between an ACSI school and typical public schools. ACSI schools aim to be “schools that contribute to the public good through effective teaching and learning and that are biblically sound, academically rigorous, social engaged, and culturally relevant” (ACSI, 2017).

Since all of the participants in this study attended an ACSI school, the researcher focused on the implications for ACSI schools.

The classroom teacher. Although this research study sought to focus on aspects of the mediums themselves, students continued to mention the classroom teacher as both an aid and a hindrance to learning math homework, depending on whether the homework was online or paper. For online math homework, students described the lack of personal help from their classroom teacher as a hindrance, while many students mentioned their receiving help from their teacher as an aid to learning with paper homework. This aligns with current research, which states that “many of the best online courses include high-quality face-to-face instructional support for students” (Herold, 2017).

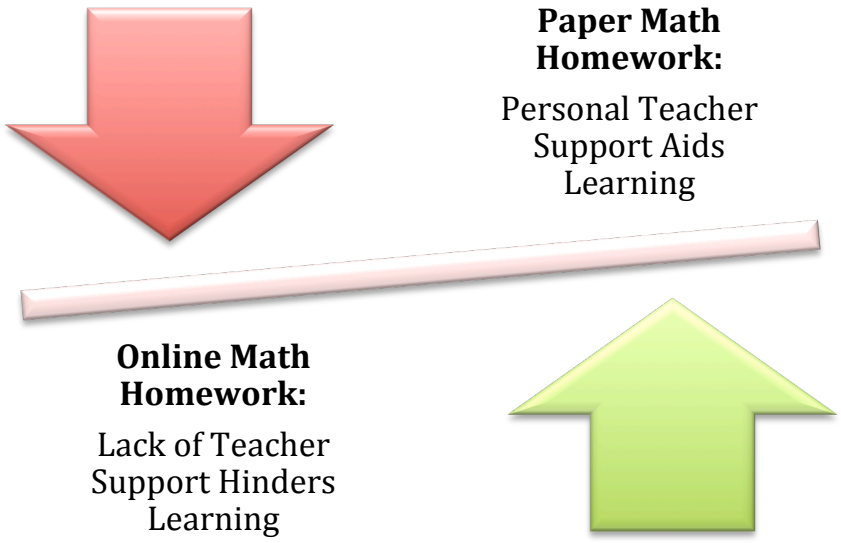


Figure 36. Participants' description of the role of the classroom teacher.

However, students also mentioned that learning with online math homework could be difficult at times because the homework was different from the lesson taught in class. One survey participant who was assigned online math

homework but received paper assessments stated that the online math homework “setting doesn't prepare me for a test.” This sentiment aligns with research conducted by Duhon (2012), which found that learning gains made through computer practice did not generalize to paper-and-pencil performance. From this data, teachers should recognize the need to ensure that all math homework, whether online or paper, should be aligned with what is taught in class.

Additionally, students contrasted immediate feedback from online homework with delayed feedback with paper math homework. Students mentioned that a hindrance to learning with paper homework was the amount of time it took for the classroom teacher to grade the homework and for students to receive feedback, while immediate feedback from online math homework was an aid to learning. To address the need for students to receive feedback on their homework, high school math teachers can provide the answers to some paper homework problems at the same time that the homework is assigned to assist students who learn from the instant grading and feedback provided by online math homework. This action will also alleviate some of the work required from teachers to grade students’ homework within a short time frame.

Use of technology. Online tools were a prevalent topic throughout this research study. Students consistently listed the online examples as aids to learning. Another aid to learning that stemmed directly from technology was how easily accessible online lessons and homework were. This should encourage teachers to be aware of students’ access to lessons and homework assignments.

If carrying around a math textbook is too bulky, schools and administrators should look into a curriculum that offers digital copies of the textbook along with the hard copy. This way, even students who have paper homework will have easy access to examples. One of the most significant hindrances to online math homework was the fact that students either guessed or cheated for the multiple-choice questions online. Most participants in this study were assigned multiple-choice math questions when they had online math homework, and the participants openly admitted to guessing or cheating. This finding contradicts the idea—often stated by proponents of online math homework—that online homework helps to eliminate cheating by randomizing values (Bonham et al., 2001). Therefore, classroom teachers should make every effort possible not to include multiple-choice questions when assigning online math homework. Online math programs often include teacher settings where the teacher can control many characteristics, including how many questions are assigned. Teachers must be aware of these settings and select the settings that will aid their students in learning the material, rather than just guessing or cheating.

Showing work. Whether discussing online or paper math homework, students continuously brought up the idea of muscle memory and how writing math problems down on paper helps them to remember the concepts. While the mantra “show your work” has been repeated by math teachers for decades, it is often associated with paper math homework. It is true that paper homework facilitates writing down your work, since the student already has a paper and pencil at the ready. However, since the data was clear that showing work aids

learning, special attention needs to be given to how showing work can be effectively incorporated into online math homework. This may have to happen through the incorporation of tablets, phone apps, new software that allows students to show and save their work, or simply strict accountability that students must show their work on paper when completing online math homework. All of these avenues should be given priority to allow students completing online math homework to reap the benefits of showing their steps for math problems and being able to look back on their work.

Recommendations for Future Research

The purpose of this study was threefold: to understand how high school students perceive online math homework, to determine what aspects of online math homework aid and/or hinder student learning, and to improve the student learning experience with online math homework. Despite several students claiming that they "hate math," the vast majority of participants in this study were high-achieving math students. Out of the 64 participants in this study, 88% of students self-identified as earning mostly A's and B's throughout their high school math career. Six students classified their math grades throughout high school as mostly C's, while only two students self-identified as earning mostly D's in their high school math classes. None of the participants of this research study typically earned failing grades in math. While students who typically perform well in math, such as those included in this study, may find that certain aspects about online and paper homework aid or hinder their learning, students who struggle with math may differ in their views about what aids or hinders their learning. Further

research is needed to investigate the perceptions of what aspects of online and paper math homework aid or hinder learning for high school students who self-identify as struggling in mathematics.

This study provided insight into high school students' perceptions about online and paper math homework. Students were able to address aspects of both online and paper math homework that they view as aids or hindrances to their learning. Although students identified hindrances to both online and paper math homework, the majority of students stated that both online and paper math homework are more good than bad and that both online and paper math homework are useful for their learning. Further research should explore high school students' perceptions about the value of math homework. Research into high school students' beliefs about the necessity of math homework will provide insight for parents, administrators, and school districts as they debate whether homework itself is valuable.

Several of the aids or hindrances to learning that were mentioned by students included the classroom teacher, specifically the aid of personalized help from the classroom teacher and the hindrance of the classroom teacher taking a long time to grade homework. Therefore, further research should be conducted into teacher awareness of student perceptions about online and paper math homework. Further research should also be conducted to investigate whether classroom teachers implement online math homework in ways that aid and/or hinder learning, as identified by the current research study participants. Additionally, investigation into the amount of support and professional

development provided to classroom teachers who use online math homework should be conducted.

Lastly, this research study only looked at three Association of Christian Schools International schools. It is important to investigate whether students at other schools would have the same perceptions about online and paper math homework as did the students at these three ACSI schools. Therefore, this study should be further applied to a larger student population. This study was limited to students at three ACSI schools, which resulted in the researcher collecting data from only 64 students. A larger sample size with other ACSI schools located throughout the United States and internationally should be conducted. Further research with high school students attending public schools should be conducted to determine if ACSI affiliation impacts student perceptions about online and paper math homework.

Conclusions

The purpose of this study was threefold: to understand how high school students perceive online math homework, to determine what aspects of online math homework aid and/or hinder student learning, and to improve the student learning experience with online math homework. As research shows, online homework continues to grow, and researchers and instructors are wasting time by debating whether online homework is good or bad for students (Herold, 2017). The American Institutes for Research argues that research should instead be asking, “for whom does online learning work, under what circumstances, and what kinds of supports can make a difference?” (as cited in Herold, 2017).

The current research study sought to understand what aspects of online and paper math homework served as aids or hindrances to student learning, with the goal of improving the quality of learning associated with online math homework. The data suggests that while online resources, such as examples, were the most commonly mentioned aid to online math homework, many students indicated that online resources also prevented them from having to think for themselves, as they could just follow the online examples step by step. One student indicated in his or her survey that, “Sometimes the examples [for paper homework] are so basic I cannot figure out how to do the problems; this is the complete opposite problem of the online homework.” This sentiment was echoed by another survey response, which said, “It’s easy to just get the answer [for online homework] via the step-by-step. There’s not a lot of actual hard work sometimes.”

The current research study also provided insight into aids or hindrances for paper math homework. The data showed that an overwhelming number of students listed showing work as the most significant aid to learning with paper homework. Student survey responses as to why writing things down is an aid to learning with paper homework included “writing always helps with comprehension,” “I remember things better when I write them down,” and “I get to see it visually and write it down, cementing it in my knowledge.” However, many students also cited losing their homework and having to carry their heavy textbooks around as hindrances to learning with paper math homework.

The current research study supported previous research, which stated that

regardless of medium, support from the classroom teacher is vital to learning mathematical concepts (Mullen & Tallent-Runnels, 2006). As stated by Jacobson (2006), although students may not always make the best choices in regard to their own learning, students' attitudes and perceptions do have a significant impact on the quality of learning (Brooks, 2003). This research study determined that the majority of students did not have a strong inherent like or dislike toward either online or paper math homework. Instead, students often stated that they preferred whichever medium allowed them to earn higher grades or receive more support. Therefore, if students continue to receive the necessary support, they can continue to learn mathematical concepts through the use of both online and paper math homework.

APPENDICES

Appendix A

How the Instruments Answer the Research Questions

Research question	Survey item that addresses the question	Focus group protocol item that addresses the question
1. What are the perceptions of private high school students enrolled in daily, face-to-face math classes regarding both online and paper math homework?	12, 13, 14, 17, 18, 19, 20, 22, 29, 30	11, 12, 13, 14, 15
2. What aspects of online math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?	10, 15, 16, 21, 25, 26, 31, 32	1, 2, 3, 4, 5
3. What aspects of paper math homework aid and/or hinder learning, according to private high school students enrolled in daily, face-to-face math classes?	11, 17, 23, 24, 33, 34	6, 7, 8, 9, 10

Appendix B

Timeline of Study: 2017

January 9: Proposal Hearing

February 17: Christian Schools Conference

Late February: Obtained and Confirmed Research Sites

March 13: Submitted to IRB

March 21: Obtained IRB approval (adjustments were not necessary)

Late March/early April: Scheduled Visits to Research Sites

Research Site 1 Data Collection

- May 2: Researcher administered survey in person to students at the research site.
- May 2: Researcher closed online survey.
- May 3: Researcher contacted students who expressed interest in focus group.
- May 8: Researcher conducted focus group at the research site.

Research Site 2 Data Collection

- April 26: Researcher administered survey in person to students at the research site.
- April 26: Researcher closed online survey.
- April 26: Researcher e-mailed students to schedule focus group (no response).
- May 1: Researcher again e-mailed students to schedule focus group (received no response).

- May 2: Researcher contacted faculty liaison regarding focus group (no student response).
- May 8: Faculty advisor directed researcher to finish other data collection.

Research Site 3 Data Collection

- April 25: Researcher administered survey in person to students at the research site.
- April 25: Researcher closed online survey.
- April 26: Researcher contacted students who expressed interest in the focus group.
- May 2: Research conducted focus group at the research site.

Appendix C

IRB Approval from FAU

Institutional Review Board
Division of Research
777 Glades Rd.
Boca Raton, FL 33431
Tel: 561.297.1383
fau.edu/research/researchint

Charles Dukes, Ed.D., Chair

DATE: March 23, 2017

TO: Roberta Weber, Ed.D.
FROM: Florida Atlantic University Social, Behavioral and Educational Research IRB

PROTOCOL #: 1031720-1
PROTOCOL TITLE: [1031720-1] Perceptions of Online Math HW from High School Students Enrolled in Face-to-Face Math Classes at Private Schools

SUBMISSION TYPE: New Project
REVIEW CATEGORY: Exemption category #*A1*

ACTION: DETERMINATION OF EXEMPT STATUS
EFFECTIVE DATE: March 21, 2017

Thank you for your submission of New Project materials for this research study. The Florida Atlantic University Social, Behavioral and Educational Research IRB has determined this project is EXEMPT FROM FEDERAL REGULATIONS. Therefore, you may initiate your research study.

We will keep a copy of this correspondence on file in our office. Please keep the IRB informed of any substantive change in your procedures, so that the exemption status may be re-evaluated if needed. Substantive changes are changes that are not minor and may result in increased risk or burden or decreased benefits to participants. Please also inform our office if you encounter any problem involving human subjects while conducting your research.

If you have any questions or comments about this correspondence, please contact Danae Montgomery at:

Institutional Review Board
Research Integrity/Division of Research
Florida Atlantic University
Boca Raton, FL 33431
Phone: 561.297.1383
researchintegrity@fau.edu

* Please include your protocol number and title in all correspondence with this office.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within our records.

Appendix D

Approval to Use Survey (Koc)

From: **Selma Koc** [redacted]
Subject: Re: Permission to Use Survey Instrument from Koc & Liu, 2016
Date: December 7, 2016 at 8:55 PM
To: Gisselle Gutierrez [redacted]

SK

Sure. You can go ahead and use those questions.

Good luck with your dissertation.

Best,

Selma Koç
[redacted]

Appendix E

Approval to Use Survey (Liu)

From: **Xiongyi Liu** [redacted]
Subject: Re: Permission to Use Survey Instrument from Koc & Liu, 2016
Date: December 12, 2016 at 11:13 AM
To: Gisselle Gutierrez [redacted]

XL

Hi Gisselle,

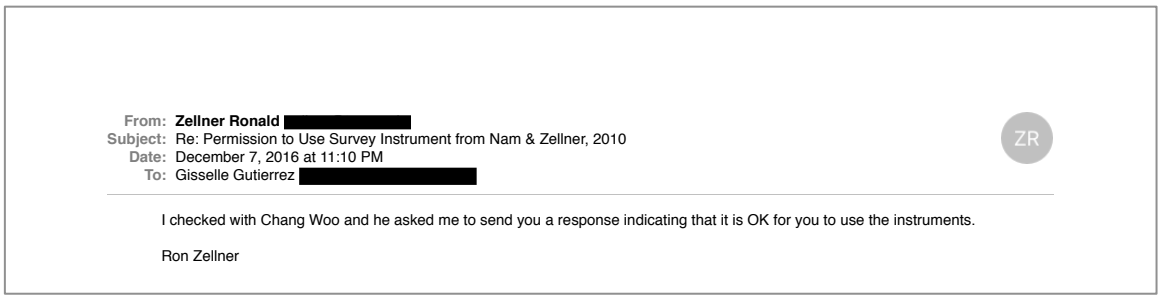
Yes, I would be glad to extend permission if Dr. Koc gave you the permission, too.

Sincerely,

Xiongyi Liu, Ph.D.
Associate Professor, Curriculum and Foundations
College of Education and Human Services
[redacted]
Phone: [redacted]
Email: [redacted]

Appendix F

Approval to use Survey (Nam and Zellner)



From: **Zellner Ronald** [redacted]
Subject: Re: Permission to Use Survey Instrument from Nam & Zellner, 2010
Date: December 7, 2016 at 11:10 PM
To: Gisselle Gutierrez [redacted]

ZR

I checked with Chang Woo and he asked me to send you a response indicating that it is OK for you to use the instruments.

Ron Zellner

Appendix G

Student Survey

Perceptions of Online Math Homework from High School Students Enrolled in Face-to-Face Math Classes

Thank you for your voluntary participation in this study. The purpose of this study is to explore what high school students enrolled in face-to-face classes at private schools think about online and paper math homework.

Procedures: You will be asked to respond to 28 questions about online and paper math homework and three demographic questions. The survey will take approximately 10 – 15 minutes to complete.

Risks: The risks involved with participation in this study are no more than the participant would experience in regular daily activities. It is unlikely that you will experience any harm or discomfort. Your participation or lack of participation will not be shared with teachers or administrators and will not be used for evaluation in any way.

Benefits: The results of this research will contribute to a greater understanding of the online homework environment. You will have the opportunity to give your perspective on a topic that has rarely been researched within a high school setting. You will also help give a voice to high school students who are engaged in online math homework. The results of this study could help to inform educators about how to best implement online math homework.

Data Collection & Storage: Any information collected about participants will be kept confidential and secure. Only the FAU researchers working with this study will be allowed to see the data, unless required by law. The survey data will be stored on a secure server for three years. The investigators may publish the data collected from this study, but will not reveal the identity of any participants.

Contact Information: For questions or problems regarding your rights as a research subject, contact the Florida Atlantic University Division of Research at (561) 297 – 0777. For other questions about the study, contact the principal investigator Dr. Roberta K. Weber at (561) 799 – 8519 or co-investigator Gisselle Gutierrez at (561) 267 – 3298.

Thank you for your help!

Gisselle Gutierrez, Doctoral Candidate
FAU College of Education
ggutierrez2012@fau.edu

Dr. Roberta K. Weber, Principal Investigator
FAU College of Education
rweber@fau.edu

Assent

1. I have read the information that describes this study. All questions I had regarding the study have been answered to my satisfaction. I verify that I have turned in my signed Parental Consent Form and that I am freely participating in this survey. I know that I can withdraw myself from the study at any time with no penalty.

- ◯ I agree to participate in this study.
- ◯ I do not agree to participate in this study.

Demographics

1. What is your gender?

- female
- male

2. Which of the following categories do you most identify with?

- African American (born in the United States)
- African (born in Africa)
- Asian
- Caucasian
- Caribbean Islander
- Hawaiian/Pacific Islander
- Hispanic
- Indian
- Native American
- I prefer not to answer at this time
- Other (please specify)

3. What kind of grades do you usually get in math classes? Please consider ALL math classes that you have taken in high school – not just the one you are in right now.

- mostly As
- mostly Bs
- mostly Cs
- mostly Ds
- mostly Fs

Qualifications

1. Please select your grade level.

- ◯ 9th grade
- ◯ 10th grade
- ◯ 11th grade
- ◯ 12th grade
- ◯ none of the above

2. At least one of my math classes in the last three years has used some type of online math homework.

- ◯ yes
- ◯ no

3. At least one of my math classes in the last three years has used some type paper math homework.

- ◯ yes
- ◯ no

Focus Group

1. Would you be interested in being part of a focus group of 3 – 5 students where you will tell me more about what you like and don't like about online math homework?

The focus group will be held on your school campus one day after school.**Free Papa John's pizza and drinks will be provided**. The date will be decided once we have determined who the participants will be. Your teacher will not know if you select yes or no.

- ◯ yes
- ◯ no

Contact Information

1. Please provide your name and an e-mail address that you check regularly so that the researcher can contact you to set up the focus group.

Your teacher will not know who chooses to participate and who doesn't. All names and e-mails will be kept completely confidential; your name will NEVER be attached to your survey answers.

name:

e-mail:

Online and Paper Math Homework

Select the option that best describes how you feel.

1. Online math homework provides me with resources that help me solve my homework problems.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

2. Paper math homework provides me with resources to help solve my homework problems.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

3. I would rather have online math homework than paper math homework.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

4. I earn higher test grades after I have online math homework.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

5. I think that online math homework helps me learn how to do math.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

6. When completing online math homework, I use the online resources provided.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

7. Online math homework does **not** provide me with resources that help me solve my homework problems.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

8. Paper math homework does **not** provide me with resources that help me solve my homework problems.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

9. I would rather have paper math homework than online math homework.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

10. I earn higher test grades after I have paper math homework.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

11. I do **not** think that online math homework helps me learn how to do math.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

12. I do **not** use the online resources provided when I am completing online math homework.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

13. I think that paper math homework is useful for my learning.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

14. There are things about paper math homework that prevent me from learning how to do math.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

15. There are things about paper math homework that help me learn how to do math.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

16. There are things about online math homework that prevent me from learning how to do math.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

17. There are things about online math homework that help me learn how to do math.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

18. Online math homework is more good than bad.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

19. Online math homework is more bad than good.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

20. Paper math homework is more good than bad.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

21. Paper math homework is more bad than good.

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	I prefer not to answer.
○	○	○	○	○	○	○

Aids and Hindrances

1. Describe anything about online math homework that helps you learn.

2. Describe anything about online math homework that prevents you from learning.

3. Describe anything about paper math homework that helps you learn.

4. Describe anything about paper math homework that prevents you from learning.

Completion

Thank you for your time and participation in this study!

Appendix H

Letter of Cooperation for Research Site 1

Letter of Cooperation

February 23, 2017

To the Florida Atlantic University (IRB):

I am familiar with Gisselle Gutierrez's research project entitled "Perceptions of Online Math Homework from High School Students Enrolled in Face-to-Face Math Classes at Private Schools." I understand that [redacted] will be involved in Mrs. Gutierrez's study and will facilitate e-mail access to recruit students to complete the survey; students who participate in the survey will be asked if they are willing to participate in a focus group. There will be a minimum of one focus group at [redacted].

I understand that Gisselle Gutierrez's research will be carried out adhering to sound ethical principles and any and all participant involvement in this study will be solely on a voluntary basis. The students and their parents will be asked to sign a consent form before any involvement in the research occurs. This research study will also provide confidentiality of the research data and participant information, as described in the protocols and consent forms.

Therefore, as the institutional authority of [redacted], I agree that Gisselle Gutierrez's research project may be conducted at and in collaboration with our school.

Sincerely,

[redacted]

Headmaster

Appendix I

Letter of Cooperation for Research Site 2

Letter of Cooperation

February 14, 2017

To the Florida Atlantic University (IRB):

I am familiar with Gisselle Gutierrez's research project entitled "Perceptions of Online Math Homework from High School Students Enrolled in Face-to-Face Math Classes at Private Schools." I understand that [redacted] will be involved in Mrs. Gutierrez's study and will facilitate e-mail access to recruit students to complete the survey; students who participate in the survey will be asked if they are willing to participate in a focus group. There will be a minimum of one focus group at [redacted].

I understand that Gisselle Gutierrez's research will be carried out adhering to sound ethical principles and any and all participant involvement in this study will be solely on a voluntary basis. The students and their parents will be asked to sign a consent form before any involvement in the research occurs. This research study will also provide confidentiality of the research data and participant information, as described in the protocols and consent forms.

Therefore, as an institutional authority of [redacted], I agree that Gisselle Gutierrez's research project may be conducted at and in collaboration with our school.

Sincerely,

[redacted]

High School Principal

Appendix J

Letter of Cooperation for Research Site 3

Letter of Cooperation

February 9, 2017

To: Florida Atlantic University (IRB):

I am familiar with Gisselle Gutierrez's research project entitled "Perceptions of Online Math Homework from High School Students Enrolled in Face-to-Face Math Classes at Private Schools." I understand that [redacted] will be involved in Mrs. Gutierrez's study and will facilitate e-mail access to recruit students to complete the survey; students who participate in the survey will be asked if they are willing to participate in a focus group. There will be a minimum of one focus group at [redacted].

I understand that Gisselle Gutierrez's research will be carried out adhering to sound ethical principles and any and all participant involvement in this study will be solely on a voluntary basis. The students and their parents will be asked to sign a consent form before any involvement in the research occurs. This research study will also provide confidentiality of the research data and participant information as described in the protocol and consent forms.

Therefore, as an institutional authority of [redacted], I agree that Gisselle Gutierrez's research project may be conducted at and in collaboration with our school.

Sincerely,

[redacted]

Appendix K

Recruitment Flyer

Exciting Opportunity

for (*school name*)

Math Students!!

Dear Parents and Students,

My name is Mrs. Gisselle Gutierrez, and I am a high school math teacher at [redacted]. I am currently in the process of earning my Ph.D. in Math Education from FAU, but before I do, I need to conduct exploratory research on a topic that interests me. As a math teacher, I thought online math homework would be the perfect topic to investigate, since my own students have very strong feelings about it!

In order to investigate how students feel about online math homework, I will be asking students from three ACSI schools in [redacted] to take a 25 question online survey. Students who volunteer will also take part in a focus group after school, where we will discuss what you think about online homework in more detail. Free pizza and drinks will be provided!

Please be aware that your participation is completely voluntary, and you can withdraw at any time without consequences. My goal is for the information collected to help math teachers around the country teach students in the best way possible.

I will be sending home a Parental Consent form soon. If a student wants to participate in the Online Survey and/or Focus group, one of the student's parents must sign this form and it must be returned to the student's math teacher.

If you have any questions or concerns regarding any part of the survey or study, please contact me at GutierrezG@BocaChristian.org / (561) 267 – 3298 or my FAU Faculty Advisor, Dr. Roberta K. Weber, at RWeber@fau.edu / (561) 799 – 8519.

Have a great day and God bless!

FAU Institutional Review Board

Approved on:	03/21/2017
Expires on:	N/A

Gisselle Gutierrez, M.Ed.
[redacted]
High School Math Teacher

Appendix L

Focus Group Invitation E-mail

FAU Institutional Review Board

Approved on:	03/21/2017
Expires on:	N/A

Hello (*name of participant*),

My name is Mrs. Gisselle Gutierrez, and you recently participated in my dissertation research study by taking a survey about online math homework.

First of all, thank you so much for participating in the survey!

Second, I appreciate you volunteering to take part in a focus group where we will discuss your thoughts about online math homework. I am hoping that you are still available to take part in the focus group. Each focus group will be small, consisting of myself and 3 – 5 students from your school. There will be free pizza and drinks provided for all students who attend the focus group.

The focus group will take place at (*school name*) in Room ___ . I have two potential dates and times:

Option 1: *date and time – 2 hours*

Option 2: *date and time – 2 hours*

Please let me know which one of these dates and times works best for you.

Again, I really appreciate your help with my research study. If you have any questions or concerns, or if it is easier to text and let me know what focus group works best, my cell phone number is [redacted]. I look forward to seeing you all again soon!

Mrs. Gisselle Gutierrez, M.Ed.
[redacted]
High School Math Teacher

Appendix M

Focus Group Protocol

Focus Group Instrument

INTENT: The purpose of this study is to explore the perceptions that high school students enrolled in face-to-face math classes at private school have regarding online math homework

RESEARCHERS: Dr. Roberta K. Weber and Gisselle Gutierrez (Doctoral Candidate)

DISCIPLINE: Dissertation Research

TITLE: Perceptions of Online Math Homework from High School Students Enrolled in Face-to-Face Math Classes at Private School

NAME OF INTERVIEWEES: _____

_____

_____

Place: _____ Date: _____

Starting Time: _____ Ending Time: _____

Procedures:

1. Thank group for participating.
2. Tell the study purpose.
3. Give overview of the study.
4. Promise confidentiality.
5. Confirm time interview will end.
6. Collect signed student assent forms and confirm permission to audio record.

Introduction:

Thank you so much for participating in this study.

The purpose of this study is to explore what high school students enrolled in face-to-face classes at private schools think about online and paper math homework. Everything that we talk about here will be kept confidential. If any of you are mentioned in my research, you will be given pseudonyms. For example, "Amy Smith said that her favorite class is Geometry."

We have agreed to meet for 2 hours, and at the end of that time I will bring the interview to a close. The consent and assent forms that you and your parents have signed says everything that we just talked about. By turning your assent form in, you are confirming that you understand what this study is about and that you are a willing participant. If you would still like to participate in the study, please turn your assent form in. Is it still ok with you if I audio record our interview?

Interview Questions:

Directions

Before we begin the interview, I just wanted to remind you that I am looking for your *opinion*. There is no right or wrong answer. Just let me know what you think. I'm not going to be doing a lot of talking except for asking the questions, so feel free to talk as much as you want to.

After I ask a question, we will begin on the left side of the room and then allow everybody to speak in order. For the next question, we will start on the right side of the room and have everyone speak in the opposite order. If you do not have a comment, just say pass.

Warm – Up

a) How many years have you been at (*school)*?
b) What is your favorite subject?
c) Do you enjoy math?
d) For how many years have you had online math homework?
e) For how many years have you had paper math homework?

Perceptions of Online Homework

1. What is it like to have online math homework?
    a. Probe: Tell me more about ____.
    b. Follow Up: What is a typical day in class like when you have online homework?
2. What do you like and dislike about online math homework?
    a. Follow Up: Has there been a specific time when you got really frustrated with online homework?
    b. Follow Up: Has there been a specific time when you were happy that you had online homework?
3. Do you feel like you learn when you have online math homework?
    a. Probe: Why do you feel that way?
    b. Follow Up: What kind of effort do you put in when you have online math homework?
    c. Follow Up: What kind of test grades do you get after having online math homework?
4. Are there any aspects of online homework that help you learn?
    a. Follow Up: Tell me more about _____ .
5. Are there any aspects of online homework that don't help you learn?
    a. Follow Up: Tell me more about ____ .

Perceptions of Paper Homework

6. What is it like to have paper math homework?
    a. Probe: Tell me more about ____.
    b. Follow Up: What is a typical day in class like when you have paper homework?

7. What do you like and dislike about paper math homework?
    a. Follow Up: Has there been a specific time when you got really frustrated with paper homework?
    b. Follow Up: Has there been a specific time when you were happy that you had paper homework?
8. Do you feel like you learn when you have paper math homework?
    a. Probe: Why do you feel that way?
    b. Follow Up: What kind of effort do you put in when you have paper math homework?
    c. Follow Up: What kind of test grades do you get after having paper math homework?
9. Are there any aspects of paper homework that help you learn?
    a. Follow Up: Tell me more about _____ .
10. Are there any aspects of paper homework that don't help you learn?
    a. Follow Up: Tell me more about ____ .

Comparison of Online and Paper Homework

11. What is the same about paper and online math homework?
12. What is different about paper and online math homework?
13. Do you feel like you learn more with online math HW or with paper math HW? Why?
14. Would you prefer to have online math homework or paper math homework? Why?

Closing Question

15. Is there anything else about online or paper math homework that you wanted to share?

Closing

Thank you for participating in the study. Everything that we talked about today will be kept confidential. I will e-mail each of you a copy of your part of the interview for you to read. You can make any changes that you want to it, and then e-mail it back to me.

Appendix N

List of Qualitative Codes and Their Frequencies

Code	Research Site 1	Research Site 3	Total Frequency
Showing Work	27	8	35
Guessing	9	2	11
Cheating	6	0	6
Like	6	7	13
Dislike	3	8	11
Multiple Choice	2	2	4
Tech Issues	3	7	10
Online Tools	9	14	23
Multiple Attempts	3	9	12
Learning Gains	3	5	8
Access to HW	11	11	22
Losing HW	6	1	7
Help on HW	8	5	13
Personalized	4	0	4
Accountability	3	0	3
Easy	4	1	5
Grading	0	12	12
Muscle Memory	11	4	15
Staying Focused	0	2	2
Don’t Know What to Do	0	4	4

Appendix O

Qualitative Themes, Categories, and Codes

- ***Theme***: Aids to Learning
  - Category: The Human Factor
    - Sub-Category: Student Controlled Factors
      - Codes: Showing Work, Learning Gains
    - Sub-Category: Teacher Controlled Factors
      - Codes: Accountability, Help on HW, Personalized
  - Category: Aspects of the Medium
    - Sub-Category: Online Factors
      - Codes: Online Tools, Multiple Attempts, Access to HW, Grading
    - Sub-Category: Paper/Pencil Factors
      - Codes: Muscle Memory, Access to HW, Personalized, Staying Focused

- ***Theme:*** Hindrances to Learning
  - Category: The Human Factor
    - Sub-Category: Student Controlled Factors
      - Codes: Guessing, Cheating, Losing HW
    - Sub-Category: Teacher Controlled Factors
      - Code: Grading
  - Category: Aspects of the Medium
    - Sub-Category: Online Factors
      - Codes: Multiple Choice, Tech Issues, Personalized (or lack there of)
    - Sub-Category: Paper/Pencil Factors
      - Codes: Access to HW (textbook), Losing HW

- ***Theme:*** Emotional Response
  - Category: Positive Emotions
    - Codes: Like, Easy
  - Category: Negative Emotions
    - Codes: Dislike, Don’t Know What to Do

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