Fall 10-28-2021

Secondary Teachers Use of Web 2.0 Technology to Instruct English Learners in Mathematics: A Qualitative Case Study

Laura Alevy

Secondary Teachers Use of Web 2.0 Technology to Instruct English Learners in Mathematics: A Qualitative Case Study

By

Laura Alevy

A Dissertation

Presented in Partial Fulfillment of Requirements for the

Degree of

Doctor of Education

In

Department of Secondary and Middle Grades

In the

Bagwell College of Education

Kennesaw State University

Kennesaw, Georgia

October 28, 2021

The Undersigned Faculty Committee Approves the

Dissertation of

Laura Alevy

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Dr. Binyo Zheng, Chair

_____

Dr. Maria Montalvo

_____

Dr. Guichun Zong

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Approval Date

ACKNOWLEDGEMENTS

I would like to thank God, for helping me through all the difficulties and guiding me on my doctoral journey to achieve my dreams.

I would like to acknowledge and give my warmest thanks to my Chair, Dr. Binyo Zheng, and my committee members, Dr. Maria Montalvo and Dr. Guichun Zong for their guidance, direction, and encouragement during my journey. This study would not have been possible without their knowledge and advice that assisted me to accomplish this research that may serve as an example for other teachers who seek to teach EL students, personally and professionally.

I am deeply thankful for all my Ace faculties at Kennesaw State University. They implanted in me a strong appreciation for hard work and education. They gave me a solid foundation for learning and broad knowledge during those wonderful years.

DEDICATION

I want to dedicate this accomplishment to my husband, David, who always supported me and encouraged me to achieve this accomplishment in my journey. The many nights my husband stayed awake with me as I worked on my paper to make sure I was doing well and excelling, I thank you for that. I love you!

I want to thank my sons Randy, Robin and my daughter Lana, for their continuous support and encouragement over the years. Their inspirations and belief in me have allowed me to extended my education to receive a doctorate degree. I am sure they are proud of me, and they always inspired me that it is never too late to achieve my dreams. My children taught me that with the love and support of those around you, you can achieve just anything! I love you my sweethearts!

Abstract

With the increasing population of immigrants in our society, there is also a corresponding increase in the number of English Learners (EL) in the school system. With their low performance on standardized tests and high drop rate in high schools, an urgent need to focus on productive and effective instructional ways to connect the technology and pedagogical practices to enhance ELs' progression in math is needed. Web 2.0 tools are a perfect example of how to connect technology and pedagogical practices in the classrooms to help ELs get motivated to engage and participate in mathematics classrooms. Web 2.0 technology is an online platform that offers a variety of applications to make sharing and collaboration in the classroom possible. Anyone can create and share information using Web 2.0 technology and with the internet, it can be accessed anywhere and at any time. The purpose of this qualitative case study was to explore secondary mathematics teachers and their use of Web 2.0 tools when instructing ELs. The data-collection was done through interviewing secondary mathematics teachers who have at least three ELs in their classroom. The results of the findings showed that most of the teacher participants indicated that they have little experience of how to use Web 2.0. The results also indicated that Web 2.0 tools technology was missing from teachers' lesson plans and not being used to help meet the instructional needs of ELs in mathematics classrooms. The study recommended the necessity of intensifying and enhancing training for teachers on the use of Web 2.0 tools when instructing EL students.

Keywords: Web 2.0, technology, English Learners, secondary school, mathematics

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Chapter One: Introduction

Background of the Study

The Department of Educational Technology in the Department of Education in the United States Government (2019) stated that technology can be a powerful tool to help foster student engagement either in-school or virtually. The school administration across America shows the effect of technology in education, where people are very familiar with technology these days, and it is not foreign anymore in the education field. In recent years, the technology investment in public schools ranging from K-12 institutions has grown astronomically (Education Superhighway, 2019). Almost 98% of all schools today own computers. Today, 44.7 million students and 2.6 million teachers in more than 81,000 schools have the Internet access they need for digital learning (Education Superhighway, 2019).

With all this current access to technology, teachers need to know appropriate ways of using specific technology during instructions. Tatli et al. (2019) indicated that there are many difficulties shown with teachers' pedagogical attitude towards using technology. Diacopoulos (2015) stated that teachers could use technology in their classrooms to support existing pedagogy and help tackle their students' needs. Teachers will have a positive impact in their classrooms during teaching when they use the correct tools in their instructions, such as Web 2.0 tools (Celik, 2018). Incorporating technology in classrooms and using them as a facilitator when educating students is possible with the increasing accessibility of technology.

Public School Review (2020) showed that there are two out of three new jobs today, and 90% require applicants to have a high-tech field in order to be a qualified applicant. The Department of Education is trying to prepare all students to be ready for college and a career in literacy during high school graduation by having state work towards placing essential standards

in mathematics (2016). The Common Core Performance Standards (CCPS) require technology and for the Internet to be available to teachers and students in almost every school district to help all students gain knowledge and collaborate with the use of technology. Teachers must utilize technology as an essential tool to help focus more on the learner. Thus, it is important for educators to know the best strategies for instructing all students' levels to meet those standards (National Council of Teachers of Mathematics (NCTM), 2020). Teachers can find the best strategies to teach all students in the classroom when the instructions tackle the needs of the increasing population of English Learner students (ELs). The Center for Immigration Studies (CIS) (2020) indicates that more than 44.9 million immigrants settle in the United States with about 4.9 million EL students entering public schools with 378 languages. There were about 3.7 million Hispanic EL students enrolled in the public-school system (CIS, 2018). The most common home language for ELs is Spanish, which is 78 percent of that population (GBPI, 2020). According to the National Center for Education Statistics (NCES, 2018), among the different races and ethnicities, Hispanics have the highest dropout rates.

The Georgia Budget and Policy Institute (GBPI) (2020) showed that Georgia educates the eighth highest number of ELs in the nation, and ELs enrollment in ESOL (English to Speakers of Other Languages) grew by 61 percent from 2011 to 2019. Increasing numbers of ELs over the past few years have led to an increase in Federal Law notifications to school districts to ensure ELs participate in school education programs to help them improve their English language.

Also, the Federal Law requires that school districts ensure that EL learners participate meaningfully in the schools' educational programs where schools still strive to bridge language barriers (Meyer, 2018). In 2016, the U.S. Department of education in the State of Georgia showed that ELs' graduation rate is 56.5% which is considered low, and low achievement has a

negative impact on the ELs' college education and career prospects (National Academies of Sciences, Engineering, and Medicine, 2017). This low graduation rate is problematic for the educational department. Rita et al. (2019) indicated that when teachers are provided with great skills of technology over traditional teaching, this can lead to improvement in students' learning. Therefore, integrating technology in the classroom can facilitate interaction and discussion among teachers and students.

Incorporating Web 2.0 technology into the classroom provides advantages that support and attract students. The NCTM (2015) demonstrated that integrating Web 2.0 technology in classrooms provides benefits that support and even entice students to become creators and not merely recipients of knowledge. Many research publications showed that Web 2.0 technology is a relevant technological tool that when used correctly in instructing EL students, will inspire our students to learn and engage in education (Joven, 2018). Students get motivated and participate in their classrooms when Web 2.0 tools are used the correct way. NCTM (2015) also realized the effect of integrating technology in mathematics lessons helps deliver the material in a pleasant way.

NCTM (2015) and The Common Core Performance Standards (CCPS) suggested using visual aids and technology to teach mathematics through the use of Web 2.0, which is a set of social, economic, and technological trends. It is the latest technology that allows one to build collaborative environments in mathematics education. Web 2.0 technology is one of the options that lead to an improvement in students' learning by providing rich content (Alsalhi et al., 2019; O'Hara et al., 2013). Using Web 2.0 tools will help create an environment where the mathematic teachers can act as facilitators of EL students' knowledge creation rather than a distributor of content (Burk, 2016). Joven (2018) asserted that schools should work hard to find the best way to

close the academic gap in math for EL students by letting teachers explore suitable technology to help ELs obtain math knowledge. Schools need to find a way to solve the academic math gap for ELs by educating teachers about the appropriate technology, thus helping ELs gain knowledge of mathematics.

Personal interest in this topic

My personal interests and goals included improving my own personal instruction in order to provide good teaching to ELs regarding the use of Web 2.0 and helping mathematics teachers discover the benefits of using Web 2.0 to improve their instruction. Being an EL student in the main classroom in college, I struggled with language barriers. When I first came to the United States, I was in the ESOL program for 2 years, and I faced many challenges in my academic career. It took me an extra semester to graduate because of my English barriers. At that time, I had to put a lot of effort into attempting to understand the learning materials presented in classes. I struggled with terms and word problems in math. The main problem during my study at college was that I had to understand what the question was saying in order to know how to answer it. So, I had to be independent, and I had to find my own strategies to be successful. As a student, finding an extra source to improve language acquisition was my goal.

In addition to that, I am a certified teacher with a concentration in mathematics, and I earned a certification for teaching students who are English Speakers of Other Languages (ESOL). Also, I completed two technology courses focused on the effects and potential of technology for using, teaching, and learning mathematics and the best educational sites on the World Wide Web to do this. From these technology courses, I also learned many methods on how to integrate the use of the Internet into an educational setting and how to provide the best methods and models for using them in the classroom. These two courses provided me with a

strong background in technology and helped me witness the benefits of using technology in our classrooms to support our students. Halim et al. (2019) concluded that integrating technology in lessons played a significant role in supporting language in teaching and learning. What I learned in the previously described courses regarding the benefits of using technology to better teach and learn, aligns well with Halim et al's. (2019) work.

After, I earned my master's degree, a different personal/professional experience connects me to the proposed research topic. I had a chance to teach courses for English as a Second Language overseas for 6 years. I had big responsibilities, was fully dedicated, and spent a large amount of time getting the information to my students and finding the best strategies to educate them. Now, I am teaching foreign language courses to freshmen students. I am a very passionate person, and I always work with my students to help them improve their language (s). Being an educator with different ethnicities, an EL student once in the past, and an ESOL and foreign language courses educator, I want my research to be around this type of issue. I chose this research topic because throughout my life experience, the ESOL program has become important to me.

Statement of the Problem

The problem addressed by this case study was ELs' low performance on standardized tests especially in mathematics, and their high drop rate in high school. This case study attempted to understand secondary mathematics teachers' use of Web 2.0 tools to teach mathematics to Hispanic ELs in order to improve their academics in classes. Hispanic students have a higher rate of dropouts than that of most racial/ethnic groups (NCES, 2018). The U.S. Department of Education (2018) stated that the performance of ELs in high school still lags far behind that of their non-EL peers; however, researchers have shown that Web 2.0 technology has

assumed a significant role in helping language instruction and learning (Clay et al., 2009; Naik et al., 2009; Alhassan, 2017). The low performance of ELs in their academic outcomes continues to grow, but many resources, such as Web 2.0 technology, can be used to overcome this growing problem.

Arslan (2019) researched the use of Web 2.0 technology as a perfect way to interact with students in the teaching and learning processes, helping to improve academic language proficiency. Furthermore, Joven (2018) studied the effectiveness of technology in teaching EL students and the ways of motivating them. Researchers reached out about using Web 2.0 to teach ELs to break the barriers that the students face in the math classroom (Alsalhi et al., 2019; O'Hara et al., 2013). Addressing this issue was to target the teachers' practices of using the tools of Web 2.0 as an effective way in instructing EL in mathematics and to help mathematic teachers discover the benefits of using Web 2.0 to improve their instructions in a diverse classroom.

Although research has investigated many approaches to helping ELs with mathematics, there is still inconsistency on how to teach this population to increase their academic performance in mathematics. Providing content knowledge and academic language skills for ELs to do better in math class depends on how mathematics content is taught in schools (Estrella, 2018; The National Assessment of Educational Progress, 2019; Georgia Department of Education, 2018). Alali (2014) indicated that integrating Web 2.0 tools into lessons will provide a significant benefit to ELs' learning in mathematics main classrooms, but it shows that the mathematics teachers are not using them adequately in their classrooms. Due to the growing number of ELs requiring improvement in their academic performance in math, public schools need to provide an effective method of teaching and educating.

Purpose of the Study

The aim of this qualitative case study was to investigate the teachers' use of Web 2.0 tools and its integration when instructing ELs in the mathematics classrooms. Also, the study aimed to explore the relationship between the benefit of using technology and the improved way of using Web 2.0 in teaching. The study directly focused on four secondary mathematical teachers in one school district located in northeast Georgia who were not certified to teach EL students. However, these teachers had a common interest in teaching secondary math and a common position of instructing EL students. The findings of the existing study may help in recognizing and reinforcing the effects that encourage and make teachers use Web 2.0 tools in classroom teaching, hence to make teaching and learning more interesting to ELs to help them perform better in their standardized tests.

Research Questions

The following research questions addressed the primary question of the study: How do teachers in a northeastern suburban secondary school use Web 2.0 technologies to instruct ELs in mathematics? The study had two sub-questions:

1. What is the benefit of technology in general and Web 2.0 tools in helping ELs learn mathematics?
2. How can teachers do better in applying technology, and how can they do better in using Web 2.0 technology when instructing ELs in the mainstream classroom?

Nature of the Study

In this qualitative single descriptive case study, the aim was to explore the practices of mathematics teachers using Web 2.0 when instructing ELs. Qualitative research was based on the view that reality is constructed by individuals interacting with their social words, and the

main interest of qualitative researchers is to understand the meaning or knowledge constructed by people (Merriam, 1998). My research study supported this phenomenon by using multiple data sources and was appropriate because Yin (2014) stated that the researcher is allowed to describe the phenomenon and the real-life context in which it occurs. The researcher of this study needed to accomplish a deep understanding of mathematics teachers' practices of using Web 2.0 regarding the instruction of ELs. According to Merriam (1998), a descriptive case study uses a single case design; therefore, the researcher focused on only one case. In relation to this study, the researcher focused on a target group of secondary mathematics teachers and focused on one case centered on the teachers' experience of using Web 2.0 to instruct EL students.

In relation to the problem and how to solve it, the researcher gave a complete description related to the use of Web 2.0 tools by secondary mathematics teachers, rather than one specific explanation. This case study was collected from interviews by e-mail or online, artifacts, and participating teacher's lesson plans as a form of document analysis. The interviews consisted of open-ended questions, which was the method used for data collection. The interviewees answered the questions, including any details required at any time. The second data collection for this study was artifact documents, which included the lesson plans from the participants. The data collection from the lesson plans presented and explained the teachers' use of Web 2.0 tools in their learning as well as their teaching methods while educating ELs. Data gathered from the participants' interviews and the lesson plans were organized for analyzation. From the data collection, the results lead us to the purpose of the problem that was obtained from the teachers' instructions for ELs and their experience of using Web 2.0 tools in math classrooms.

Analyzing the data in this qualitative research, no direct guide or specific rules were used when questions were answered. The data collection for a qualitative case study has no regular

rules for analyzing the data, which is the most complex part (Houghton et al., 2015). The purpose of analyzing the data was to organize and find patterns to create themes from the collected data. According to Srivastava and Thomson (2009), framework analysis is a qualitative method that is flexible during analysis of the data. In the analysis, the data gathered was selected, charted, and sorted in accordance with key issues and themes using five steps: familiarizing, identifying a thematic framework, indexing, charting, mapping, and interpretation (Srivastava & Thomson, 2009). In this study, the data analysis reflected the use of Web 2.0 tools by teachers who teach mathematics to ELs in one school district. The results of the data displayed the purpose of using Web 2.0 that depended on the teachers' way of educating mathematics to a large population of EL students.

Significance of the Study

The current teaching methods need a significant shift to meet the needs of EL participants in mathematics classes with the use of the latest technology. Previous research focused on the examination, implementation, and use of different technologies when teaching EL students, such as Tatli et al. (2019), Rahimi et al. (2014), and Trisnawati et al. (2018). In addition, this study is important because it focused not only on technology but also on the incorporation of Web 2.0 technological tools in math instruction for EL students, which have great effectiveness in motivating them to learn the content area. NCTM (2015) encourages the use of technology in mathematics classrooms, which explains why there is an increase in the demand of teachers having prior education in technology use. Therefore, finding the strategies that mathematics teachers use with Web 2.0 will be needed to ensure that EL students receive better teaching, so that they can improve in their standardized tests.

This study is also significant due to the fact that NCLB requires EL students to hold the same responsibility of completing the same test as English first language peers. Creating an application of Web 2.0 technology will assist ELs with oral and written verbalization skills, which can improve their understanding of mathematics concepts. So, information about teachers' uses of Web 2.0 to increase ELs' achievements will be needed.

This study was significant because integrating Web 2.0 tools and combining it with the traditional teaching methods in the classrooms, makes teachers act as facilitators, thus helping ELs become lifelong learners.

Finally, this study was significant because it aimed to allow educational leaders to better prepare mathematics teachers for instructing EL students using Web 2.0 tools in mathematic classrooms or find other methods of ensuring the success of EL students in secondary mathematics courses.

Limitation of the Study

In this qualitative case study, there were limitations to generalizability for many reasons. First, the study focused only on one high school in the district in northeast Georgia. Second, the small number of participant teachers in this secondary school are limited. There are only four mathematics teachers who have ELs in their classrooms. The third limitation of the study is based on the participants' lesson plans, where half of the participants do not rely on lesson plans during teaching. Another limitation is the limited time, where the participants did not have enough time to participate in the data collection process. The researcher understood that the interviews were conducted in a timely manner at the discretion of the participants.

Vocabulary of the Study

***The Common Core* State Standard (CCSS).** It is a set of high-quality academic standards in mathematics and English language arts/literacy (ELA). The CCSS define what skills and knowledge each student must have at the end of each class. These learning goals outline what a student should know and be able to do at the end of each grade. The standards were formed to ensure that all students graduate from high school with great skills and knowledge that is necessary to succeed in their life.

English Learners (ELs). ELs, are students who are unable to communicate fluently or learn effectively in English. ELs are students who are in the process of learning English. English Learners are active learners of the English language who may benefit from various types of language support programs (National Council Teachers of English, 2008).

Limited English Proficiency (LEP). The student is an individual who was not born in the United States or who speaks a language or languages other than English at home. Also, student who have difficulty communicating effectively in English (Joven, 2018).

Personalized learning community (PLC) or personalized learning environment (PLE). An ongoing process in which teachers work collaboratively in series of collective inquiry and to achieve better learning with improve results for the students. It provides the learner an individual learning experience and gives an opportunity to create a social connection with others (Burk, 2016).

Social networking. Social networking is a computer-based technology that facilitates the sharing of ideas, thoughts, and information through the building of virtual networks and communities. It refers to those websites such as Facebook, My Space, and etc., which promote social interaction with other people (Social Networking, 2020).

Web 2.0. Web 2.0 is the process of using online resources to form cooperative learning online through discussion and collaborative projects (Parmaxi & Zaphiris, 2016). Web 2.0 programs, such as Google Docs and Edmodo, among others, utilize blogs and wikis to grant students the ability to work collaboratively (Darwish & Lakhtaria, 2011). According to Wilson et al. (2011), Web 2.0 refers to the second generation of the Web, where user-centered web applications and services enhance social connectedness, the sharing of media, information, and collaboration among individuals and organizations.

Second Language Acquisitions (SLA). Sometimes called second-language learning. According to Hopue (2017), the definition of second language acquisition is learning and gaining a second language once the mother tongue or first language acquisition is established. SLA is the practice of learning other languages that adding to the native language.

Summary

The number of immigrants is growing in the US, causing a concurrent increase in the number of EL students in schools. This chapter presented an overview of the case study and information on the need for research on secondary teachers' use of Web 2.0 when teaching mathematics. This case study was held in one school district located in northeast Georgia that had the highest percentage of EL population. This case study also included my personal interest and discussed why this study is important to me, the statement of the study, the purpose and the nature of the study, research questions, significance of the study, and definition of key terms that were mentioned. Chapter 2 of this case study included the literature review as it pertains to the secondary mathematics teachers and their use of Web 2.0 in teaching EL students. The topics included the theoretical framework, the situation of ELs in the United States, and research on

mathematics teachers and technology, teachers' challenges, and teachers' beliefs. The last section included the research gap that existed in secondary mathematics.

Chapter Two: Literature Review

Organization of Review

This chapter reviews the literature addressing theories related to the study of teachers using Web 2.0 tools, EL students in mathematics classrooms, the challenges faced by mathematics teachers, and the use of Web 2.0 tools for teaching EL students. The existing research literature enabled delimits the area of research, and the existing literature helped to develop the tools for collecting data.

The purpose of this case study was to explore the teachers' use of Web 2.0 tools that are related to secondary mathematics when teaching ELs in order to have them engage in math and perform better in a standardized test. This study investigated the teachers' use of Web 2.0 with the benefit of Web 2.0 tools in helping ELs learn mathematics and the better way teachers can apply Web 2.0 tools when instructing ELs in the mainstream classroom.

By conducting this study, the researcher was able to answer whether the teachers were using Web 2.0 tools, knew the benefits, and the challenges to support the learning process of teaching ELs in mathematics. The specific research question addressed to guide the study was the following: How do teachers in a northeastern suburban secondary school use Web 2.0 technologies to instruct ELs in mathematics?

Literature Review

The literature review was organized into sections that provide an overview of published studies that helped to justify both the relevance of my research topic and the need for the study that was proposed. The literature review began with a search for documentation and an outline that explained the relevant sources that were needed to improve the reader's understanding of the issue. The sources used to search for the literature review were ProQuest Scholarly Databases,

EBSCOhost, Google Scholar, Sage Journals, and ProQuest Dissertations. All the scholarly articles were searched under a peer-reviewed article. The literature review is organized into these sections: Theoretical Framework, English Learners Situation in the United States, Teaching English Learners in the Mathematics Classroom, Technology Usage in Education, Technology and EL students, Integrating Technology in the Mathematics Classroom, Types of Web Technology Used in Education, Web 2.0 Technology in Education, Benefits of Using Web 2.0 to Instruct ELs, Teacher Challenges in Teaching EL students, Web 2.0 as a Powerful Socialization and Communication Tool, Web 2.0 Technology in the Mathematics Classroom, Teachers' Beliefs Toward Using Technology/Web 2.0. Finally, the literature review ended with studies that pertained to this study and gaps in the literature.

Theoretical Framework

To frame this qualitative case study, the researcher drew on many mentioned theories in the area of technology to instruct EL students that are based on Vygotsky's (1986) socio-constructivist learning theory, Krashen's (1982) comprehensive input to help ELs achieve their motivation and language acquisition based on his Second Language Acquisition Theories, and the model Personalized Learning Communities (PLCs) that is used by Rahimi et al. (2014).

Social Constructivism Learning Theory

Socio-constructivist learning theory is a collaborative and knowledge-based process which develops students' interactions with their society. It is one of the most remarkable frameworks for learning and improving student knowledge due to its broad description of what impacts improvement in the classroom. This theory has been applied by researchers to study the main reasons for enhancing a student's knowledge and to create a higher level of understanding in the classroom.

The way of instruction can express more interactions that are designed to scaffold the active learners toward higher thinking (Vygotsky, 1986). Dager and Yadav (2016) indicated that through constructivist learning theory and by integrating new ideas into the previously learned ones, learners can build new knowledge. Their study focused on a system of education to prepare the students for highly competitive standardized tests by increasing their critical thinking through the adoption of constructivist pedagogy. The study concluded that when education turned from filling one's mind to producing knowledge-based products, students can learn better in the long run and can improve their exams. In addition, socio-constructivist learning theory showed direct implications for instruction, therefore, interacting with support drives the learner to a higher level of development. Farkas (2012) concluded that when teachers use Web 2.0 technology in the classroom, they have to alter the classroom learning environment into social constructivist in order to have an effective instruction. According to Weinburgh et al. (2014), teachers have a big role as facilitators to build constructivist learning theory for the learners when integrating new ideas into what has been learned before --which can build new knowledge for the students. Thus, teachers should focus more on finding powerful support in teaching mathematics to increase the basic knowledge, and to ensure the academic success of EL students. Arslan & Costu (2021) indicated that Web 2.0 technology is extremely attractive for students, helps them be independent, ensures more cooperation, and increases the pedagogic effect. Overall, building ELs' critical thinking and networking great support in mathematics are key to learning.

Comprehensive Input

An effective teacher has special characteristics and cultural aspects benefiting EL students. The teacher is aware of the student's needs and works hard to make her verbal communication more understandable based on the student's linguistic needs (Gupta, 2019). To

make the message understandable to students, it is referred to as comprehensive input (Krashen,1982). Krashen (1982) talked about the learning setting and how it gives students motivation to increase English language learners' acquisition. Students can be motivated in a comfortable environment that encourages them to learn. Krashen (1982) explained the difference between "acquisition" and "learning," where acquisition is the product of a subconscious process: "It requires meaningful interaction in the target language - natural communication - in which speakers are concentrated not in the form of their utterances, but in the communicative act." On the other hand, "learning" is the product of regular instruction and it includes the conscious process. According to Krashen, "the learning system performs the role of the monitor or the editor." Comprehensive input with a motivational environment is a good essential technique to language acquisition. Web 2.0 technology is a perfect tool to motivate students which can lead them into the learning process.

According to Diallo (2014), Second Language Acquisition (SLA) theory centered on the successful methods that allow the acquisition and mastery of the second language. The researcher stated that EL students must access quality academic content while they are learning English. This means that mathematics teachers must modify lessons to meet the needs of ELs in their classrooms. Diallo (2014) investigated the teachers' use of technological tools to support and help ELs to become more proficient in English. The traditional methods of teaching compared with the new methods that implement new technological tools help to teach English to ELs. The theory of SLA by Krashen (1982) shows the comprehensive input displayed in the classroom by using new coherent technology for learners' materials. The results showed the importance of implementing technology in the classroom to help and support teachers' differentiation while there are ELs in their main classrooms (Diallo, 2014). Therefore, when

enrolling EL students in the mathematics class, the teacher will be adequately prepared to ensure the student's academic success. The use of technology to improve ELs is more important in this technological world. Thus, it is necessary to research appropriate Web 2.0 technological tools and use them as comprehensive input resources by mathematics teachers to educate ELs.

Personal Learning Community (PLC)

Teachers can switch the learning strategy by applying Web 2.0 to create PLCs to assist students' collaboration in their classroom. Rahimi et al. (2014) developed a system using Web 2.0 that can support learners and manage their own learning. With the support from the teacher, the system can help the students set their goals, succeed in their own learning, and increase their communication with others in the process of learning. The system consists of three main elements including the student's control model, where the student balances between supporting and encouraging the activities for co-producing knowledge. A second element includes the learning potential of Web 2.0 tools and services, where these tools and services can support creative and collective contribution, knowledge-production, and the development of new ideas by the student. A third element includes the project-based teaching approach where Web 2.0 supports the socializer role of students based on three levels. The first level can facilitate student-centered instruction. Web 2.0 can trigger deep and active interactions between teachers and students through supporting conversational interactions, social feedback, and social networks (Hossain, 2012). Second, Web 2.0 can foster interaction and social learning between students. Alhassan (2017) concluded that the actual use of Web 2.0 tools in the classroom helps the students to interact with others and will lead students to understand. Third, the social and openness aspects of Web 2.0 make it possible to connect students to "More Knowledgeable Others" outside of the classroom boundaries. Attwell (2010), stated that Web 2.0 tools help

students to explore outside their classrooms by communicating with other peers. Technology-enhanced learning activities are activities that can be used to assist and scaffold students to develop and deploy Web 2.0 based PLCs and accomplish their learning projects. Therefore, PLCs presume and support an active role for students by placing them at the center of their learning processes, supporting their learning, and enhancing their control in the educational process.

English Learners' Situation in the United States

In the United States, the EL population is increasing every year. The Migration Policy Institute (2019) indicated that there are more than 44.9 million immigrants living in the United States. With the increasing number of EL population, the schools will be overwhelmed with EL students. According to the National Center for Education Statistics (NCAS, 2019), public schools have 378 languages that are spoken by these students. In Fall 2017, Spanish was the home language of 3.7 million EL public-school students, representing 74.8 percent of all EL students (NCAS, 2017). The National Center for Education Statistics (2017) survey showed that in the school year 2016-2017, EL students have increased by 10% in many states where most teachers reported teaching ELs in their classrooms.

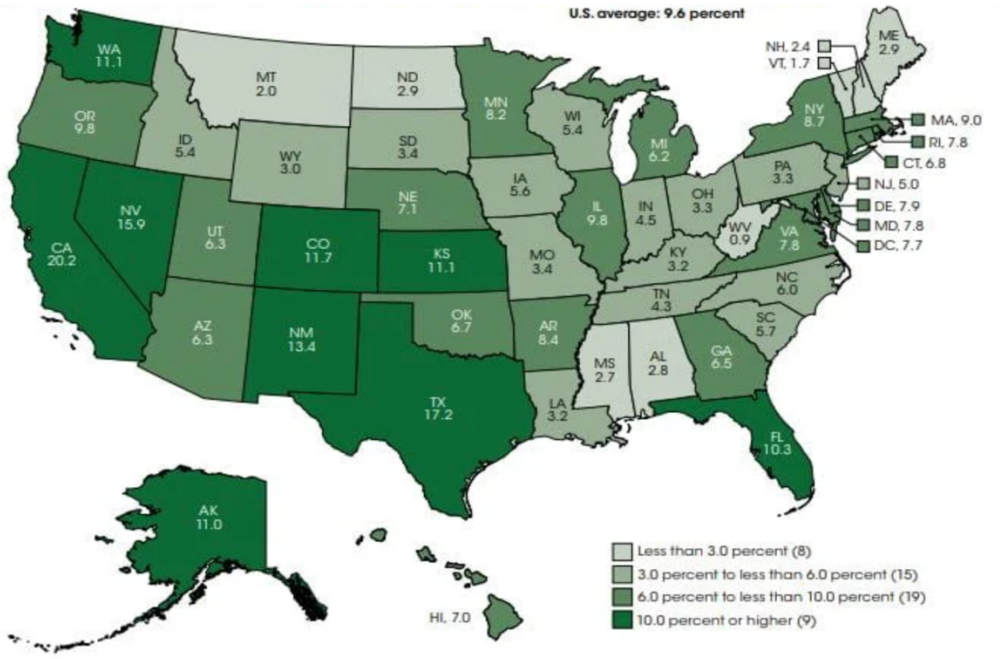

Figure 1: percentage of public-school students who were English language learners, by state: fall 2016-2017

Figure 1 shows areas in the United States with an increasing number of EL students in the 2016-2017 school years (Ferlazzo, 2019). The United States government requires every school to provide ELs with meaningful instruction. With this growth of EL students in public schools, great attention needs to be focused on their educational achievement for many reasons. Some of the reasons Batalova and Zong (2016) stated are that most of the students entering the U.S. public schools have limited English proficiency (LEP), have a native language other than English, or they may use another language at home. Thus, the public school system should be aware of and responsive to the challenges faced by students who have LEP.

National Center on Immigrant Interaction Policy (2018) showed big achievement gaps between ELs and non-ELs in mathematics high school scores, where the results are shown in Table 1. Georgia Department of Education (2016) stated that many EL students are typically

below grade level due to their English proficiency and English not being the main language spoken at home.

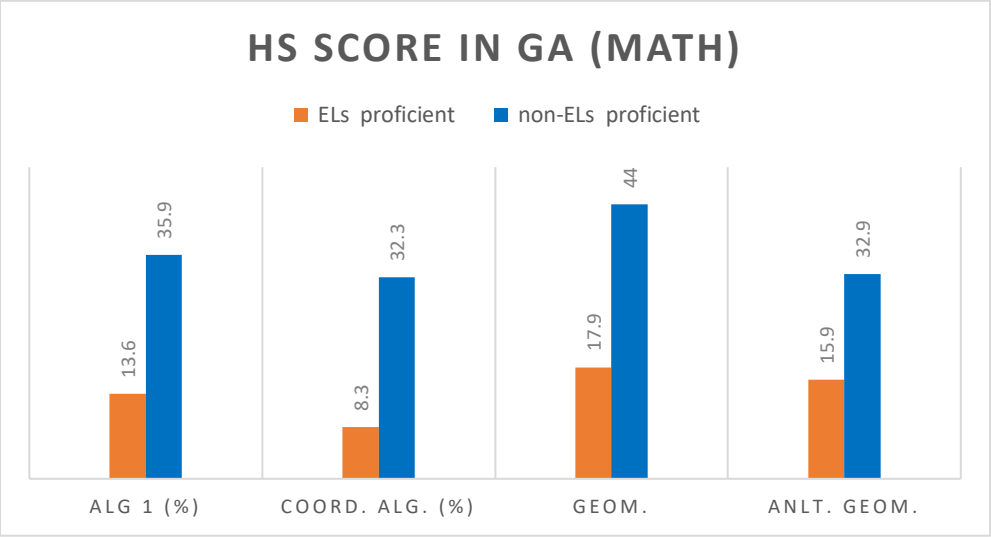

Table 1: ELs and non-ELs who scored proficient in high school end-of-course tests (%), SY 2016-

The enrollment of the K-12 EL population continues to increase, and public schools could be beneficial to the educational system due to linguistic and cultural diversity; thus, this increasing number is a challenge for mainstream teachers when teaching these students (Khong & Saito, 2014). Teachers must look at facilities to support students' language proficiency while practicing by sharing with others in the classroom. Therefore, as the achievement gap persists in the U.S., these growing numbers of ELs in the public schools make us confront and focus on mathematics teachers' use of Web 2.0 technology in their classrooms to help ELs attain success.

Challenges for English Learners

There are several requirements and challenges for ELs that affect their academic progress. EL students must take World-Class Instructional Design and Assessment (WIDA), and students have to place in their level according to their scores. The No Child Left Behind Act

(NCLB) of 2001 wants all the students to have a certain test of evaluation, including EL students, and the skills that they need to communicate in content classes.

According to the education department, EL students have to meet all the requirements to pass the WIDA test to be in the same level in the regular classroom. EL students' academic progress is being affected by having the WIDA exam in order to be promoted to regular classrooms. The WIDA test helps the ELs be differentiated into different levels of English classes, where the student has to get to level 6 (L6) to get promoted (WIDA, 2017). On the other hand, the Department of Education requires EL students to join the regular classrooms even if they are not required to have the same comprehension level as the native English students.

Additionally, the NCLB of 2001, requires all schools and school districts to apply the federal and state educational policies, where ELs have to join the mainstream classrooms. On the other hand, the NCLB Act does not require teachers to be qualified to work with EL students. Ballou (2018) stated that even if ELs are joining the regular classroom, that does not mean they are at the same comprehension and reading level as the native English language. All the states must do a standardized test for all students, including ELs, to show the students' progress in Reading and Mathematics. In standardized tests, content-based tests such as math tests are administered in English and normed on native English-speaking test populations (Abedi, 2002). Therefore, ELs must practice English to improve their language background proficiency to pass the standardized test to graduate from high school.

In addition, the American Youth Policy Forum (2020) stated that ELs face a big challenge in developing English language proficiency while learning academic content in English. Fang (2010) indicated how important it is to follow the instructional methodology that plays an important role in how the EL must acquire enough skills to communicate in content

classes, both orally and written. On the other hand, ELs can communicate fluently in everyday classrooms, but the problems are related to academic English in content areas. Cummins (2003) indicated that ELs can develop the fluency of everyday conversational English within two years, but they need a minimum of five years to develop appropriate grade-level proficiency in academic language. Burk (2015) suggested that it would be beneficially ideal for ELs to achieve through effective teaching and learning when using a good instructional facility. Some scholars are concerned about the teacher preparation programs with the use of technology to teach ELs.

All the challenges that ELs face, like having the WIDA test, NCLB act, and skills they need in content classes, contribute to difficulties in learning. Therefore, research on teachers' use of Web 2.0 technology is needed to help ELs improve and increase students' language proficiency to meet their needs in the mathematics classrooms.

Teaching ELs in the Mathematics Classroom

For several decades, there has been a well-known problem related to the low level of achievement of ELs in mathematics courses, which impedes them from graduating from high school (Estrella, 2018). Indeed, many teachers share the same misconception about teaching ELs in math, where they believe that math is not associated with any language because math is only using symbols (Bresser, 2019). On the contrary, language plays an important role in learning mathematics and ELs are facing difficulty in the mathematical classrooms where they need a lot of effort in listening, comprehending, and engaging to improve in academic language. ELs have difficulty during their exploration of mathematical concepts and teachers take this into consideration to help ELs in achieving their ability to meet their needs (Gupta, 2019).

O'Hara et al. (2015) concluded that teachers can use technology to instruct EL students where the instruction of specific vocabulary is crucial and the vocabulary knowledge correlates

with reading comprehension. Therefore, mathematics teachers must provide a common approach to enhance ELs' literacy in the content area, while helping them improve in their standardized tests. However, further research is needed to understand the teachers' practices of instructing ELs in the mathematics classroom.

Technology and EL Students

Nowadays, math teachers and their classrooms run differently than a few years ago. The teachers are expected to facilitate activities that students are encouraged to use more to promote math critical thinking and achieve ELs' learning goals. GaDOE (2008) and NCTM (2015) inspire technological tools that can increase motivation and help students to improve in mathematics. The technological tool can be used to facilitate ELs' acquisition of the second language as they learn the content knowledge.

Researchers have looked at technology as a rich resource for achieving EL students' learning goals. O'Hara et al. (2013) researched teachers' ability and their knowledge on how to improve ELs learning in order to achieve good literacy skills by using technology applications like wikis and blogs. In their study, two significant themes emerged: the challenges the teachers faced when instructing EL students and EL students showing an improvement. The results revealed that technology is an effective instructional tool for ELs to engage in learning in the classroom. Also, EL students can learn new words via technology, which can later be used in context to improve their language development (O'Hara et al., 2013). Therefore, the use of technology in the classroom can be an active instructional tool to help EL students reach their goals.

Star et al. (2014) researched "Studying technology-based strategies for enhancing motivation in mathematics." Researchers have sought to spark students' interests and build their

sense of competency in mathematics through the use of technology. The study evaluated the impact of three different types of technology-based activities on students' short-term motivation in math lessons related to algebraic reasoning. Results indicated that the effect of each technology activity, with respect to math learning, resulted in improvements in students' scores on the math learning measure in all three inductions (Star et al., 2014). So, the appropriate intervention of the technological tool reinforces teaching in EL students.

Technology offers a variety of effective teaching and learning methods for any classroom, which has a positive impact on the learning goals of EL students. Integrating technology with mathematics instruction enhances learning and gives confidence in learning the content of math, which helps students to progress better (Hossain & Quinn, 2012). So, research on instructing ELs using Web tools by mathematics teachers is essential to find their ability in learning.

Integrating Technology in the Mathematics Classroom

The use of technology in the mathematics classroom provides dynamic opportunities for instruction. It gives students and teachers the ability to interact with teaching content and expand learning beyond the classroom. According to the NCTM (2015), effectively applied content-neutral technologies in math can increase students' access to information and ideas, and enhance student interactions to support and enrich sense-making in mathematics classrooms.

Integrating technology into the math classroom allows teachers to have customized learning experiences, improve collaborative learning, and motivate students who want to perform better academically. Schraldi (2020) indicated that integrating technology in the mathematics classroom can provide individual students with content and support which helps the individual

needs because no two students are the same in learning. So, adding technology to math lessons provides support for each individual student in the class.

Joven (2018) investigated the influence of using formal technology in EL math classrooms on students' motivation to learn and improve their math proficiency. The researcher used a quantitative study conducted on EL students in a traditional math class, and EL students with daily structural computerized intervention. Using the Motivations Strategies for Learning Questionnaire (MSLQ), the study findings indicated that using technology in the mathematics classrooms for EL students can improve their intrinsic motivation, self-efficacy for learning, and task value. However, research on understanding the secondary math teachers' practice of using Web 2.0 to instruct EL students were still needed and required more consideration.

Web 2.0 Technology

Types of Web Technology

Piehler (2014) in his survey of K-12 schools showed that over 90% of the teachers reported that using technology can be a motivating tool for students. Using specific tools in education provide big support for learning in every classroom. Web 1.0 and Web 2.0 are both types of technology that have been used in education. Naik et al. (2009) in their research "Comparative Study of Web 1.0, Web 2.0 and Web 3.0" indicated that Web 1.0 was the beginning of the World Wide Web (WWW) which is still found in education without providing interaction. Web 1.0 lacks dynamic representation. It provided limited information, a read-only program that students can only use to get knowledge about a topic. Therefore, Web 1.0 can continue to have a purpose. It can be used as a personal website to search for certain information and read about it only. In contrast, Web 2.0 technology provides many advantages in learning.

According to Aghaei et al. (2012), Web 2.0 has the potential to change education by

providing tools to collaborate and support students' learning. Choudhury (2014) in his research indicated that Web 2.0 is the second generation of the Web, which allows assembly and management of large global crowds with common interests in social interactions. Besides that, Web 2.0 applications facilitate collective knowledge production and social networking, as well as increase user information exchange. Hattem (2014) in his research used Twitter and Language Learning in the classroom where he concluded that micro-gaming language activities had a positive effect on students' participation, collaboration, and achievement of learning outcomes. So, Web 2.0 technology provides valuable pedagogical tools in learning and teaching. Table 2 compares Web 1.0 and Web 2.0. Therefore, to prepare students to learn throughout their lives, it is necessary to switch to new future technology, Web 2.0, and to examine the teachers' use of this technology in their education.

Web 1.0	**Web 2.0**
Reading	Reading/Writing
Companies	Communities
Client-Server	Peer to Peer
HTML, Portals	XML, RSS
Taxonomy	Tags
Owning	Sharing
IPOs	Trade sales
Netscape	Google
Web forms	Web applications
Screen scraping	APIs
Dialup	Broadband
Hardware costs	Bandwidth costs
Lectures	Conversation
Advertising	Word of mouth
Services sold over the web	Web services
Information portals	Platforms

Table 2: A comparison list of Web 1.0 and Web 2.0

Web 2.0 Technology in Education

Web 2.0 technology has the potential advantages to establish effective teaching and learning environments while students are collaborating with others rather than just reading.

Hossain and Quinn (2012) expressed different tools of Web 2.0 such as blogs, wikis, and podcasts. They concluded that interacting with freely accessible tools of Web 2.0 enabled high school students and math educators to build collaborative learning environments and improved the quality of math education provided. Additionally, NCTM (2015) indicated that Web 2.0 technology has tools that are easy to use for learning and to apply with built-in sharing and collaboration which can attract EL students to mathematical subjects and motivate them to learn mathematics.

Web 2.0 tools increase the students' motivation for learning using activities. Trisniawati et al. (2019) noticed the effect of using Web 2.0 on the interest in mathematics learning which ultimately increased by the use of Edmodo, a free and secure learning platform. The results showed that using Edmodo increased two main factors in students' interest in mathematics class motivation and encouragement. The inner factor is motivation where students participated in learning activities, do assignments, and complete quizzes. Using Edmodo also helped all students to share in a small and big group where students looked enthusiastic to present the material in front of the class (Trisniawati et al., 2019). Also, in the virtual high school course, the teacher used Web 2.0 tools to include activities such as debates, role-playing, and participation in research groups. The results showed the average pass rate was 71.4 percent compared to the national average of 44 percent. The survey found that using Web 2.0 generates success in course (Andrist, 2017). On the other hand, Kurt et al. (2019) revealed that some teachers have little experience in using and selecting Web 2.0 applications. However, using Web 2.0 tools when teaching ELs in mathematics is undetermined and necessitates further exploration of teachers, particularly at the secondary school level.

Benefits of Using Web 2.0 to Instruct ELs

Creating teaching patterns through Web 2.0 applications can enhance EL students' academic skills. Azid et al. (2020) indicated that when teachers integrate appropriate teaching tools in a diverse classroom, the outcomes result in meaningful teaching strategies. In their qualitative research, they used the Direct Instruction Model teaching strategy with Web 2.0 tools and another without Web 2.0 tools. The results revealed that students' learning of mathematics in the classroom showed an increase in mathematics achievements and motivated them to finish their tasks. Therefore, integrating Web 2.0 tools help ELs' accomplish their academic skills.

Also, Halim and Hashim (2019) in their research agreed that utilizing Web 2.0 technology helps ELs gain various positive attitudes in learning. Halim and Hashim (2019) concluded that incorporating Web 2.0 technology in the classrooms can have a lasting effect on EL students' learning experience, thus improving their expertise in the content.
Halim and Hashim (2019) investigated and reviewed the benefits of utilizing Web 2.0 tools in EL classrooms; their conclusion offered various benefits like:

- Increase ELs' engagement in learning
- Enhance ELs' writing skills
- Create a comfortable and convenient learning environment
- Enhance social skills
- Encourage ELs to communicate inside and outside the classrooms
- Increase ELs' enthusiasm and self-confidence to learn ESL skills

Based on the previous research by Green et al. (2014), Web 2.0 technology has a meaningful impact on the learning process, helps students achieve academic skills, and supports EL students'

progress. Azid et al. (2020) suggested further research to explore teaching sessions using Web 2.0 tools and their reflection on the students' improvement and achievement across the country.

Web 2.0 as a Powerful Socialization and Communication Tool

Adding Web 2.0 tools in teachers' lesson plans increases the communication between students. Web 2.0 focuses on a social networking environment that is an ideal tool for ELs to understand math concepts with confidence. Social networking can offer beneficial activities for ELs to improve their communication (Berry, 2018). Researchers indicated that technology is a powerful way to enable students to improve their communication skills which can be implemented in their learning. Rahimi et al. (2014) used the model Personalized learning communities (PLEs) using Web 2.0 technology, where teachers can be facilitators for their students through social networking. The study showed the benefits of using PLEs in education, where it focuses on learning rather than on teaching and following the direction of the problem.

Web 2.0 tools can increase students' communication which motivates them for learning. Qomariyah et al. (2019) suggested in their research to use educational social networking like Edmodo, which is a free and secure educational learning network to provide activities and enhance EL learners' communications outside classrooms and nurture close ties with other students. Integrating Web 2.0 technology in the classroom helps teachers to change the classroom environment into social interaction with groups sharing the learning content. Also, Moschkovich (2015) stated that instead of giving EL students definitions and divorcing language to work on mathematical problems, instruction needs to consider not only the cognitive aspect but also has to focus on the sociocultural aspect like participation in mathematical practices. The use of Web 2.0 in teaching increases the sense of communication and interaction with the teacher and others.

On other hand, Zhang (2016) revealed in his research that when a teacher asks questions, ELs are not able to respond with their limited speaking and thinking skills, so in turn, they are not engaging in classroom interactions. Whereas when ELs practice communication using Web 2.0 tools inside and outside their classrooms, they can improve their literacy instruction which can, in turn, affect their academic performance (Zhang, 2016). Teachers can create academically beneficial activities using Web 2.0 to increase ELs' interaction to create an easy way of communicating with the students rather than following the direction of the problem. Therefore, research was needed to address the mathematics teachers' use of Web 2.0 tools in instructing ELs in the main classroom.

Web 2.0 Tools in the Mathematics Classroom

The Common Core State Standard (CCSS, 2014) stresses the importance of helping students persevere in the solving problem process. Integrating Web 2.0 technology into the curriculum gives a meaningful learning process that eventually helps upgrade the students' skills in the mathematics classroom. NCTM (2016) justified that technology can support the learning of mathematical procedures and skills, as well as the development of advanced mathematical proficiencies such as problem-solving, reasoning, and justifying. An example of the 10 best Web 2.0 tools in mathematics are shown in Table 3.

The 10 Best Web 2.0 Tools in Mathematics	
Pixton	- For Arithmetic and Geometric sequences - It can enhance a lesson by giving students the opportunity to creatively demonstrate their knowledge of a topic and communicate word problems visually.
Blabberize	- Polynomials - Students can demonstrate their knowledge of key polynomial features including intercepts, factorizations, and end-behavior.
Blogger	- Blogs allow educators and students to collaborate, share instructional resources, create content, and connect to mainstream social media.
GeoGebra	- Provides the ability to dynamically look at mathematical concepts. - Most useful Web 2.0 tools for teaching and learning mathematics.
Voki	- Students can share their knowledge - Helps students organize their thoughts to focus on key details.
Kahoot	- Math teachers can create learning games to improve education in their classrooms. - Visualizing complex ideas no longer has to be a barrier to entry.
Khan Academy	- Creates a global community of learning with videos, practicing material, and tracking progress. - Allows teachers to track the progress of their students.
Wordle	- For Algebraic Equations - Excellent tool to integrate literacy into other content areas.
Showme	- Systems of equations - Strengthens students' abilities to solve systems of equations and apply this skill to real-world problems. Students' computational skills and mathematical understanding will benefit since they are not told which method to use when solving the systems.
Educreations	- For Quadratic Functions - Excellent tool for teachers to create and share multimedia lessons. - A unique interactive whiteboard and screen casting tool that's simple, powerful, and fun to use. - Teachers can create short instructional videos and share them instantly with students.

Table 3: The 10 Best Web 2.0 Tools

Researchers showed that integrating Web 2.0 in mathematics class helps EL students to practice their language skills on their own while they are solving the problems without any fear of making a mistake. There are several studies that have appropriate pedagogical methods that examined the specific Web 2.0 tools regarding their use in the mathematics classrooms.

Using Voki Tool in Math Classroom

McCoy (2014) designed an effective way of teaching mathematics using Voki and Wordle tools in the classroom. The teacher created an online Web 2.0 PLC using Voki where the assignments were virtual and stimulate the discussion. The results showed all students worked through different types of questions and word problems according to their levels and their comprehension level on the assignments. The finding showed the students' attitudes and verbal communication toward mathematics improved after the project (McCoy, 2014). Konstantinidis et al. (2013) support their ideas and they concluded in their study that Web 2.0 technology provides

unique opportunities to change the process of teaching and the nature of learning experiences, where the content of mathematics can be provided to all students. So, Web 2.0 helps students to improve their language learning while learning content.

Desmos Polygraph

Caniglia et al. (2017) showed in their research the significance of using Desmos' Polygraph which is based on graphing utility that is highly intuitive. Multiple resources such as Polygraph activities have a useful feature that includes teachers accessing students' conversations. Desmos has a feature that enables the teachers to monitor ELs' problems, ask questions, and investigate to what extent students use formal vocabulary. Desmos' Polygraph is an appropriate tool that strengthens ELs' oral language skills in mathematics (Caniglia et al., 2017).

Web 2.0 technology can be the perfect teaching method adopted in mathematics classrooms to support mathematics teachers. Hampton (2019) concluded in his study from the teachers' use of Desmos for calculation and drawing different lines, that Web 2.0 tools fit incredibly well in the instructions and make it easy for students to focus on the intended goal of creating, comparing, interpreting, and evaluating a fit line model. Hampton also noted that Web 2.0 tools allow math teachers to see students' responses in real-time, showed students' jobs were more efficient than pencil and paper, and how easy it is to share the student responses with the class-leading to productive conversations (2019). Web 2.0 tools enable mathematics teachers to access the information that is related to the lesson materials and can be effective in teaching class. Therefore, investigation on using Web 2.0 technology in teaching mathematics and the way it is instructed for ELs is still needed.

Edmodo Tool

Trisnawati et al. (2018) indicated that many factors influence the interest in learning mathematics like the various types of e-learning. PLCs, such as Edmodo Web 2.0 tool, support an environment of unique idea exchanges and cultural awareness supporting a theory of collaborative learning. Due to the fact that the atmosphere in the Edmodo remains active, educators will become like a kind of supervisor. Edmodo helps teachers to create classes and then share the assignments and quizzes. Edmodo is an interactive thread of reading and writing at the same time, which makes the students easily respond to each other's comments instantly (Trisnawati et al., 2018). Edmodo increases student confidence and enables student learning to become part of the active classroom community.

Teachers' Challenges

Teachers' Challenges in Teaching EL Students

For the past decades, researchers have examined the difficulty and challenges that teachers face while teaching ELs and tried to find an effective way to improve the low academic achievement of ELs (Star et al., 2014). Khong and Saito (2014) reviewed the types of challenges that teachers in the U.S. face while teaching ELs in the classroom. They concluded that teachers experienced problems in exchanging ideas and information with their ELs and they faced difficulty collaborating in efforts to educate them. They also emphasized that stronger teacher education programs can be a solution to problems related to the teaching and learning EL students, however, these programs are insufficient for teachers to overcome all of the challenges they face (Khong & Saito, 2014). Another study indicated by Capo et al. (2011) stated that many teachers lack the use of technology in their classrooms for several reasons such as lack of time, lack of training, and lack of equipment. Therefore, some teachers have reasons to not use

technology in their classrooms, where teachers should provide technology education to support EL students to help them pass the standardized test.

On the other hand, a challenge in educating ELs is displayed through the standardized test, which is a requirement from the NCLB Act (2002) that all students, including ELs, must take. The test includes the same content for both ELs and non-ELs and the results still showed low performance for ELs in math.

Teachers always seek to find a suitable method of teaching to increase EL students' interest in learning. Rita et al. (2019) suggested that contemporary teaching should focus more on learner-center and know how to provide the great benefits of technology over traditional teaching to improve student learning and allow students to take more responsibility for their learning. Star et al. (2014) indicated that gaining the students' interest can result in both the technology as well as from the teacher beliefs on the instructional practices. Therefore, more study is needed to provide mathematics teachers with better selective technological tools that can enhance ELs' education.

Teachers' Knowledge of Using Web 2.0

Experts agree that when teachers have a significant amount of knowledge and understanding of the purpose of using Web 2.0 technology, they can easily transfer the education to enhance students learning and improve their performance.

Peterson et al. (2018) in their article "Teaching pre-service teachers how to utilize Web 2.0 platforms to support the educational needs of students with disabilities in general education classrooms," investigated the pre-service teachers by having them use Web 2.0 tools in their disability classroom. They focused in their study on the use of these tools in differentiation instructional strategies. In the survey question of 82 pre-service teachers about their knowledge

of Web 2.0 tools, the findings revealed that the participant teachers' responses in the study showed zero knowledge and a low level of understanding of using Web 2.0 technology in their classrooms at the beginning of the study. After utilizing Web 2.0 technology and being provided with the correct knowledge on how to use it, all students got support from other peers and all of them completed their assignments. On the other hand, teachers who were lacking preparation programs for Web 2.0 tools have less familiarity with differentiating in their classrooms (Peterson et al., 2018). Therefore, examining the use of Web 2.0 technology in math class provides a perfect foundation for developing educational practice with the need for knowledge to integrate the proper tools in exclusive classrooms.

Teachers' Attitude Toward Using Technology /Web 2.0

Teachers' attitude toward the use of technology is important because it may enhance mathematics teaching and learning (NCTM, 2000). Karkoulia (2016) investigated teachers' attitudes towards the use of Web 2.0 in EFL teaching classrooms. The study was aimed at the type of web 2.0 tool the teachers use and the way they use them in their classroom. The results showed that most of the teachers showed a combination of successful integration of Web 2.0 tools with a positive attitude. On the other hand, Hao and Lee (2015) concluded that the teachers' concerns about using Web 2.0 are correlated with their knowledge on how to use the tools, which can lead teachers to show a negative attitude towards these tools.

Another study by Tatli et al. (2019) investigated the prospective teachers who graduate without acquiring the capability to use technology. In their study, they used Web 2.0 as an external stimulus in the context. Technology Acceptance Model (TAM) was used to show the results of the instructional materials they can earn after using Web 2.0. The findings revealed that the teachers' attitude towards using technology/Web 2.0 had changed. Teachers before

training had a different belief and less knowledge about technology where they believed it was a waste of time, distracted students, and/or restricted their imagination, but after the training program, all these negative opinions diminished significantly (Tatli et al., 2019). Therefore, research is needed to determine the gap between the mathematics teachers instructing ELs in the use of Web 2.0 tools and the positive attitude towards using them in their classrooms.

Research Gap

This qualitative case study focused on the secondary mathematics teachers using Web 2.0 tools regarding their instruction with EL students. EL students' low standardized math test performance suggests a need for better consideration of their math instruction. There are several authors who also express their views on this topic, or on a similar topic, where gaps in the literature are acknowledged. The acknowledgments will be presented in chronological order. Kul and Celik (2018) examined the factors affecting pre-service mathematics teachers' where the purpose was to integrate Web 2.0 tools in their mathematics education. They showed positive attitudes towards applying Web 2.0 technologies in their classrooms. Kul and Celik (2018) concluded that Web 2.0 tools help in the students' learning and communication as well as attract their attention more than visual elements. Tatli et al. (2019) also examined the prospective teachers on using Web 2.0 tools using the context of the Technology Acceptance Model (TAM). The results showed a significant difference before and after the training. This study provided a strong use of Web 2.0 in the classroom without specifically mentioning the effect of using Web 2.0 to instruct ELs in the mathematics classroom.

Berry (2018) examined the perceptions of secondary mathematics teachers (SMTs) regarding equitable instruction for secondary ELs in the mainstream secondary mathematics classrooms. Through the interviews, the researcher's reflections, and observations several

findings resulted. The study showed that secondary mathematics teachers are struggling when teaching ELs. According to Russell (2015), this study addresses the important gap in the literature by examining the relationship between an EL facilitator and novice teacher as a support for teacher learning. The study described and analyzed the professional learning of a novice teacher by focusing on social participation with an EL facilitator within one high school. Ultimately, teacher education is a necessity that requires improvement in its current condition to meet the high needs of the current demographics. Also, there must be a call for wider collaboration between university teaching faculties and local districts in order to support secondary teachers and equip teachers with the necessary tools that can help all teachers grow to accomplish success in teaching ELs (Russell, 2015). Within these two articles, the authors did not mention the use of technology and the instructional way of teaching them in mathematics classrooms.

Burk (2016) examined the high school teachers' perceptions about having enough knowledge and usage of Web 2.0 technology in teaching ELs. The data collection of the study covered 86 teachers from different schools and subjects. The outcomes indicated that implied Web 2.0 technologies were not used on a consistent basis to help with the instructional needs of EL high school students (Burk, 2016). Burk did not address the mathematics teacher's pedagogy as it relates to the high school EL population using Web 2.0 technology, and this research could determine if secondary teachers of ELs perception of their pedagogy affected their use of Web 2.0 as an instructional tool in the math classroom.

In conclusion, based on the reviews made on various studies in this paper, integrating Web 2.0 technology in lessons will provide a large benefit to ELs learning in the main classroom. Web 2.0 tools make it possible for teachers and learners to go out of the classroom

environment and help improve the students' communication (Onbasili, 2020). Using Web 2.0 technology allows EL students to have a more meaningful learning experience that ultimately helps upgrade their English proficiency level. Besides, Web 2.0 technology has assumed a largely significant role in helping language instruction and learning (Clay et al., 2009). Applying technology in the classroom leads to improvement in students' learning and shifts learning to a more student-centered model rather than a teacher-centered learning model process, thus providing rich content (Alsalhi et al., 2019). Additional research is needed to determine the teachers' use of Web 2.0 technology and the need for this technology to instruct English Learners in mathematics.

Contribution to the K-12 education

Web 2.0 can create a lot of improvement in knowledge development in education. This research project will contribute many benefits. There are many advantages for mathematics teachers who have ELs in their classroom and for ELs who must be in the mathematics mainstream classroom. Mathematics teachers will realize that applying a variety of Web 2.0 tools in their classroom will establish vast networking of sources for EL students' long-term pedagogical skills. They will notice that those tools will have the ability to create a virtual learning environment, encourage communication, and help ELs to progress in mathematics. The other contribution to mathematics teachers is that the use of Web 2.0 tools makes the students more motivated to learn mathematics. This is because Web 2.0 gives a positive change in motivation and helps EL students to display an indifferent attitude toward the traditional teaching methods. Also, by providing Web 2.0 to ELs, the mathematics teacher will support them to change students' attitudes and contributions especially the students who have their own space

and time. They can identify a number of ways in which the learning practices will help to improve ELs' results.

The contribution that the EL students will earn from this research project is that Web 2.0 technologies will provide them with the opportunity to share and engage their work and projects with others. It will help them to build a good relationship with their teachers and native English students. Using Web 2.0 tools will be a guide for EL students to focus more on their achievements and goals, as well as allow them to collaboratively build their similar ideas on each other's work. Additionally, EL students will easily become full of trust, confidence, and high self-esteem to perform better in their tests.

Summary

This chapter presented a review of the literature that is related to mathematics teachers' use of Web 2.0 in teaching ELs that is based on the constructivist learning theory and Second Language Acquisition (SLA) theory. The theories were building new knowledge on what was previously learned about technology (Dager & Yadav, 2016; Weinburgh et al., 2014). Arslan (2019) focused on the impact of educational methods related to mathematics teachers when instructing the most growing population with Web 2.0 technology.

The increasing number of EL students in public schools showed a big impact on teaching and learning (NCAS, 2017). EL students are facing several challenges that are related to the requirements from the WIDA test and the NCLB which requires every EL student to join the main classroom (WIDA, 2017; Abedi, 2002; Ballou, 2018). Teaching ELs in the mathematics classroom by using technology can increase the motivation and engagement to improve in mathematics where NCTM and GaDOE encourage mathematics teachers to integrate the technology in their lesson plan to improve the students critical thinking (Arslan, K. 2019;

GaDOE, 2008; NCTM, 2015; O'Hara et al., 2013). However, Joven (2018) suggested that it is about time for the mathematics teachers to have the responsibility to use technology to provide the knowledge to instruct EL students.

The use of Web 2.0 in education can increase ELs' motivation and engagement (Alsalhi et al., 2019). The benefits of using Web 2.0 help to increase socialization and improve communication between ELs and non-ELs. Burk (2016) suggests that more study must be done about the use of Web 2.0 tools to instruct EL students in a mainstream classroom.

Teachers are facing many challenges in teaching EL students in their classroom such as the teachers' knowledge of using technology and adapting to technology like Web 2.0 tools (Adcock & Bolicl, 2011; Star et al., 2014). Therefore, researchers suggested that further study at the high school level is needed in order to determine the future of Web 2.0 usage by secondary mathematics teachers in order to help improve EL students' learning.

Chapter Three: Research Method

Methodology

This research further explored the secondary mathematics teachers' use of Web 2.0 for instructing English Learners (ELs). This qualitative study employed a case study research tradition. Qualitative approaches to research are used to understand people's beliefs, behavior, attitudes, experiences, and interactions (Merriam, 2002). The participants were teachers who had at least three EL students enrolled in their secondary mathematics classroom. The participants in this single case study were selected using a purposive sampling technique. According to Palinkas al et. (2015), purposive sampling is when the researcher chooses the participants who have special experience in the phenomenon of interest. This study included interviews in addition to document analysis and open-ended responses from secondary mathematics teachers. Next, I discussed research design. I gave a thorough description of the data analysis strategies for the study and the procedures that were used in order to understand and describe the use of Web 2.0 in the mathematics classroom.

In my case study, the researcher purposively selected four secondary school teachers from the northern secondary schools in the Georgia school district. The secondary school mathematics teachers that were participating must have had two or more years of teaching experience and must have had at least three EL students enrolled in his/her mathematics course. In order to determine which teachers met these criteria, an introductory letter was sent to all the mathematics teachers in the secondary school. The introductory letter included two questions that qualified prospective participants. These questions asked if the teachers had been teaching mathematics in secondary school for more than two years and if they had more than three EL students in their classrooms. After receiving the response form from three to five teachers, the

informed consent was sent to be signed. Then, the sample size and recruitment process were completed.

Research Design and Rationale

A qualitative research approach was used in the current investigation. This particular approach was selected since the goal of the research was to reach a deep understanding of mathematics teachers use of Web 2.0 in the instruction of EL students. Qualitative research was based on the view that reality is constructed by individuals interacting with their social worlds, and the main interest of qualitative researchers is to understand the meaning or knowledge constructed by people.

I chose a qualitative case study research tradition as a method of investigation in order to understand, describe and analyze the teachers' use of Web 2.0 technology to instruct ELs in mathematics. A researcher found, "case study research is defined as a qualitative approach in which the investigator explores a real-life, contemporary bounded system or multiple bound systems over time, through detailed, in-depth data collection involving multiple sources of information, and reports a case description and case themes" (Creswell, 2014). So, the case study research was appropriate for my type of research study. My study was an in-depth investigation to collect information about teachers' use of Web 2.0 technology to instruct English learners in a northern school. The findings on the use of Web 2.0 tools in the classroom were helpful for the mathematics teachers and ELs.

Role of the Researcher

This case study was an in-depth interview with observation and open-ended questions, which is one of the forms of data collection. The second form of data collection for the study was the teachers 'observation. In order to examine the use of Web 2.0 technology in secondary

school mathematics when instructing English learners, the researcher understood that although each mathematics teacher that participated in the research had to provide their own experience in teaching EL students, their responses to the questions would vary and may or may not be the same. These questions had no right or wrong answers. Collected data was also included in the lesson plans obtained from the study participants. Teacher lesson plans served as artifacts, as suggested by Yin (2011), to more thoroughly identify and explain the use of Web 2.0 to teach ELs in the mathematics classroom. Data was gathered from the lesson plans of teachers participating in the study and was triangulated with the data gathered from the teachers' observation and interviews.

The processes of triangulation and data analysis serve to validate case study research (Guion, 2002). According to Merriam (1998) in the qualitative study, there are no systematic rules for analyzing the data. The aim of analyzing the data was to create and organize the finding pattern to create themes. In this case study, the triangulated data from the interviews, observation, and lesson plans were compiled, organized, and analyzed using ATLAS.ti (2013) software. In addition, triangulation of data enables a process of using multiple perceptions to clarify the meaning, verifying the repeatability of observation or interpretation (Stake, 2010).

In this case study, the triangulation across observations, interviews, and artifacts were collected. Multiple forms of data were collected and analyzed for this research. I observed the teachers in mathematics classrooms three times. Field notes were used during observation in the classroom. The four participating teachers were conducted the interview with open-ended questions using either in-person or an online video conference to gather the teachers' strategies, challenges, and drawbacks of using the Web 2.0 tools. The classroom artifacts included four teachers' lesson plans. I explored whether the Web 2.0 tools were integrated and checked if there

was any benefit that EL students experienced from using it. Through the data gathered, the results reflected the purpose of obtaining the secondary teachers' use of Web 2.0 when instructing ELs in the mathematics classroom.

Participants

The participants in the study included three to five secondary mathematics teachers who taught English learners daily in their classrooms. The chosen teachers had no training or prior ESOL certificate for teaching EL students and they did not speak their language. For all these reasons, the school comprised a good fit for this case study. First, permission from the school district was requested to conduct the case study. When the district approved, permission to conduct the study was requested by the principal of the sample high school. Once I received the IRB approval from both the school and KSU, the study invitation and informed consent forms were handed to the participant teachers in the study in school. Then, I asked the participants a few questions to check their eligibility for acceptance in the study. The questions included whether they spoke the EL students' language, had more than three EL students in their mathematics classroom, and had any training or certificate for teaching EL students. Then, the participants were handed an Informed Consent Form.

Research Setting and Context

This qualitative case study was conducted in a northeast suburban public school in the State of Georgia. The secondary school had 2,551 students in grades 9-12 with a student-teacher ratio of 17 to one. The school has English Learners enrolled in their secondary mathematics courses. The school has the largest ESOL department in our public-school district. The district has a remarkable diversity with 65% white, 25% Hispanic, 4% Asian, 3% African American, and 3% other. Twenty-three percent of the students in the school were eligible for a free lunch. The

school had a 35% minority enrollment that counts around 893 students (US News, 2019). The total number of Hispanic students was 663 students attending secondary school, and 179 ELs were joining the ESOL program. Being a substitute teacher at this secondary school, the school was very familiar, and it was very accessible when joining most of the teachers and students. The mathematics teachers in this school had EL students in their classrooms. According to the Local County School District, the school was struggling to meet the needs of ELs as demonstrated by the disparity of their EL student scores on mathematics state assessment data (Figure 2).

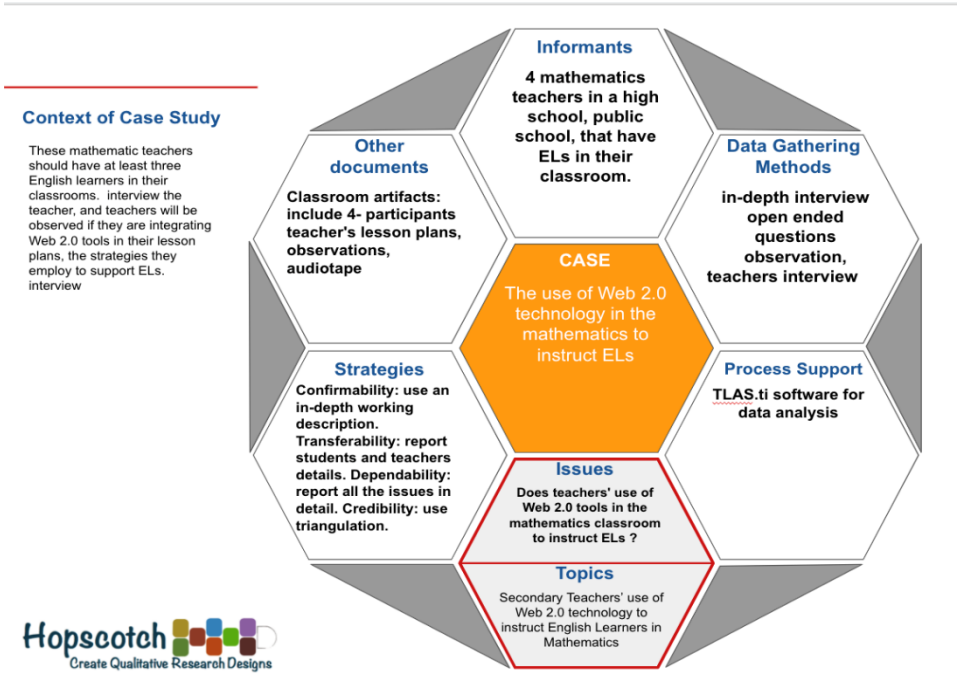

Figure 2: Context of Study

Data Collection and Data Sources

The collection of the data for this study was dependent upon the research methods and design that was a qualitative case study. According to Yazan (2015), case study research should collect data from multiple sources of evidence, with data needing to converge in a triangulating fashion and benefiting from the prior development of theoretical propositions to guide data

analysis and collection. This helped the researcher to explore the process of the "how" and the "why" of the main investigation.

The data was collected from various sources such as interviews, notes from classroom observations, and classroom artifacts that included participant teachers' lesson plans. All these data sources served as good resources for triangulating the data and were used to support the continued data collection. As asserted by Stake (2005), using various data sources, such as conducting classroom observations, collecting and analyzing classroom artifacts, and conducting teacher interviews in the current study, assists both quality and confidence in the data collection for the study. In addition, triangulation of data enables a "process of using multiple perceptions to clarify the meaning, verifying the repeatability of observation or interpretation" (Stake, 2010). Data sources for this study were selectively transcribed interviews, field notes from classroom observations, and documented analyses from the lesson plans. Also, the process of triangulation and data analysis served to validate case study research (Guion, 2002). These different data sources were used in order to continue the data collection and served as a means of triangulating the data.

Participants

For this study, mathematics classrooms were observed three times for each of the participating teachers for 30 minutes to explore the teachers' use of Web 2.0 technology to instruct English language learners in mathematics. This helped in understanding the interaction of ELs in the mathematics classroom. Creswell (2008) stated that it is essential for the researcher to be part of the activities in the setting they observe. I was a participant-observer, engaging in their activities after I earned permission from the teachers and the students. During the observations, the field notes were collected to record all the classroom events.

Interviews

For this study, the participating teachers conducted the interview protocol using either in-person or an online video conference to gather the teachers' strategies, challenges, and drawbacks of using the Web 2.0 tools when instructing EL students in their mathematics classroom (Appendix A). The questions were open-ended questions that allowed them to respond freely. I consistently focused on creating a comfortable environment and a positive interaction between myself and the participants by being respectful, nonjudgmental, and nonthreatening.

Classroom Artifacts

For this case study, I collected a variety of classroom artifacts as data sources. These artifacts included three teachers' lesson plans. Teachers' lesson plans served as artifacts according to Yin's (2009) suggestions. These artifacts helped me to understand the goals and decisions of the participants that were not completely revealed through interviews or observation. I collected and analyzed the mathematics teachers' lesson plans to find out if they provided Web 2.0 tools in their lessons. Also, I explored whether the Web 2.0 tools were integrated in the classrooms and checked if there was any benefit that EL students experienced from using it. Those responses will apply to the appropriate research questions.

In case the pandemic situation was extended and schools followed the rules for the pandemic, there was an alternative way of data collection. First, emailing the consent forms to the three to five secondary mathematics teachers who were participating in the study was a way they could make sure they could sign the forms. For the interview, the participants would have been contacted by either calling or emailing them. Using a telephone interview to call the participant teachers and ask them the questions or emailing them the questions so that they had enough time to respond in more detail were alternative ways to conduct the interview in case of

COVID policies. Also, for the observation, I would have taken permission from teachers to join the class during their virtual meetings. For the classroom artifacts, the participants would have been asked if they could email their lesson plans.

Data Analysis Strategies

The data collected for this qualitative case study included data from observations, interviews, and document analysis. The data was analyzed in order to create categories from coding that ended in themes. The data analysis depended on the type of case study (Yazan, 2015). For this case study, the researcher ensured that the data was gathered with a full understanding of the overall case. The purpose of this qualitative case study was to understand and describe the experience of secondary mathematics teachers regarding their use of Web 2.0 to instruct EL students. According to Yazan (2015), there are no specific rules for analyzing qualitative data. In addition, the analyzing section of the qualitative study was the most important section because there was an organization and development of themes. The data analysis process continued until no new codes or concepts emerged (Rijnsoever, 2017). At this point, theoretical saturation had been reached and all relevant information that was needed to gain complete insight into the study had been found (Rijnsoever, 2017).

During the observation, I focused on the field notes to record all the classroom events and activities that took place in the classroom. For observation, there was analysis done for all my field notes for every participant teacher. I made sure that I had a few hours following each observation to review the comments. For the interview, I also ensured that I established a thorough deliberate examination of the transcribed interviews. I made the interview questions intentionally revisit the key ideas. I audio recorded with the permission of the participants, and I selectively transcribed then thematically coded all the classroom events. Then, I analyzed the

mathematics teachers' lesson plans and recorded all the information about Web 2.0 tools and whether they were using them or not. I kept a log of all the data gathered, including the days and times of data collection and the analysis methods that I was using at the time.

Also, ATLAS.ti (2013) was used, and inductive coding and analysis of the recorded data was performed. ATLAS.ti is a leading Qualitative Data Analysis (QDA) software for personal computers. An inductive approach was organized into three sequential stages: open coding, axial coding, and selective coding to be used in order to code the category (Friese, 2014).

1- Open coding: This stage began while collecting data. The researcher compiled the responses from the participants into a Microsoft Excel Document after the interview and documents collection. The reason was to be able to gather enough data in order to find details required for developing themes. The field notes from classroom observations, artifacts, and interview transcripts were categorized. This phase included the ATLAS.ti software, where coding was assisted by structures called nodes that provided the storage capacity for references to the code text. The nodes were aligned with the research questions.
2- Axial coding is the breaking down of core themes that required the entrance of opinions, experiences, and teachers' responses. This stage also involved organizing the code broad data from the first stage to create a meaningful analysis. It allowed the data to be grouped and collected the codes that had similar content.
3- Selective coding was the final stage of data analysis. It was completed after having found the core variable or what was thought to be the core, the tentative core. The core explained the behavior of the participants in resolving their main concerns.

Triangulation of Data

From the triangulation of the observation data, interview data, and the lesson plan data, themes and sub-themes were identified and categorized to the research questions that reflected high school use of Web 2.0 technologies when instructing ELs in mathematics. The data collected in this qualitative case study was obtained from focused interviews and documents. According to Yin (2009), a single source is not recommended, and many sources of data are needed to make the case study stronger. The researcher used multiple sources of evidence in this case study to address a much wider range of issues relating to the study which provided several measures of the same phenomenon (Yin, 2009). Using multiple sources of data was more expensive and time-consuming but having more sources of data made the data richer and more accurate.

The interview questions addressed five questions to clear the research questions. I determined whether the teachers were using Web 2.0 tools to help EL students in mathematics and if they still preferred the traditional way of teaching mathematics which included students having to solve and answer the problems. I deduced whether or not teachers needed more professional development in utilizing Web 2.0 instructional methods. I examined if ELs felt that they did not have enough accessibility to a device connected to the internet for them to use Web 2.0 tools. I looked for the external causes, including the continuous rapid advancements in technology, lack of updated hardware and software in schools, and lack of consistent technological support.

Also, the data from lesson plans were reviewed to triangulate specific Web 2.0 technology discussed in the interview's responses. I checked whether mathematics teachers found it easy to apply any Web 2.0 activities in their lesson plan for EL students. I also

determined if the teachers needed to provide the correct and useful engaging Web 2.0 technology program that could help EL students engage in math problems. I looked for the challenges that teachers faced while teaching EL students in their classrooms such as a lack of professional training for teachers. From the teachers' interview, I checked whether mathematics teachers had difficulty in finding the best Web 2.0 tools to integrate into their mathematics classrooms and if using Web 2.0 tools for ELs was difficult for them. In addition, I checked if they were facing problems with ELs from not having enough engagement and interaction in the math class, and if they knew of any Web 2.0 tool that would improve ELs solving mathematical problems.

Limitations of the Study

The research was qualitative research that had a good acknowledgment of the limitations. According to Creswell (2008), each research has limitations that may affect the results; also, it can be helpful to the researchers who may conduct similar research. This case study did not show the order to generalize the results across all secondary mathematics classrooms. First, the setting for this study contributed to several possible limitations. The case study for this research was performed on a secondary school level mathematics course in a suburban secondary school. Second, the other component of the setting which possibly limited the transferability of the findings was the small population of ELs within the study. It involved minors over a period. In a school with over 2551 students, only 179 were identified and given ESOL services. This small EL population created a phenomenon of shared experience among the ELs. The students originated from different countries and educational backgrounds, demonstrated different English proficiency levels, and offered unique perspectives on the mainstream classroom. Third, my own participation within the school also served as a limitation to this study. During class, the observations were only limited to mathematics teachers. There was no comparison between the

ELs and the native language speaking students. The participants were limited to a small number, where only four mathematics teachers were eligible to be consented to participate in the study for examination of the use of Web 2.0 tools to instruct EL students.

Strategies to Ensure Trustworthiness

Trustworthiness is the quality of a person or a thing that inspires reliability. There were concepts of internal validity, external validity, reliability, and objectivity that were used to measure the trustworthiness of this case study. Since qualitative research is made from different paradigms, trustworthiness was secured within the rigor with which the study was conducted. In order to ensure rigor in qualitative research, Guba (1981) suggested these four major concerns that should be related to trustworthiness: transferability, confirmability, dependability, and credibility.

1. **Transferability**, I made sure to report EL students and teachers with details along with the context of the research. Gube (1981) defined that external validity or generalizability requires that the inquiry be conducted in ways that make chronological and situational variations irrelevant to the findings and also relevant in any context. I ensured that the transferability of the data was established through the objectivity of the data and the findings were generalized to any setting. Naturalistic generalization invites readers to apply ideas from the natural and in-depth depictions presented in the case of studies to personal contexts (Melrose, 2009). The sample of participants was based on the targeted sampling and demographics of the participants and the criteria for them was delineated in this study. The requirements for the participants in this study included: teaching a grade 6-12 mathematics course, having at least three EL students in the course, not speaking the language of the EL students,

and not having had any previous training relevant to EL students. It was important to know that it was possible that some findings could be applied to other research because of the similarity (Guba, 1981). Therefore, I ensured that when the readers chose to transfer understandings gained from this study to another situation that the research was presented as correctly as possible.

2. **Conformability** of this study, Guba (2014) stated that objectivity is a key to reach conformability and to ensure data is accurately represented via the participants' ideas and not created by the researcher. The findings in this study were established as data analysis and were made with the researcher's self-awareness of biases and inferences because this would impact the interpretation of the data. I used various data sources in this study such as classroom observations, classroom artifacts, and teacher interviews. This triangulation reduced the effectiveness of investigator bias and created confidence in the data collection for the study.
3. **Dependability** of this qualitative case study was my responsibility as a researcher to ensure that I did not make mistakes in conceptualizing the study, collecting the data, interpreting the findings, and reporting results (Guba, 1981). I logically selected the participants for observation and interviewing during the research. I used the in-depth methodological description to allow the study to be repeated. I saved all the participants' confidentiality agreements. Also, I had a running record for my data collection and analysis, allowing the readers to authenticate my findings by following this process.
4. **Credibility** within the rationalistic paradigm, internal validity is logically determined (Guba, 1981). Since qualitative research is always dealing with peoples' perceptions

of reality, the answers always vary and there is no single answer to the questions. Qualitative researchers provide credibility through triangulation (Guba, 1981). I encouraged participants to engage in more profound reflections and detailed examples. Besides that, the decision to collect data from the interviews and lesson plans of the teachers ensured that the data triangulation was not limited, and that the documents analysis of all findings was impartial. So, the data collection was made with integrity: accuracy, precision, and transparency. In the end, I had the participants review my preliminary analysis and they had to confirm that they recognized their experience in my interpretation. I remained aware of my role as a researcher to reach all steps without bias or unethical manners.

Ethical Considerations

The ethical way of dealing with the participants was to obtain informed consent from all participants who chose to be part of the study. Each participant was informed that they had the option of withdrawing from the study at any time. An Institutional Review Board (IRB) approval form from the university and the school district was obtained before any research was conducted. Consent was also handed to all participants. I made sure the names of the participants were not mentioned in the study, their names were replaced by fictional names. In order to ensure confidentiality of all the participants, including teachers in interviews, the schools, and the locations, fictional names in transcriptions and publications were used. There was no identifying information about any individual who revealed the participants. Also, the researcher had to treat each participant in the research in a good manner and in full respect. In order to minimize researcher bias, interviews were recorded and transcribed. Field notes were reviewed and checked to reduce the signs of bias.

Summary

The problem addressed by this qualitative case study was to try to understand secondary mathematics teachers' use of Web 2.0 tools and how these teachers contributed with their level of expertise to instruct ELs in the mathematics classroom. This case study helped to identify the themes for using Web 2.0 tools and the benefits of teaching mathematics to EL students in the mainstream classroom. The data for this case study contained transcriptions from the interview responses and the teacher's lesson plans. When the data was collected, it was organized, recorded, and coded according to its themes using ATLAS.ti (2013) software. From the data analysis, results revealed teachers' understanding of using Web 2.0 to teach ELs. In addition, ethical concerns were taken into consideration through IRB approval prior to the data collection. The ethical assurances of the study participants, including the participants' protection from harm, were done using informed consent and confidentiality assurances which were collected. Dependability and credibility that had to include in the appropriateness of the research methods during the study, and the data that had to record with honesty and truthfulness. So, this chapter described the qualitative study design and the summary of the data analysis process. Chapter four included the results of the study and analysis of the data.

Chapter Four: Finding

This qualitative case study was conducted to attempt to understand secondary teachers ' use of Web 2.0 tools to instruct ELs in the mathematics classroom. This research study could help EL students who make up 4.6 million students in the United States (Center for Immigration Studies (CIS), 2016). The sample included four secondary mathematics teachers with Georgia certification in a high school that consists of a majority population of EL students. The data collection consisted of five open-ended questions that participants responded to. This chapter includes 1) justification of the trustworthiness of the gathered data, 2) descriptive data about the site and sample 3) reporting of the findings related to the research questions, 4) evaluation of the findings, 5) correlation with current research and summary of the findings.

Trustworthiness of the Data

This qualitative research study is a way of "understanding how people make sense of their world and the experiences they have in the world" (Merriam, 2009). Linneberg and Korsgaard (2019) indicated that most qualitative researchers are keen to ensure that their results are essentially reliable and trustworthy, which can be shown through their transparency regarding how the conclusions relate to the data.

In this qualitative case study, credibility was established with the deliberate actions of the researcher to ensure that all of the data collection was honest, accurate, and transparent. The researcher had to find suitable interview questions to make the participants engage, clarify, and restate their answers. Campbell et al. (2013) indicated that the more the interview questions are specific, the more it will help in interpreting and coding the answers. Also, confirmability of the findings was created with the researcher's self-awareness of biases, which could affect the explanation of the data. According to Guba (1981), "data exist in support of every interpretation

and that the interpretations have been made in ways consistent with the available data." The case study went through a submission process and got approval from the Institutional Review Board (IRB) (Appendix D) to ensure the confidentiality of the participants before any data was collected. The researcher obtained permission from the district superintendent and school principal for invitation of approval from the sample school (Appendix C).

Descriptive data

a) Descriptive data about the site.

The school study was in the northern suburban area of Georgia with many Hispanic stores and restaurants. The school was in the middle of the city. At that time, the school's English Language Department had 36% of minority enrollment for the year 2021 (majority Hispanic) and 26% of students were from low-income families (US News, 2021) (Table 4).

Demographic	**Enrolment (2,585)**	**Percentage (%)**
White	1501	63%
Hispanic	672	26%
African American	108	4 %
Asian	126	4 %
Two or more races	74	3%

Table 4: Student Population by Race/Ethnicity for the school year 2019-2020

b) Descriptive data about the sample.

The teacher population at the school consisted of 147 teachers, teaching grades 9-12 with different ethnicities in the classroom. The school had 19 mathematics teachers, and all the mathematics teachers were invited to join the study if they were eligible to meet a certain criterion: teaches mathematics in the school study, had a valid Georgia mathematics teaching certification for grades 9-12, had at least three ELs in their mainstream classroom, did not speak Spanish, and were able to answer the interview questions. An invitation with the summary of the

research explaining the eligibility criteria and an Informed Consent Form were handed to the participants with the confidentiality agreement (Appendix B).

The researcher kept a copy of all the signed consent forms from the participants. The participants had already been informed that all the data collected would be kept confidential. They were also informed that fake names would be used instead of their real names, the school's name would not be mentioned in the study, and that they could withdraw from the study at any time. The participants were asked to answer the questions for their eligibility to be accepted in the study.

The researcher built a rapport with the participants to be able to gain deeper insight into their responses. Although the number of teachers included in this study was minimal, only four teachers met the inclusion requirements to be a part of the study. Demographic information of gender, a number of years teaching mathematics, and the number of ELs in their classrooms are indicated in Table 5.

Teacher	Gender	Number of ELs	Grade
Teacher P.	Male	25 EL students.	11th grade
Teacher V.	Female	10 EL students.	9th grade
Teacher L.	Male	8 EL students.	12th grade
Teacher G.	Male	12 EL students	10th grade

Table 5: Teachers' Demographic information in one section

Findings Related to Research Questions.

The general research question that was guiding this study was:

How do teachers in a northeastern suburban secondary school use Web 2.0 technologies to instruct English learners in Mathematics?

Sub-questions:

What is the benefit of technology in general and Web 2.0 tools in helping ELs learn mathematics?

How can teachers better apply technology and how can they better use Web 2.0 technology when instructing ELs in the mainstream classroom?

a) **Interview data.** The participants responded to the interview questions, which consisted of five questions. The secondary mathematics teachers' responses to the interview questions varied. Their answers differed and were based on their years of experience in teaching and using technology as well as their background knowledge and experience in teaching EL students in the main classroom. Responses from questions four and five of the questionnaires addressed the first question of the research, which asked secondary mathematics teachers about the use of Web 2.0 technology while teaching ELs in their classrooms. Responses from questions two and three addressed the second question that asked mathematics teachers about better implementation and use of Web 2.0 tools to improve the instruction of EL students.

b) **Observation data.** During the observation, the researcher focused on the field notes to record all the classroom teachers' instructions, activities, and events that took place in the mathematics classroom. The notes were elaborate and legible in order to retain thick data in a form that could be retrievable even after impressions of the moment have faded from memory. Then, observation and analysis of all the field notes for every participant teacher were done.

c) **Lesson plan data.** The data collection also covered the lesson plan from the participants regarding the use of Web 2.0 tools to instruct ELs. Three out of four teachers submitted their lesson plans, and the information from the lesson plans was collected to add to the data collection. One participant showed the use of Web 2.0 tools in her classroom and mentioned that in her interview. Also, one participant submitted the regular template of the lesson plan, and the other two teachers showed from their own notes how they explained the steps of the lesson during class instruction. None of the teachers mentioned any type of specific Web 2.0 tool in their lesson plans; however, teacher V mentioned in her interview response that she used Desmos in the quadratics unit to show parabolas/graphs, and she used the software Microsoft Word during student note-taking; "I use Word to write along with the students as they take notes, using word made me guide the notes and keep my EL students engage." Also, Teacher V and L submitted their lesson plan that was not in a template format. They used videos and visual scaffold to help ELs follow procedures step by step with the instructions.

d) **Triangulation of the data.** The interview responses and the lesson plan data were collected in order to address the research questions. Data from the participants' responses were submitted to the ATLS software. Additionally, the data from the lesson plans were noted to record the specific use of any known technology in the lesson plans. From the triangulation of interview responses and the use of any technology in the participants' lesson plans, themes were identified

and categorized from the two research questions of using Web 2.0 tools in instructing ELs in mathematics, which is described in Table 6.

Research Questions	Interview Questions	Themes	Sub-themes
What is the benefit of technology in general and Web 2.0 tools in helping ELs learn mathematics?	1- Do you use any Web 2.0 activities to teach ELs? What are the advantages of using it? How do you modify lessons for ELs? 5- Do you think the use of Web 2.0 is successful in helping your ELs improve in mathematics? If yes, explain. 4-What kind of technology do you use to teach ELs new concepts?	necessity of using Web 2.0 using a special program of Web 2.0 support the language	- helpful - adapted - easy to use - benefit -support -sources - translate -activities -challenge -visual -language -share -engage
How can teachers do better in applying technology and how can they do better in using Web 2.0 technology when instructing ELs in the mainstream classroom?	3-What are the skills (technology) that you think secondary mathematics teachers need in order to address ELs needs in the mathematics classroom? 2-Have you faced any challenges with using Web 2.0 in the classroom? If yes, what were the challenges?	training practicing knowledge of using Web 2.0 tools	-Practice -professional learning -Training - familiar with Web 2.0 -know technology school

Table 6: Themes and Sub-themes from Interview Questions

Results:

Themes were generated from responses of all the secondary mathematics teacher participants on the interview questions. All the participants' responses varied according to their years of experience and background of having Web 2.0 technology knowledge. Since this was a case study, the results were described in a thorough case study manner. During the analysis of

the data, while the secondary mathematics teachers did not reply with the exact answers, their responses were similar, allowing the researcher to collect these responses and determine how the teachers responded.

Research Question One: What is the benefit of technology in general and Web 2.0 tools in helping ELs learn mathematics?

Question one, four, and five were viewing the way the teachers considered Web 2.0 tools as a great benefit for ELs in their classrooms. While analyzing the research questions, all the participants' responses and notes from the researcher were uploaded to ATLAS Software, and nodes were created. The data analysis showed three themes that were revealed from the coding.

The first theme presents the teachers' benefits of using Web 2.0 tools, which were built upon the terms "helpful, adapt, support, easy to use, and benefit," thus helping in the development of the findings for the study. The second theme was collected from the responses of the four sources who provided the benefits of using a special program of Web 2.0 tools, which included sources, translation, activities, and challenges. The third theme showed the benefit of teachers' support for ELs to improve in math. The patterns that were presented and related to the teachers' use of Web 2.0 in instructing ELs are shown in Figure 3. The following paragraphs are on the discussion of the three themes: the necessity of using Web 2.0, using any special program of Web 2.0, and Web 2.0 technology used as a support language in math.

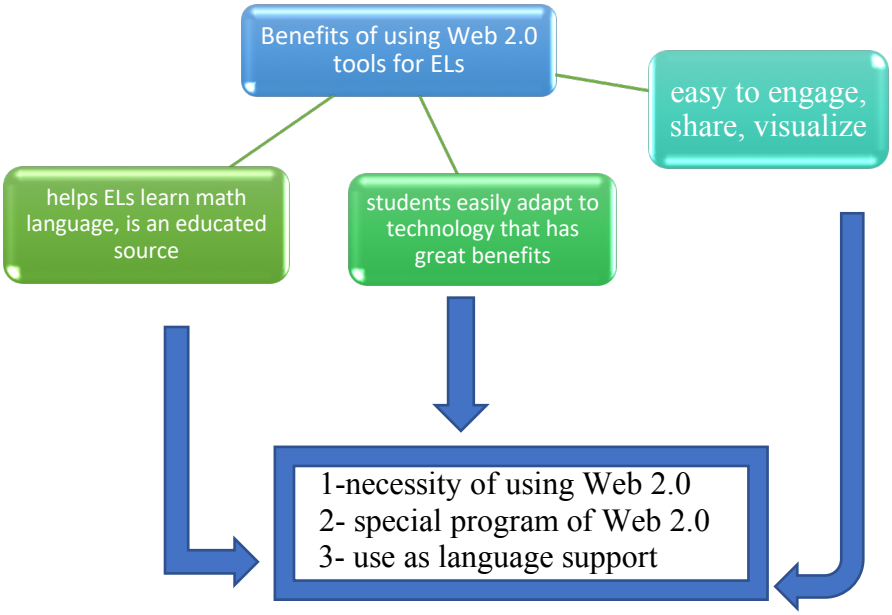

Figure 3: The patterns that are presented are related to the benefits of using Web 2.0.

Theme 1.1: Necessity of using Web 2.0 to support ELs to engage

Regarding the interview questions, participants in this case study shared the same point of view related to the secondary ELs' ability to learn mathematics using Web 2.0 for sharing content with other students in class. Teacher V reported her perception of using Web 2.0 technology in class. She said, "I think with any technology, I feel like it is beneficial for anybody. Anything that has research behind it that is positive can fit anybody." Some teachers found that students easily adapt to technology, and they saw that students like to learn mathematics by using technology. Teacher L said that "I am sure that the students know how to use technology better than us… any program we can give it to them they can work well with it, and it will really help them…" Teacher V agreed that Web 2.0 would be an easy program for EL students, and technology could help students to engage and learn math. She said, "Students are good at using this stuff (Web 2.0), they can figure it out fast." Teacher V reported "…for challenges in the classroom, I would think due to motivation, something with technology is super

quick but too easy to get distracted by something else! If there is a good program so they would stay with the screen, then it would be OK." Teacher G did not answer this question.

Theme 1.2: Use any special program of Web 2.0

Regarding the interview questions, all participants were asked the same questions during the interview about the types or sources of technology they used to teach ELs new concepts that could help them improve in mathematics. Some teachers used modifications, such as visuals, to help ELs with the mathematics content. Participant teacher V said, "I think technology is needed for EL students to learn math, including lots of visuals, it can be from Web 2.0 and technology resources." Unfortunately, some teachers felt negative about using Web 2.0 tools in their classrooms because their mathematical teaching methods depended on educational videos and YouTube videos that were offered by the mathematics department and which ELs could watch anytime. Teacher L said:

> What I do use is 'It's Learning', where we must download our notes, quizzes, handouts, and most beneficial, videos of our class notes. There is a video for everything that we do in class. So that any student can perform whether they are present in class or not. By having these videos, all students, specifically ESOL students, can view, review, and rewind as many times as necessary to obtain the material.

Theme 1.3: Web 2.0 tools used as language support

Regarding the interview questions, all participants in this case study agreed that the instructional practices of ELs in mathematics emphasized language acquisition from missing vocabulary words. Teacher J said that "…students need to know English to learn mathematics…. they can understand math if it were in Spanish….". Teacher L felt that teaching math content and vocabulary to EL students were difficult because these students struggle with math concepts

because of their language. Teacher P said that "if Web 2.0 has tools to translate… So, they can see if the single word is not clear…that will be good." Some teachers feel that more technological support is needed for secondary mathematics teachers when it comes to instructing EL students. Moreover, participant teacher V found out that she was taking the time to teach and repeat the meaning of the terminology in her statistics classroom because ELs did not know the definition of the terminology that was being used in class. Teacher V agreed that incorporating Web 2.0 into the mathematics classroom would benefit ELs in statistics class, saying,

> It (Web 2.0) would be helpful for statistics. You know, it is the hardest thing you know, because it requires a lot of understanding of the terminology, really, because we must go with the symmetrical data. What is skewed left-skewed right, teaching them new words and they say what is skewed? What does that mean? and like showing them the different shapes and the stuff of this data. I used tons of visuals, and it should be nice to have it, good to have it.

Teacher L said, "they prefer to have a way to serve as a translator of information during the lesson." Also, teacher P agreed that students could be successful in mathematics if we could give them this opportunity (of using Web 2.0); he said, "…academically, Web 2.0 could help them because some EL students are smart, but they do not know the language. It's the same way if I go to Mexico, I will not understand anything. If a Spanish teacher gives me any problem, I do not know how to answer it."

Overall, all teacher participants agreed that Web 2.0 technology provides a big benefit for all students, especially ELs, but none of the teachers used Web 2.0 daily in their classrooms. All participants recognized that students could easily learn through technology. The teacher participants agreed that if a specific program is offered to ELs, Web 2.0 tools could be a good

source of support for ELs to engage in class. Teacher participants responded that they did not know that Web 2.0 tools provide ELs with translation into their own language, which would help increase their language learning in mathematics. Some teachers felt that ELs needed to improve their language skills, but there was limited support for having Web 2.0 technology, and more resources and support were needed to ensure ELs' success in their classrooms.

Research Question Two: How can teachers better apply technology and how can they better use Web 2.0 technology when instructing ELs in the mainstream classroom?

In order to provide data, interview questions asked participants their view on how to better use technology and Web 2.0 tools to instruct EL students in the mathematics classroom and to describe the challenges they faced as teachers as well as the type of skills they needed to address ELs' needs. By analyzing the research questions, participants' responses and the notes from the researcher were uploaded to ATLAS software where the nodes were created. Data analysis showed two themes that were revealed from the code. The first theme was teachers' perceptions of the challenges that teachers faced and the challenges of teaching ELs with Web 2.0 tools. The second theme was the teachers' needs in order to provide better teaching methods for ELs in the math classroom. The following is a discussion of the two themes on the challenges teachers faced when instructing ELs in the mathematics classroom (Figure 4).

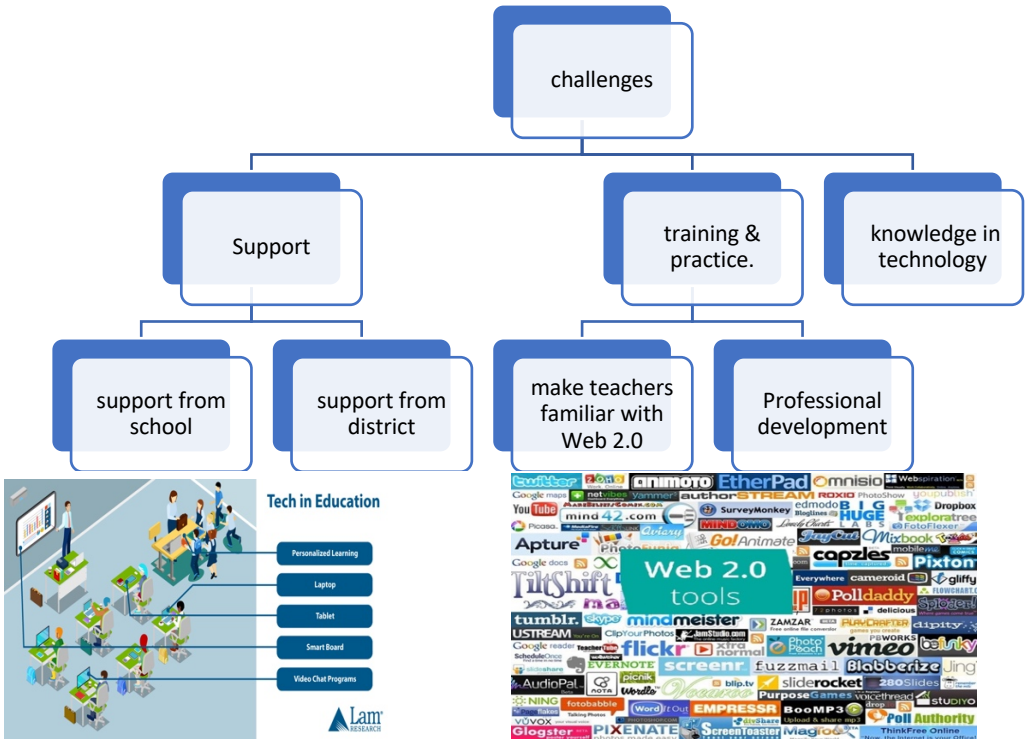

Figure 4: Challenges teachers face with their respective solutions

Theme 2.1: Teachers are asking for training and practice in using Web 2.0.

Regarding the interview questions, all the secondary mathematics teachers answered each interview question in order to create themes. Regarding the teachers' training and practices in using Web 2.0 tools in their classroom, multiple and diverse responses came from the interview. Some participants suggested that training our teachers to learn how to use Web 2.0 technology gives the teacher the ability to feel comfortable supporting ELs in mathematics. Most teachers felt that they needed help to improve their skills in technology because they had no idea how to use Web 2.0 in their classrooms. It was very difficult for them to use in their classrooms when they did not have the background knowledge to utilize it. Teacher V said:

> I think one of the challenges I have faced would be practice and training (Web 2.0). So, the challenge would not be knowing how to use the materials and use technology. But when we got training, we can use it in the classroom.

Some teachers were willing to use Web 2.0 if there was good support for them to follow. Teacher P explained about using technology by saying, "…we need help in using technology … there is a lot of technology out there, but we do not know which one to use … or which one is good…or how to use them." Some teachers appreciated the technology and Wi-Fi at school, but they were not able to support ELs because of their lack of training in the use of new technology. Participant teacher P said that:

> Like old teachers, I do not know how to use any of this new stuff. I think we need training more than any technology-type of stuff. Yes, we have technology and Wi-Fi, but it is not a problem, training is the problem, which is more important than anything, especially for old teachers.

Moreover, teacher L responded about the challenges of practicing Web 2.0 in his mathematics classroom. He said:

> Training…I would think so! either within the county or just honestly within the school, or if there is like a teacher who knows how to do it, and they may be able to put some sort together so we would be fine.

Most teachers mentioned that they preferred to have a training program on how to apply Web 2.0 in their classrooms. Teacher L said:

> The school should train the teachers on how to use technology because so much stuff out there, and they (the schools) said use like delta math, use quizzes, khan academy but they never taught us how to use it. Like they said hay take this use it, how?

Theme 2.2: Lack of knowledge of how to use Web 2.0.

Based on the participants' responses, many teachers consider themselves not having or missing the knowledge of using Web 2.0 tools. All participants showed that their secondary mathematics teacher education programs focused only on the content of mathematics and depended on the co-teacher in the class to review the mathematics materials with EL students. Teacher P said, "EL students have a co-teacher who follows them with their assignments where she can answer their questions." Teacher P responded that "I do not use any Web 2.0-based activities, especially for ESOL." Teacher L said,

> No, I never heard of Web 2.0 tools…we have in our system a video about each content, EL students can watch it;" where teacher L agreed with his idea by saying, "-most of the teachers is uh ...do not like technology, … teachers do not know how to use that kind of stuff (Web 2.0 tools). Like they told us, so many of the programs are out there, they say, use it…and hey, go ahead and use this, and most of them do not know how to use them. You know they say to use this program over here, but how? So, there are many kinds of stuff out there which are really very good. But we just do not know how to use technology.

Teacher L said, "I really do not use any of those sites or apps."

The second question of the research questioned the participants about the best way of applying and using Web 2.0 technology to instruct ELs. The results showed various criteria for using Web 2.0, such as assisting students by translating the mathematical problems into their native language. This helps support the students in mathematics in their own language, but training and practice in using Web 2.0 are required for teachers, and knowledge on how to use Web 2.0 in the classroom is needed. In the presence of all these requirements, teachers can have a better method of teaching mathematics problems to ELs to increase the performance of ELs in

standardized tests. Teachers felt less prepared to teach mathematics to ELs and needed more knowledge for Web 2.0 tools that help secondary EL students engage in mathematics.

Evaluation of Findings

This case study was conducted to explore the basic issues relative to secondary mathematics teachers when it comes to the use of Web 2.0 technology in mathematics classrooms when educating the highest EL population in the country. The total sample consisted of four mathematics teachers at a suburban high school in the state of Georgia. The results revealed the teachers' knowledge about the benefits of using Web 2.0 tools and the better ways they can apply them in their classrooms. The results of the study confirmed the previous studies, which found teachers who applied Web 2.0 were significantly able to support the educational needs of ELs (Peterson et al., 2018; Arslan, 2019; Parmaxi et al., 2018; Qomariyah et al., 2018).

The current study revealed the benefits and challenges of using Web 2.0 tools in the mathematics classroom with respect to teachers and the better ways to assist in teaching EL students. Using Web 2.0 technology is the best learning opportunity for EL students and can lead to a good educational system, which was confirmed by many teachers. One teacher applied GeoGebra in her mathematics lesson and confirmed that "Web 2.0 would be really helpful for statistics…it is the hardest thing you know because it has… terminology." Where another teacher confirmed that "Web 2.0 could help them because some EL students are smart, but they do not know the language." However, even though teachers at the school where the study was conducted realize the benefits of using Web 2.0 technology in their classrooms, ELs are still showing low performances in tests, and teachers are still not able to incorporate Web 2.0 technology in their classrooms to help solve this problem due to several factors.

a) Study Finding/Conclusions about Research Sub-question one: What is the benefit of technology in general and Web 2.0 tools in helping ELs learn mathematics?

Implications for practices

The researcher asked three questions that were related to the benefits of using technology and especially Web 2.0 in the classroom. Each teacher participant had different answers, ideas, and suggestions about using Web 2.0 tools. The Findings related to research question one indicated that all participant teachers agreed that Web 2.0 technology is necessary to add to the mathematics classrooms. Teacher participants reported that students can easily adapt to technology, and they see that students like to learn mathematics using technology. Overall, the findings suggest the necessity of using Web 2.0 in mathematics classrooms acts as a huge support for ELs to understand the content.

The findings of the advantages of using Web 2.0 tools to instruct ELs showed the teachers' ideas on how to use them in their classrooms. Participating teachers agreed that ELs need to have visual technology while sharing communication to help them understand the content. Other participants believed that teaching ELs in their classrooms using methods like watching YouTube and online videos on how to follow the steps to solve the problem is enough to make EL students understand the content. However, another participant agreed that Web 2.0 can offer a lot of visual and communication tools, which improve the students' critical thinking skills. Therefore, the findings suggest that using a special program of Web 2.0 tools for each lesson in mathematics can be a big benefit for all students in class in general and for EL students in particular.

Additionally, participant teachers felt that teaching mathematics content and vocabulary to ELs was difficult, where they have always had to repeat the meaning of some terms every time they were solving the examples. Some participants agreed that EL students can be successful in

mathematics if they understand the language. Another teacher reported that adding Web 2.0 tools to the class can help ELs to translate the mathematical problems to their language, and it can support ELs to understand the meaning of the vocabulary in the content. Therefore, this finding implies that teachers can apply Web 2.0 tools in their classroom to support ELs' in their native language, and it can be a good source for helping them in mathematics content.

In conclusion, teacher participants indicated that when they need to choose Web 2.0 tools to meet learning objectives, they had little or no experience on how to use them. Additionally, teachers prefer to use Web 2.0 tools to master learning objectives that can help their students, especially ELs, in their classrooms. Moreover, the programs should provide resources to meet the learning needs of their EL students while offering an integrated learning method. Therefore, to meet the learning needs, teachers preferred to have a special program of Web 2.0 tools that give more self-efficacy and confidence to teach math to ELs.

b) Study Finding/Conclusions about Research Sub-question two: How can teachers better apply technology and how can they better use Web 2.0 technology when instructing ELs in the mainstream classroom? Implications for Practices

The findings showed that teachers' knowledge about the benefits of using Web 2.0 was limited. Most of the participating teachers felt that they liked to have the training to increase their technology skills by learning more about Web 2.0 tools. Overall, the findings suggest that the school system and school district need to provide professional development to help ELs improve their performance and increase collaboration with native students in the classroom. Therefore, preparing the teachers in a program on how to use Web 2.0 tools can create a strong and positive relationship between teachers' Web 2.0 self-efficacy beliefs and the use of tools in the classroom setting.

Additionally, the study showed that most of the participants reported that they had no idea about Web 2.0 applications or how to use them. Therefore, this shows participant teachers need to have wide background knowledge of Web 2.0 technology and how to collaborate it with their teaching in order to become facilitators for students' learning rather than being the only source of information.

In conclusion, the findings of teachers' knowledge about the benefits of using Web 2.0 tools are very low, where using it can be a very helpful tool in the mathematics classroom. On the other hand, most of the participant teachers felt they need to improve their skills in technology. However, all teachers agreed that they need training or professional learning courses. The researcher then concluded that although mathematics teachers were not familiar enough with the use of Web 2.0, they have the incentive to learn how to integrate Web 2.0 applications and how to choose the right tool to instruct ELs in mathematics.

Discussion of Conclusion

Conclusion related to Research Purpose

This case study was conducted to reveal the issues relative to secondary mathematics teachers' use of Web 2.0 technology to instruct ELs and their own noticing of these practices that could access high-quality mathematics instruction for ELs. The research took place in a suburban high school that has the highest EL population in the county in the state of Georgia. The region is expected to add more Hispanic/Latino residents by 2040 (Carnathan, 2018).

Many reports have shown that educational facilities are failing to adequately develop and implement more effective educational tools as a way to help ELs improve their language barriers to become more effective people in society. Even though the U.S. Department of Education encourages the schools to use different pedagogical strategies when educating ELs, teachers stated

that not much has been done to provide them with the professional development they need in their schools.

With the increasing number of EL students in public schools, the U.S department of education always supports the teachers to provide various pedagogical strategies to educate this group of students. The reason for that is, the Hispanic students have a higher rate of dropouts (NCES, 2018) due to the assessment test that showed low performance for ELs when compared to non-ELs in math (U.S. Department of Education, 2019). In the State of Georgia, MPI (2018) stated that the gaps between ELs and non-ELs on end-of-grade math tests generally were larger in the older grades. The problem of the low performance and academic outcomes for ELs in public schools continues to increase because the population continues to increase as well.

EL students tend to show low performance since they received a way of instruction that was not effective enough for them to learn. In addition, when teachers focus on educating EL students with the use of Web 2.0 inclusion in their lesson plans, it can provide better collaboration and improvement in ELs' academics. Besides that, teachers need to use the appropriate Web 2.0 tools to provide EL students with what they need in order to better invest their abilities in understanding mathematics (Alhassan, 2017; McCoy, 2014; Arslan, 2019).

The researcher stated that high school EL students understand and perform better in learning mathematics when they receive instructions that are related to technology and to their daily life. Web 2.0 technology is providing many tools of communication that allow interaction of students with other students to improve their language concurrently with the content of mathematics.

Teacher participants indicated that when they needed to choose Web 2.0 tools to meet learning objectives, they had little or no experience on how to use, it which hindered their

decision on which tools to choose if any at all. Additionally, to help their students master learning objectives, teachers agreed to use Web 2.0 tools in their classrooms as it gives them more self-confidence when teaching ELs mathematics in the mathematics classrooms. Moreover, the Web 2.0 programs should provide EL students with the benefits of tackling their needs while offering an integrated learning method.

Conclusion related to Research

The findings of this study are related to the mainframe of the research. The conceptual framework mainly addressed the teachers' use of Web 2.0 tools and how they impact their classroom pedagogical practices in teaching mathematics for ELs. In addition, this study was significant to the field of education, which will make an essential contribution to the body of knowledge.

a) The findings of research question one supported the previous literature and the findings coincided with Yuan (2019) who found out that teaching ELs needs to be rich in comprehensive input in order to create motivation for them to acquire the language faster than traditional teaching methods. The findings from the research at the school of the study indicated that one participant teacher used the GeoGebra once as a tool in the classroom, and it helped his/her students to practice using this tool to demonstrate the comprehensive skills in math. Also, the findings of the second theme matched with the previous research. Alhassan (2017) indicated that teachers prefer to use different Web 2.0 tools like videos and visual aids that are used in education. Additionally, the secondary mathematics teachers at the school of the study indicated that some teachers were willing to use Web 2.0 as a means of support with certain types of videos the school offered, which assist as instructional resources to ensure the academic success of ELs.

The current findings also confirmed with SLA Theories that teachers need to develop expertise in applying practical strategies that are based on socio-constructivism, and using technology in mathematics classrooms can be the best comprehensive input for ELs giving the students motivation and improvement in their language (Yuan, 2019). All the participant teachers agreed that using Web 2.0 technology in their mathematics classrooms can help to facilitate student and teacher collaboration, which can help ELs in their test preparation. National educational organizations recognized that the effect of integrating any type of technology in the curriculum can improve student performance in the math classroom (NCTM, 2008).

b) The findings of research question two matched most of the previous literature. The results of this current study revealed that teachers in the school of study needed help to improve their skills in technology and preferred to have a training program. This supported Alhassan's (2017) research that indicated that training is one of the most important strategies that can be used to increase the self-efficacy of teachers and in turn help students to learn in the classroom. Teachers without training in the use of Web 2.0 may think using these tools in education is difficult. Also, each participants' comments imbedded in components of the conceptual framework were related to how teachers can provide better methods of teaching ELs. Teachers need to improve their ability to build strong knowledge in the struggling area that is noticed in teaching.

The current findings also showed that mathematics teachers at the school of the study believed that they face a big challenge of using technology, and they realized that Web 2.0 is hard to use in their classrooms. Prior research by Capo et al. (2011) revealed that teachers can find many reasons for not using technology in their classroom due to their decreased confidence in using it, where Alhassan (2017) indicated that in-service training builds a strong relationship

with teachers and the use of Web 2.0 tools in teaching. The findings for the research also matched the previous research that teachers need to improve their knowledge of using Web 2.0 tools. Some teacher participants in the school of the study indicated that they do not know any information about Web 2.0 technology, and others stated that they had used them during their undergraduate courses; however, they would like to earn more knowledge about how to use it. Hao and Lee (2015) concluded that teachers' interest in using Web 2.0 is related to their knowledge on how to use these tools, which may lead teachers to show a negative attitude towards these tools.

The literature review and the results of this qualitative study regarding math proficiency seem to support the idea of using Web 2.0 technology, which teachers need to practice and training on in order to help ELs perform better in a standardized test.

Summary

This chapter of this qualitative case study included descriptions of the findings, which had aimed to examine the mathematics secondary teachers and their use of Web 2.0 tools when teaching ELs in the classrooms. The data-collection phase was collected through interviews in the form of five questions and lesson plans. Data was organized, compiled, and analyzed into themes.

The findings revealed five themes for the two research questions that emerged from the data analysis: the understanding about the advantages of using Web 2.0 tools by mathematics teachers, the way they modified their lesson for differentiation, and the programs they used in their classrooms. Teacher participants indicated that they had little or no information about the benefits of using Web 2.0 tools or how to use them when instructing EL students in their classrooms. In addition, a couple of teachers indicated that having a teacher who is

knowledgeable about these tools would be beneficial for them because it can facilitate their education on how to use these tools in their lessons.

The findings also revealed themes of knowing the skills teachers need in technology to better address ELs' needs and the challenges they face when attempting to do so. Overall, most of the participant teachers at the school of study perceived themselves to have no knowledge or understanding about the use of Web 2.0. Additionally, only one teacher reported one tool of Web 2.0, GeoGebra, which had been used in the classroom to instruct one objective during the school year. Moreover, all the participants' teachers agreed to earn technological support to instruct ELs in math. and they asked their school or school district to provide them with training to better understand the use of Web 2.0 tools in order to differentiate instruction of EL students.

Finally, the findings showed that all the participant teachers agreed that incorporating Web 2.0 technology in their objective can generate many positive outcomes in their classrooms. First, teachers looked at Web 2.0 tools as a perfect tool for EL students to translate words that are not understandable in math problems and subsequently improve their language overall. Additionally, selecting the Web 2.0 tools with a suitable visual aid in teachers' lessons increased student engagement using communication, sharing of student information, and mastery of the content. Thus, secondary mathematics teachers' understanding of how to utilize Web 2.0 technology was determined by what the administration school can provide and train them in to instruct ELs.

The next chapter will discuss the conclusions, which pertain to all the findings from the study. Chapter five includes a review of the research, the implications of these findings, which are related to the use of Web 2.0 for ELs in the classroom, recommendations for future studies, and the conclusion.

Chapter Five: Implications, Recommendations, and Conclusion

Overview

Review of the Study

This study investigates the secondary teachers' use of Web 2.0 to teach ELs in the mathematics classroom. By conducting the qualitative case study, the researcher examined whether the teachers were helping EL students in math class to perform better in their standardized tests when using Web 2.0 technology in the classroom.

The study used a qualitative approach in which the researcher used two research questions that were guiding the study. The first question was, "What is the benefit of technology in general and Web 2.0 tools in helping ELs learn mathematics?" The second research question was, "How can teachers better apply technology and how can they do better use Web 2.0 technology when instructing ELs in the mathematics classroom?" The researcher used open-ended interview questions to investigate the research questions.

Chapter one introduced the research by providing information about the background, the purpose of the study, the study approach, the significance of the study, and definitions of the terms. Chapter two reviewed the influential and current theories related to this study to provide a theoretical foundation. The literature review included theory and research in the area of technology to instruct EL students that are based on socio-constructivist learning theory Vygotsky (1986), SLA theories (Krashen, 1982), and PLCs model (Rahimi et al., 2014), ELs' situation in the U.S., challenges for ELs, teaching ELs in the mathematics classroom, technology usage in education, technology and EL students, integrating technology in the mathematics classroom, Web 2.0 technology, benefits of using Web 2.0 to instruct ELs, Web 2.0

technology in the mathematics classroom, teachers' challenges, teachers' use of Web 2.0 in Personal Learning Community (PLC), and teachers' beliefs toward using technology/Web 2.0.

Chapter three explained the design of the study, which was a qualitative methodology. The participants were four secondary mathematics teachers who have at least three EL students enrolled in their classrooms. The researcher also described the trustworthiness of the study including the transferability, conformability, dependability, credibility, and ethical assurances.

Chapter four summarized the data generated from the design study in alignment with the research questions. The data were coded, analyzed, and arranged according to the research questions and displayed the evaluation of the findings and the correlation with current research, which was organized according to the conceptual framework of the study.

Chapter five will discuss the implications related to the research purpose and the review literature. Also, it will discuss conclusions and a few recommendations that were made for further research based on the participants' responses and experience, as well as the conclusion.

Implications

The practical implication in this study is that the utilization of Web 2.0 tools in learning and teaching environments for ELs requires new thinking about the concept of teaching and learning mathematics. NCTM (2008) stated that the effect of integrating any type of technology in math classrooms can improve ELs' performance. Integrating Web 2.0 applications gives the students responsibility for their own learning and helps teachers to create effective student-centered learning environments in their classroom. Web 2.0 technology encourages ELs to communicate, share, create knowledge, discuss ideas, and solve problems collaboratively (Bingimlas, 2017). Using Web 2.0 tools in pedagogy gives great benefits to the students and teachers using them.

The poor performance on standardized mathematics tests for EL students indicated the need to study how mathematics content is taught to them (Denfield, 2014). In partial, this result showed the importance of content teachers not being prepared to provide appropriate educational programs for instructing ELs in mathematics classrooms.

The participant teachers in the study were unsure of the effects of Web 2.0 technology due to the lack of training and shortage of knowledge of using it. Changes to participatory technologies require a corresponding shift in the way of teaching and learning of ELs in mathematics classrooms. Web 2.0 applications and social networks need educated teachers in this field that require strong and creative knowledge for teaching and helping EL students in the production of their knowledge. The effect of integrating any type of technology in math classrooms can improve student performance (NCTM, 2008). Educating mathematics teachers about the benefits of integrating Web 2.0 applications is important as this builds self-confidence in teachers encouraging them to utilize Web 2.0 tools in their lesson plans. As Alhassan (2017) stated, training teachers on using Web 2.0 tools increases their self-efficacy in education. Therefore, this can direct the teaching experience practices to a helpful point.

The findings imply that if mathematics teachers received training and start to know the benefits of using Web 2.0 tools, they implement them in the curriculum to support the differentiation of EL students, which can be more effective for them.

The findings also imply that if mathematics teachers were provided with an assistant who is knowledgeable on how to utilize Web 2.0 tools in the school, teachers would have the help to align the objectives and the goal of the lesson with a Web 2.0 chosen activity, which would be a useful, effective, and efficient method in teaching EL students.

Overall, the findings of the study translated to many essential implications. First, when teachers have training in using Web 2.0 tools, the instruction can be expressed with more interactions to scaffold teaching EL students toward higher thinking in the mathematics classroom. Also, mathematics teachers desire to receive training that enables them to assist ELs with test preparation using the most effective technology. In addition, mathematics teachers preferred to have knowledgeable supporters to direct them with suitable Web 2.0 tools in their lessons.

Figure 4 is the formula the study resulted in on how Web 2.0 technology, when used in mathematics classrooms, will improve EL student outcomes in standardized exams by helping them conquer the hindrances they face when learning math. The figure is a description of what EL students and teachers need in order to achieve better lifelong education.

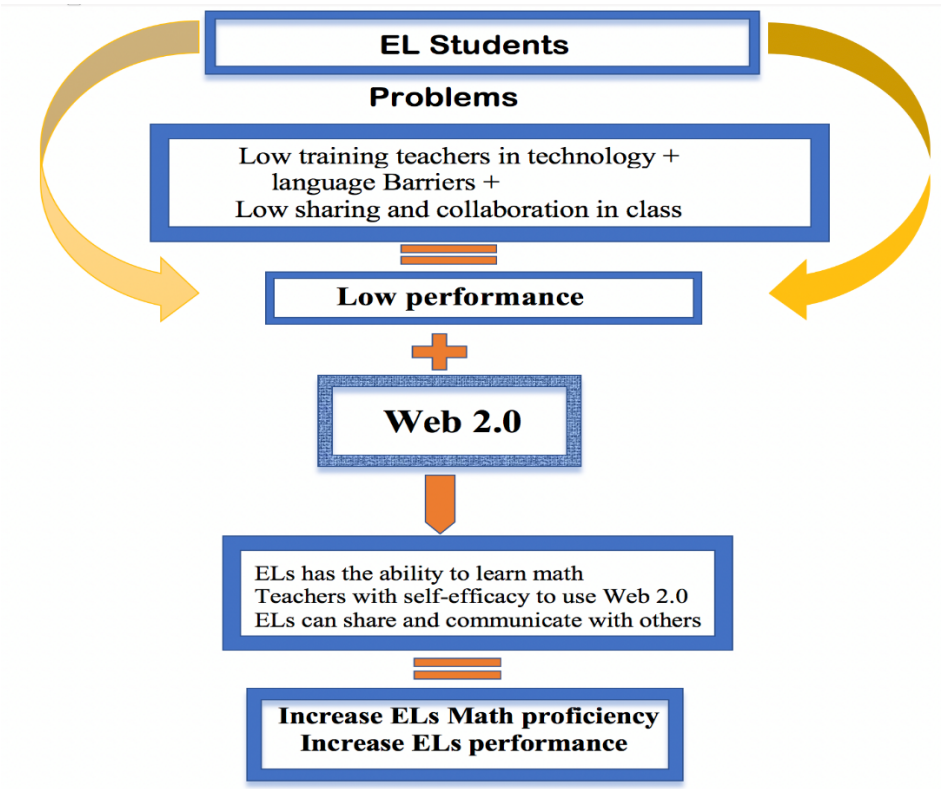

Figure 4: Framework to make a positive Impact on ELs in mathematics classroom with the use of Web 2.0 tools

Recommendations

The results of this case study show the use of Web 2.0 technology by secondary teachers to teach ELs in mathematics. According to the findings of the study, three recommendations are made for practice, and three recommendations are made for future research.

Recommendations for Practice

The conclusion of this case study created three recommendations for practice. The results showed that more than half of the participants' responses did not have any basic information on how to use Web 2.0.

The first recommendation is that the teachers' responsibility is to inform their students directly and indirectly, that teachers have to teach mathematics using the appropriate and best selection of Web 2.0 applications and motivate them to learn the content to allow them to have a better chance of acquiring new mathematical knowledge. Therefore, it is important to provide mathematics teachers with Web 2.0 tools in the curriculum, which can help EL students find the best way to discover math reasoning using sharing and collaboration. Schools also should attempt to close the academic gap in mathematics by having the teachers explore various Web 2.0 tool opportunities to offer mathematical knowledge which leads to an increase in the student's aspiration to learn more.

The second recommendation is for the school and school district, which require professional development, to provide training for mathematics teachers on how to use Web 2.0 tools when instructing ELs. Moreover, supporting teachers with access to Web 2.0 tools can lead to a strong relationship with high-quality educators (Alhassan, 2017). This support is also critical because it makes secondary mathematics teachers provide powerful instructions when teaching EL students in the main classroom. Therefore, administrative education must support

mathematics teachers by providing training and focusing on all the Web 2.0 applications to better serve the educational process for ELs.

The study found that teachers were using methods of teaching that did not include technology, such as Web 2.0 tools, as they did not have any idea about these tools. This finding indicated their lack of knowledge of the existence and usage of Web 2.0 tools. Therefore, the third recommendation is to have an academic technology educator who can assist the mathematics teachers, support teachers in the classrooms, and support specialists in order to provide the best motivation, engagement, and differentiation that Web 2.0 tools have to offer when it comes to helping EL students' math testing performance increase.

Recommendations for Future

Based on the results of this case study, the first recommendation addresses the procedural limitations of mathematics teachers as the study included only math subjects. This study was limited in scope and number of teachers because of its qualitative nature. Future studies should be done including other subjects, grade levels, and more participants added to the study. More quantitative and qualitative research should be done to provide a better picture of using Web 2.0 tools for EL students. The second recommendation for future research is that teachers and researchers should explore different advantages related to the design of technological frameworks and enhance students' high school mathematics content knowledge for EL students. More studies need to be done on the use of effective specific, Web 2.0 tools in the secondary mathematics classrooms that help ELs to practice for the standardized tests independently. The third recommendation for future research is to study the secondary mathematics teachers' use of Web 2.0 tools to instruct EL students after having training in using Web 2.0. The findings of this study showed that the school and school district should offer a better way to improve

professional development. Therefore, future research is needed to explore the impact of training in acquiring Web 2.0 skills on the education of ELs in mathematics classrooms.

Conclusion

The general problem that gave way to this qualitative case study arose from the difference in standardizing mathematics test scores between ELs and non-ELs (National Center on Immigrant Interaction Policy, 2018). The purpose of this qualitative case study was to examine the secondary teachers' use of Web 2.0 tools to instruct EL students in the mathematics classroom. This was accomplished through the interview of four secondary mathematics teachers and the gathering of their lesson plans. The main implications of the findings include participants' knowledge and benefits of using Web 2.0 to instruct ELs who showed low performance in their standardized mathematics test.

The findings in this study indicated that mathematics teachers lack knowledge of the benefits of using Web 2.0 tools in the mathematics classroom and none of the teachers have received any technology training from the school or the district. Recommendations for the practices mentioned include a) provide mathematics teachers with Web 2.0 tools in the curriculum, b) administrative education must support the mathematics teachers and have them receive training on how to use Web 2.0 technology, and c) have an academic technology educator who can assist the mathematics teachers with choosing the best Web 2.0 tool before any assignment.

Finally, the recommendations for future research include a) future quantitative studies covering different subjects and grade levels with EL students in the classroom, b) the use of effective specific Web 2.0 tools in the secondary mathematics classrooms that help ELs to

practice for the standardized test independently, and c) future research is needed to investigate the effect of training in gaining Web 2.0 skills on the learning progress.

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Appendix A: Interview Protocol-Teacher

Participant: _____

Date of Interview and Time: _____

My name is Laura Alevy and I am a graduate student at Kennesaw State University. I am conducting research to study the experience of teachers' use of Web 2.0 technology to instruct English learners in mathematics classroom.

Directions :

1. Please read the attached informed consent form before answering the questions below.

2. You will be asked open-ended questions. You may respond to them all at one time, or you may submit them one at a time as you answer them. Please answer all questions within the two-week window of when you receive them.

3. You may answer the question (s) in detail as possible in your responses and make sure you address all aspects of the question.

Interview Questions:

1- Do you use Web 2.0 tools like Edmodo, Glogster, Prezi…?
2- Have you faced any challenges with using Web 2.0 in the classroom? if yes, what challenges were they?
3- What are the skills you think secondary mathematics teachers need in order to address ELs needs in mathematics classroom?
4- Do you use any Web 2.0 activities to teach ELs? Please explain in detail and provide the name of the activity.
5- Do you think the use of Web 2.0 is successful in helping your ELs improve in mathematics? if yes, explain

Closing: I truly appreciate your participation in this study. As indicated in your consent letter, your identity will be kept confidential.

Appendix B: Letter for participants- Informed Consent Form

Participant Eligibility Survey

1. Do you currently teach at least three EL students in your mainstream classroom?
   Yes - No

2. Do you speak Spanish?
   Yes - No

3. Do you have a valid Georgia 6-12 Mathematics teaching certificate?
   Yes - No

Introduction:

My name is Laura Alevy. I am a doctoral student at Kennesaw State University. I am conducting a research study on 3 to 5 secondary mathematics teachers and their practices of using Web 2.0 when teaching English learners in the mainstream classroom. I am completing this research as part of my doctoral degree and I would like to invite you to participate.

Activities: If you participate in this research, the following will apply:

1. Each participant will have to answer questions to qualify them for study which will require 5-10 minutes.

2. Each participant will have to be interviewed via a one-time semi-structured interview process lasting 30-40 minutes. The researcher will be audio recording the session and then transcribing the responses for data collection accuracy.

3. Each participant will submit at least one lesson.

Eligibility: You are eligible to participate in this research if you:
Take the prospective participant questions and are deemed eligible based on the criteria outlined in the research participant qualifications:

1. teaching any grade 9-12 mathematics course with at least 3 English learners (EL) assigned to their mainstream classroom and
2. who have a valid Grades 6-12 teaching certificate in Mathematics through the state of Georgia.

You are not eligible to participate in this research if you:

• Speak Spanish language

• Have ESOL (English to Speakers of Other Languages) certificate

• Are not a licensed 6-12 mathematics teacher through the State of Georgia

I hope to include 3-5 teachers in this research

Risks: There are no know risks to this study.

Benefits: There are no direct benefits to you as a result of this study. However, if you decide to participate, you will receive a final copy of the entire research once complete. You might gain valuable insight into an area that affects your growth as a mathematics teacher. You will be helping additional and future teachers and EL students to improve their performance in mathematics.

Confidentiality: The results of this participation will be kept confidential. Students, staff members, schools, nor Forsyth County Schools can be identified in any draft or final report of your study. The identity of the participants confidential is: I will use a number to identify you, and I will use a code to identify the school. The people who will have access to the information are me, my dissertation chair, and, my dissertation committee.

Voluntary Participation: Your participation is voluntary. If you decide not to participate, or if you stop participation after you start, there will be no penalty to you. At any point of the study, you may withdraw from the study, if you wish. You may also not answer any question you do not feel you can answer for whatever reason.

Contact Information: If you have questions for me, you can contact me at
lalevy@students.kennesaw.edu
or 678-618-5593
My dissertation chair's name is Binyao Zheng. You can contact him at
Email: bzheng@kennesaw.edu
Phone: 470 578 3495

Signature: A signature indicates your understanding of this consent form. You will be given a copy of the form for your information.

Participant Signature	Printed Name	Date
_____	_____	_____
Researcher Signature	Printed Name	Date
_____	_____	_____

Audiotaping:

I would like to use a voice recorder to record your responses. You can still participate if you do not wish to be recorded. Please sign here if I can record you:

Participant Signature	Printed Name	Date
_____	_____	_____
Researcher Signature	Printed Name	Date
_____	_____	_____

Appendix C: School Principal Consent Form:

"Secondary Teachers Use of Web 2.0 Technology to Instruct English Learners in Mathematics: A Qualitative Case Study"

School Principal Consent Form

I give consent for you to approach mathematics teachers in grade 10,11 & 12 to participate in "Secondary Teachers Use of Web 2.0 Technology to Instruct English Learners in Mathematics: A Qualitative Case Study".

I have read the Project Information Statement explaining the purpose of the research project and understand that:

- The role of the school is voluntary
- I may decide to withdraw the school's participation at any time without penalty'
- Mathematics teachers in grade 10,11 & 12 will be invited to participate and that permission will be sought from them and also from their parents.
- Only learners who consent will participate in the project
- All information obtained will be treated in strictest confidence
- The learners' names will not be used and individual learners will not be identifiable inn any written reports about the study
- The school will not be identifiable in any written reports about the study.
- Participants may withdraw from the study at any time without penalty.
- A report of the findings will be made availability to the school.
- I may seek further information on the project from Laura Alevy

Carrie MacAllaster — 4-19-21

Principal Asst Principal — Signature

Appendix D: IRB Approval Form

IRB #: IRB-FY21-601
Title: Secondary Teachers Use of Web 2.0 Technology to Instruct English Learners in Mathematics: A Qualitative Case Study
Creation Date: 4-13-2021
End Date:
Status: Approved
Principal Investigator: Binyao Zheng
Review Board: KSU IRB
Sponsor:

Study History

Submission Type	Review Type	Decision
Initial	Exempt	Exempt

Initial Submission

Getting Started

Submissions requiring full committee review must be received at least 30 days prior to the scheduled committee meeting to allow time for pre-review. The IRB meets as needed during the regular academic year. The meeting schedule can be found here.

Submissions requiring exempt or expedited review will be reviewed as received in the order received.

For more information about the IRB submission Process, IRB Tracking, and Kennesaw IRB Tasks, please refer to the Kennesaw IRB Website.

In order to approve research involving human subjects, the IRB must determine that the research design is scientifically sound, that the risks associated with the research are reasonable and are justified by the expected benefits, that informed consent will be obtained from the subjects or their legally authorized representatives, that the participants? privacy is respected, that confidentiality of the collected data is protected, that adequate monitoring will be performed to ensure the safety of participants, that vulnerable subject populations will receive additional protection, and that the selection and recruitment procedures are equitable and just.

Responsibilities of the Principal Investigator

- promptly responding to all requests for information or materials solicited by the IRB, including the timely submission of the research study for IRB renewal, if required;
- ensuring that adequate resources and facilities are available to carry out the proposed research study;
- abstaining from enrolling any individual in a research study (i) until such study is approved in writing, by the IRB; (ii) during any period when the IRB or sponsor/principal investigator has suspended study activities; or (iii) following IRB- or sponsor/principal investigator-directed termination of the study;

- ensuring that all associates, colleagues, and other personnel assisting in the conduct of the research study are appropriately informed of (i) the study procedures; (ii) informed consent requirements; (iii) the potential adverse events associated with study participation and the steps to be taken to reduce potential risks; (iv) reportable new information requirements; and (v) data collection and record-keeping criteria;
- ensuring that all listed investigators have the appropriate credentials to conduct the portion of the study in which they are involved and have completed the applicable University required training modules;
- conducting the study in strict accordance with the IRB-approved research protocol except where a change may be necessary to eliminate an apparent immediate hazard to a given human research subject;
- reporting of deviations from the approved research protocol;
- requesting IRB approval of any proposed modification to the research protocol or informed consent documents prior to implementing such modifications;
- obtaining prospectively and documenting informed consent in accordance with the IRB-approved informed consent documents (i.e., unless the IRB has granted a waiver of the consent process)
- maintaining adequate, current, and accurate records of research data, outcomes, and reportable new information to permit an ongoing assessment of the risk/benefit ratio of study participation;
- maintaining adequate and accurate research subject records to reflect adherence to protocol specific requirements.
- reporting promptly to the IRB (and, if applicable, the sponsor and FDA) any internal or external adverse event that is considered to be unexpected, serious, and 3) possibly related to the study;
- reporting promptly to the IRB any significant changes in the risk/benefit of study participation;
- ensuring that, in the event a research subject experiences a significant adverse event, every reasonable effort is made to provide the subject with adequate care to correct or alleviate the consequences of the adverse event to the extent possible;
- ensuring that human research subjects are kept fully informed of any new information that may affect their willingness to continue to participate in the research study;
- ensuring that conduct of the research study adheres to Good Clinical Practice guidelines, if applicable. If the study meets the NIH definition of a clinical trial, ensuring that all research investigators and coordinators have completed the Good Clinical Practices training required by the University IRB;
- complying with additional requirements for federal agencies as applicable.

*required

Click "yes" to indicate you have read and understand these responsibilities. If you have any questions about these responsibilities, please contact the IRB office at irb@kennesaw.edu for guidance.

✓ Yes

Study Information

Is the study funded or being submitted for funding?

Yes
Identify the sponsor

✓ No

Do any study personnel have a financial conflict of interest related to this research?

Yes
Identify the personnel who has a financial conflict of interest

✓ No

*required
What is your status at Kennesaw State University?

Faculty/Staff
✓ Student

In accordance with federal regulations, the KSU IRB requires all responsible researchers, co-investigators, faculty advisors, and unaffiliated investigators to complete the CITI educational program.

Study Personnel

Note: If you cannot find a person in the people finder, please contact the IRB Office immediately.

*required
Principal Investigator

Provide the name of the Principal Investigator of this study. Students who will act as Principal Investigator for their research must have a Faculty Sponsor.
Name: Binyao Zheng
Organization: EDU-Secondary & Middle School
Address: 1000 Chastain Rd , Kennesaw, GA 30144-5591
Phone:
Email: bzheng@kennesaw.edu

*required
Primary Contact

Provide the name of the Primary Contact of this study.
Name: Laura Alevy
Organization: EDU-Secondary & Middle School
Address: 1000 Chastain Rd , Kennesaw, GA 30144-5591
Phone: 4705786000
Email: lalevy@students.kennesaw.edu

*required
Faculty Sponsor

If Student Principal Investigator, provide the name of the Faculty sponsor.
Name: Binyao Zheng
Organization: EDU-Secondary & Middle School
Address: 1000 Chastain Rd , Kennesaw, GA 30144-5591

Study Selection

Subject Enrollment

*required

Total number of participants to be enrolled
Three to five

Age Range
If including multiple age ranges, list each group separately.
21- 40

Inclusion Criteria
Mathematics Teacher

Exclusion Criteria

Study Selection

Subject Enrollment

*required

Total number of participants to be enrolled
Three to five

Age Range
If including multiple age ranges, list each group separately.
21- 40

Inclusion Criteria
Mathematics Teacher

Exclusion Criteria

Study Design

*required
What is the anticipated type of review?

Exempt

✓ Expedited
*required
Expedited Review

Expedited Review is conducted when a project involves no more than minimal risk to participants but the project cannot be classified as exempt. Initial review consists of review by the IRB chair and/or one or more IRB members. The study is subject to continuing oversight by the IRB on an annual basis.

Category 1 - Clinical studies of drugs and medical devices only when
(a) the research is on drugs for which an investigational new drug application (21 CFR 312) is not required or
(b) the research is on medical devices for which
(i) an investigational device exemption application (21 CFR 812) is not required or
(ii) the medical device is cleared/approved for marketing and the medical device is being used in accordance with its cleared/approved labeling.

Category 2 - Collection of blood samples by finger stick, heel stick, ear stick, or venipuncture from
(a) healthy, non-pregnant adults who weigh at least 110 pounds for whom
(i) the amounts drawn do not exceed 550 ml in an 8-week period and
(ii) collection does not occur more frequently than 2 times per week or
(b) other adults and children, for whom, considering the age, weight, and health of the participants, and the collection procedures,
(i) the amount of blood to be collected does not exceed the lesser of 50 ml or 3 ml per kg in an 8 week period and
(ii) collection does not occur more frequently than 2 times per week.

Category 3 - Prospective collection of biological specimens for research purposes by noninvasive means, including:
(a) hair and nail clippings, in a non-disfiguring manner;
(b) deciduous teeth at time of exfoliation or if routine patient care indicates a need for extraction;
(c) permanent teeth if routine patient care indicates a need for extraction;

(d) excreta and external secretions (including sweat);
(e) uncannulated saliva collected either in an unstimulated fashion or stimulated by chewing gumbase or wax or by applying a dilute citric solution to the tongue;
(f) placenta removed at delivery;
(g) amniotic fluid obtained at the time of rupture of the membrane prior to or during labor;
(h) supra- and subgingival dental plaque and calculus, provided the collection procedure is not more invasive than routine prophylactic scaling of the teeth and the process is accomplished in accordance with accepted prophylactic techniques;
(i) mucosal and skin cells collected by buccal scraping or swab, skin swab, or mouth washings; and
(j) sputum collected after saline mist nebulization.

Category 4 -
Collection of data through non-invasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Such procedures include:
(a) physical sensors that are applied either to the surface of the body or at a distance and do not involve input of significant amounts of energy into the participant or an invasion of the participant's privacy;
(b) weighing or testing sensory acuity;
(c) magnetic resonance imaging;
(d) electrocardiography, electroencephalography, thermography, detection of naturally occurring radioactivity, electroretinography, ultrasound, diagnostic infrared imaging, doppler blood flow, and echocardiography; and
(e) moderate exercise, muscular strength testing, body composition assessment, and flexibility testing where appropriate given the age, weight, and health of the individual.

Category 5 -
Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected, solely for non-research purposes (such as medical treatment or diagnosis).

Category 6 -
Collection of data from voice, video, digital, or image recordings made for research purposes.

Category 7 -
✔ Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

*required

Safeguarding Subjects' Identity

Describe how you will ensure that privacy will be respected and that confidentiality of the information will be maintained. Describe the tools to be utilized in collection and storage of data. Who will have access to it? Will any codes or locks be applied? When study is concluded, how will the documents/files be disposed of?

Confidentiality:The results of this participation will be kept confidential. Students, staff members, schools, nor Forsyth County Schools can be identified in any draft or final report of your study. The identity of the participants confidential are: I will use a number to identify you, and I will use a code to identify the school. The people who will have access to the information are me, my dissertation chair, and, my dissertation committee.ATLAS.ti (2013) will be used and inductive coding and analysis of the recorded data will be conducted. ATLAS.ti is a leading Qualitative Data Analysis (QDA) software for personal computers. The researcher will keep all gathered data in a password protected program. Research records will be retained for at least 3 years after the completion of the research.When the study is completed, all the records including the consents documents will be destroyed on or before 12/31/2024. The audio will be destroyed on or before 12/31/2024.