A Phenomenological Qualitative Study on Successful Algebra Teachers' Perceptions of the Implementation and Use of IXL

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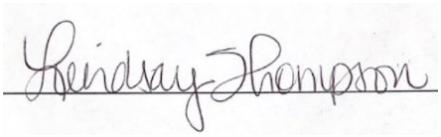
Signature 

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Abstract

High school mathematics achievement is crucial to the success of students as they advance through their education and prepare for careers, but most Georgia high school students are not high-achievers on state mandated mathematics assessments (GaDOE, 2019; Yu & Singh, 2018). The purpose of this qualitative study was to explore the life and career experiences of successful algebra teachers, their perceptions of effective use of IXL in the mathematics classroom, and the key factors for students mastering mathematics content. IXL is one of six educational online resources created and provided by IXL Learning Company (IXL, 2021). The researcher used a phenomenological research design to describe the lived experiences of six successful algebra teachers in rural South Georgia while implementing IXL with their students (Creswell, 2014). The researcher collected data through two semi-structured interviews with each participant and a review of documents and artifacts (Ary et al., 2019; Creswell, 2014). Through data analysis, the researcher identified four themes: (1) relationships, (2) motivation, (3) IXL strategies, and (4) integration of technology. The findings suggest relationships with students could motivate and improve student learning. Technology use, including IXL, can improve student learning but some technology is a distraction. Finally, teachers should use IXL purposefully to supplement teaching for a limited amount of time daily. The study's findings are significant for school districts, school leaders, and teachers.

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along and helping me to be successful. I am so very grateful to have you as my researcher! I feel so incredibly honored to have worked with you.

Chapter I

INTRODUCTION

I began my career in education teaching middle school mathematics and quickly experienced the struggle to prepare students for the standardized state assessment. Teaching mathematics was a balancing act, managing class time to ensure I taught all standards while providing enough time for students to practice and master content. I strategically planned my lessons with time allotments for instruction and practice to efficiently utilize every minute we had in class. I was disappointed to find, regardless of my efforts and lessons, some students did poorly on the state standardized assessment.

During my first seven years as a teacher, my classroom resources included some old textbooks and worksheets I created or found online. Slowly, I began incorporating technology into my classroom with interactive games on the SMARTboard and prerecorded lessons I created for students who needed to hear instruction more than once. I found math games online and took my class to a computer lab to play the games while they practiced math. The students enjoyed the break from traditional worksheets and practice on paper, and I was excited to see them engaged in mathematics practice and learning. Technology allowed more practice time during class for my students because they were engaged with the online platform and stayed motivated to use the computers. I realized the potential technology had in education and began exploring ways to incorporate technology in my lessons.

After ten years in the classroom, I became the Digital Learning Specialist in the high school in the same district, then the Director of Digital Learning and Media Services for the district. As a school leader, I helped make decisions about technology and train teachers on the effective use of educational software. One of the programs we purchased, and still use, for the

Mathematics and English Language Arts departments was IXL, an online resource designed to help students master standards. The teachers assigned IXL practice consistently and students earned grades for their progress. After working with teachers, I noticed some trends regarding the use of IXL. Some teachers assigned IXL and gave students a grade for completion without monitoring the students' progress. Other teachers assigned IXL, monitored the students' progress for learning and achievement, and then assigned a grade for completion. The last trend was teachers who actively monitored students' progress, adjusted instruction based on student mastery in IXL, and assigned grades based on progress and mastery. Teachers had different strategies implementing IXL in their classrooms, and I sought to better understand which strategies are the most effective in increasing student achievement in math. As such, I am interested in how successful algebra teachers in rural South Georgia high schools utilize IXL in their classrooms and focused on those identified teachers for this study.

Overview

Georgia Milestones Assessment scores in 2019 indicated Georgia high school students were not prepared for the next grade level content in mathematics (Georgia Department of Education [GaDOE], 2019). The Georgia Milestones data revealed the majority of students scored the second lowest rank of developing learner and the least number of students scored the highest rank of distinguished learner on the Algebra I and Geometry Milestones (GaDOE, 2019). Low scores on the high school Georgia Milestones indicated most students did not have the mathematical knowledge to be successful (GaDOE, 2020).

The world is rapidly changing with technological advances. Gravemeijer et al. (2017) indicated mathematics is crucial for students as they compete for jobs that technology or machines may control or take over. Students' skills will set them apart from competition, both

human and technological, and mathematics is essential in the changing world (Gravemeijer et al., 2017). Educational technology resources are abundant, and teachers should use them with the intent of improving student learning (Gravemeijer et al., 2017).

For the purposes of this study, the researcher examined an online resource, IXL. IXL is a personalized learning resource introduced online in 2007 by IXL Learning (IXL, 2021). Originally designed to support math education, IXL offers curriculum for grades K-12. Students practice mathematics on IXL, get immediate feedback, and never see the same question twice. IXL personalizes student learning with individualized guidance and real-time analytics (IXL, 2021a). Each Georgia Standard of Excellence for mathematics is available in IXL, which reinforces lessons taught in class. Teachers can immediately discover which skills students are struggling with after accessing the analytics available in IXL. In a 2017 study conducted by IXL researchers, Georgia public schools that used IXL between the years 2014 and 2016 indicated a strong positive correlation between IXL usage and school performance on the 2016 Georgia Milestones (IXL, 2017). The study provided data for IXL to claim IXL schools performed better in mathematics than schools not using IXL (IXL, 2017).

Statement of the Problem

High school mathematics achievement is crucial to the success of students as they advance through their education and prepare for careers, but most Georgia high school students are not high achievers on state mandated mathematics assessments (GaDOE, 2019; Yu & Singh, 2018). Students in the United States (U.S.) continue to rank behind many other advanced nations (National Center of Education Statistics [NCES], 2018). The U.S. ranked 30th in mathematics among the 35 members of the Organization for Economic Cooperation and Development and 38th out of 71 on the Program for International Students Assessments (PISA), (NCES, 2018).

Based on the results of these assessments, in 2012, students in the U.S. did not master mathematics concepts which are crucial to educational and financial success (Siegler et al., 2012).

Through mathematics, students learn to think analytically, learn problem-solving skills, and improve reasoning skills (Cardino & Ortega-Dela Cruz, 2020). The problem of underachieving mathematics students is not confined to one region in the U.S. Low achievement in mathematics is a problem across the nation, as indicated by NCES and PISA assessments, and Georgia is no exception. Georgia high school mathematics students consistently score poorly on Georgia Milestones assessments in Algebra I and Geometry (GaDOE, 2019).

Purpose of the Study

The purpose of this qualitative study was to explore the life and career experiences of successful algebra teachers, their perceptions of effective use of IXL in the mathematics classroom, and the key factors for students mastering mathematics content. IXL is one of six educational online resources created and provided by IXL Learning Company (IXL, 2021). The researcher sought to identify the best IXL implementation strategies used in mathematics classrooms and to determine key factors for students mastering mathematics content, as perceived by successful algebra teachers.

Successful algebra teachers using IXL in the classroom may offer valuable insight on how students learn mathematics and key factors for students mastering the content. The focus of this study revolved around successful algebra teachers as their teaching strategies produced positive results on Georgia Milestones Assessments, and they achieved high growth on the Student Growth Model. Through their perceptions, successful algebra teachers may reveal key factors affecting students as they learn mathematics. The experiences and perceptions of

successful algebra teachers in rural South Georgia provided data relevant to the research questions for this study.

Research Questions

The following research questions guided this qualitative study. The questions helped clarify the problem of mathematics achievement and specify the variables and population (Ary et al., 2019). In this study, the variables and population were the implementation strategies of IXL used by successful algebra teachers located in rural South Georgia high schools.

Research Question 1: What are the life and career experiences of successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 2: What are the best implementation strategies as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 3: What are the external and internal key factors for students mastering mathematics content as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Significance of the Study

Students in the U.S. rank behind many other advanced nations in the world in mathematics achievement (NCES, 2018). Georgia is no exception, as Georgia high school mathematics students consistently score poorly on Algebra I and Geometry Georgia Milestones assessments (GaDOE, 2019). However, high school mathematics achievement is crucial to the success of students as they advance through their education and prepare for careers (Yu & Singh, 2018).

The information learned may assist Georgia educators with the implementation of IXL and other online learning platforms in high school mathematics classrooms. School administrators and district leaders may improve professional development opportunities for new and existing teachers based on the findings. University and college teaching preparatory programs, Regional Educational Service Agencies (RESAs), and Boards of Education may also use the findings to improve programs, target professional development, and create policies. Legislators at every level may find the conclusions and recommendations helpful in their spheres of influence. Ultimately, from the study's findings, improvement of the use of IXL with mathematics instruction may result in increased student achievement.

Conceptual Framework

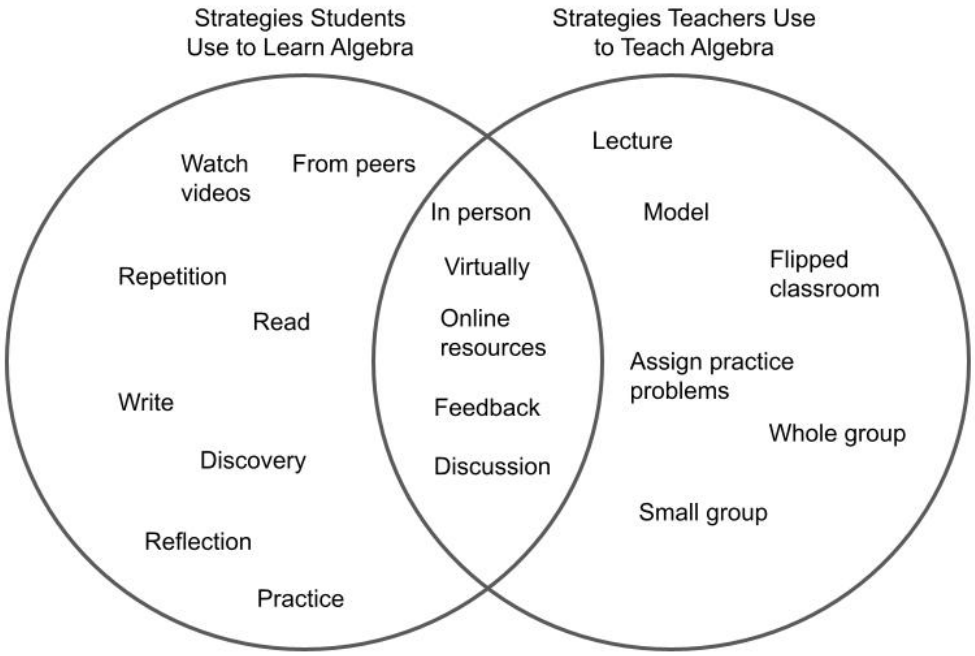
The conceptual framework for a study articulates connections between existing theories and the current study (Ravitch & Riggan, 2017). Through the conceptual framework, an argument is made about why the topic of the study matters and why the means proposed to study it are appropriate (Ravitch & Riggan, 2017). Maxwell (2013) asserted a conceptual framework is used to communicate a conception of the research available on the topic to be studied and to justify the research to be conducted. As a former mathematics teacher, the experience of teaching algebra to students who earned low standardized test scores is a connection to and inspiration for this research. Some teachers use IXL in their classrooms as a resource for students as they learn new mathematical standards. The use of the technology may have an impact on student achievement as they construct their knowledge of new mathematical concepts.

Key factors for students learning mathematics and the use of IXL in the mathematics classroom were the central phenomena researched and described in this study. The construction

of this conceptual framework was to better understand the phenomena of how high school students learn mathematics and the role technology plays in the process.

Figure 1

Strategies for Learning and Teaching Algebra

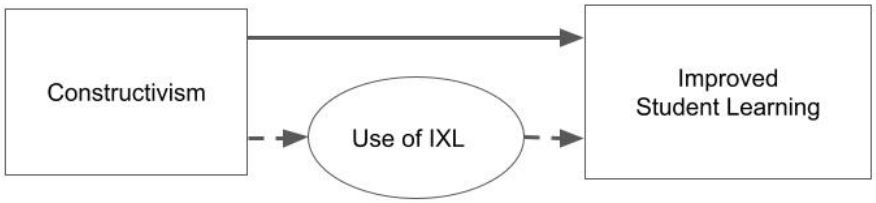


The Venn diagram in Figure 1 displays a comparison of some methods students use to learn and teachers use to teach. Not all students learn algebra the same way; students learn by different methods. Some students learn from peers while others may prefer to watch videos of how to solve problems. Teachers use many different methods to teach students, such as whole group or a flipped classroom. In flipped classrooms, students learn independently before class and the teacher supports them during class (Bergmann & Sams, 2012). The center of the Venn diagram represents methods both teachers and students use, including online resources such as IXL.

Low student achievement in mathematics is a problem in Georgia high schools; therefore, the concept of how students learn will be a focus in this framework (GaDOE, 2019; Maxwell, 2013). The strategies included in Figure 1 may or may not lead to success in algebra and the researcher intended to identify the effective strategies. Through this conceptual framework, the theory of constructivism as it relates to learning mathematics laid the foundation for this research study and explained "the main things to be studied" (Miles et al., 2014, p. 20).

Figure 2

Relationship between Student Learning, Constructivism, and IXL



The National Council of Teachers of Mathematics (NCTM) maintained students must build new mathematical knowledge through problem solving (NCTM, 2021). The idea that mathematical knowledge builds upon already developed concepts is consistent with the constructivist theory of learning. As depicted in Figure 2 by the solid arrow, constructivism may lead to improved student learning. Moursund (2007) explained constructivist learning takes place as students construct their own learning through problem solving and critical thinking in a mathematical learning activity. Students may work collaboratively to learn new concepts and develop new ideas (Lessani et al., 2016). A meaningful learning activity leads students to construct new knowledge when students are engaged, perhaps with an online resource like IXL (Moursund, 2007). The use of IXL in the classroom may be a constructivist strategy teachers use to improve student learning, as shown in Figure 2. The dashed arrow in Figure 2 represents the

uncertainty regarding the effective implementation strategies used by successful algebra teachers, which may lead to student learning. Teachers' role in a constructivist classroom is to encourage students and assess the activities to ensure students are gaining understanding and becoming expert learners (Lessani et al., 2016). Some teachers assign IXL for students to practice mathematical concepts while simultaneously constructing their knowledge and the teacher assesses student learning through the process.

Rather than a teacher giving students information to memorize, students actively create their knowledge with a constructivist approach (Clements & Battista, 1990). Isik (2018) found technology in the classroom may "support [a] constructivist approach by activating [an] individual's prior learning" (p. 705). Teachers can assign IXL to algebra students to activate prior learning while practicing previously learned concepts. Clements and Battista (1990) asserted students create mathematical knowledge through reflection on their own actions in constructivism and reality is how one interprets an experience or action. Students in a constructivist mathematics classroom will engage in discourse with peers to learn and create their own knowledge (Clements & Battista, 1990; Lessani et al., 2016). Teachers may stifle learning when teaching mathematical methods to students rather than allowing them to make sense of the problem and grasp the concept (Clements & Battista, 1990).

Kearsley and Shneiderman (1998) posited engagement theory is consistent with the constructivist approach, as students remain engaged in the learning activity and with peers to construct new knowledge. IXL may keep algebra students engaged in their learning while they are constructing new knowledge through the online resource. Durksen et al. (2017) found students are more motivated and engaged in effectively organized classrooms. The key factors leading to organized classrooms and motivated students are student confidence in mathematics,

positive classroom climate, contact and relatedness with the teacher, and connections or values with the mathematical content (Durksen et al., 2017).

Summary of Methodology

Qualitative Method

The researcher used a phenomenological research design to describe the lived experiences of six successful algebra teachers in rural South Georgia while implementing IXL with their students (Creswell, 2014). The phenomenological approach was most appropriate for this study because it provided the opportunity for the participants to share their experiences with IXL and their perceptions of factors affecting student achievement in the algebra classroom rather than ideas or concepts of using IXL and student achievement (Vagle, 2018). The researcher collected data through two semi-structured interviews with each participant and a review of documents and artifacts (Ary et al., 2019; Creswell, 2014). The researcher was the primary "instrument of data collection and analysis" and "search[ed] for meaning and understanding" from the participants regarding the implementation of IXL in algebra classrooms and student achievement in mathematics (Merriam, 2002, p. 178-179).

In an attempt to collect data from multiple participants and study the experiences of each participant through their narratives, the researcher interviewed six high school algebra teachers in rural South Georgia (Ary et al., 2019). During the study, the researcher developed an in-depth analysis of the perceptions and experiences of successful rural South Georgia high school algebra teachers by conducting interviews and reviewing documents and artifacts, such as their Georgia Milestones EOC scores, Student Growth Models, and lesson plans incorporating IXL (Creswell, 2014). The researcher used a sampling logic selection process to determine the participants, and it "generalize[d] to some population of interest" which was successful algebra

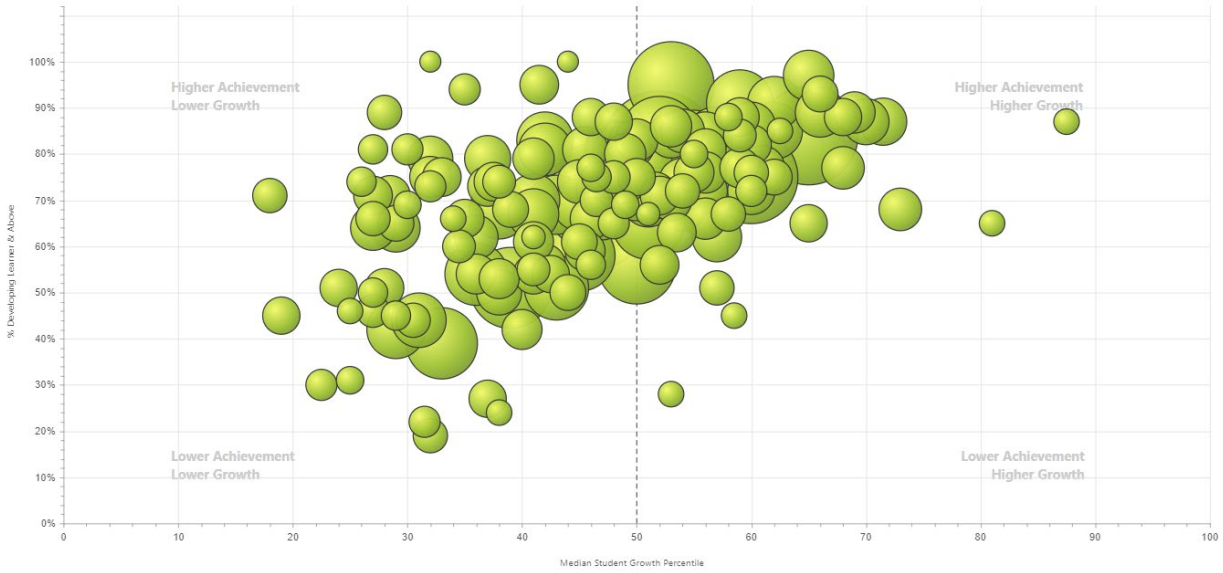
teachers in rural South Georgia high schools using IXL (Maxwell, 2013, p. 78). Employing non-random, purposeful sampling while selecting participants led to obtaining information that is particularly relevant to the research questions and goals (Maxwell, 2013). Purposefully selecting participants based on teaching experience and success with improving student achievement was necessary for the researcher to collect information-rich data (Patton, 2002).

Selected participants were high school algebra teachers in rural South Georgia; their principals considered them successful; they had acceptable student achievement rankings as measured by their Student Growth Model; and utilized IXL in their classrooms. For this study, the principal of each high school determined acceptable student achievement rankings for each participating algebra teacher.

The GaDOE's Student Growth Model describes the amount of growth students demonstrate in comparison to students with similar achievement across the state of Georgia (GaDOE, 2020a). As shown in Figure 3, the Student Growth Model consists of a graph with four quadrants and teachers' bubbles on the graph indicate student growth and achievement (GaDOE). For example, a teacher's bubble with 70% growth and 70% student achievement would be located in quadrant I, labeled Higher Achievement and Higher Growth (GaDOE). On the contrary, a bubble located in quadrant 3 has the label Lower Achievement and Lower Growth (GaDOE). Using these criteria, the researcher purposefully selected participants who "best help the researcher understand the problem and the research question(s)" (Creswell, 2014, p. 189). The rationale for these criteria was the experiences and perceptions of successful algebra teachers in rural South Georgia provide data relevant to the research questions for this study.

Figure 3

Student Growth Model



Note. The bubbles represent public school districts in Georgia and their students' achievement on the Georgia Milestone Algebra I End of Course Assessment in 2019. From Georgia Department of Education, 2021, Georgia Student Growth Model, https://gastudentgrowth.ga.doe.org.

The researcher selected participants by first identifying high schools in rural South Georgia using IXL as a mathematics resource. Then, the researcher contacted each high school principal by email for recommendations of their teachers who met the specified criteria for the research. If the list of teacher recommendations exceeded six teachers, the researcher conferred with the Southwest Georgia RESA's Math Mentor and Instructional Supervisor and respective principals to determine the best participants for the study.

To gather and triangulate research data, the researcher used interview and document data (Patton, 2002). Interview data added insight into the perspectives and experiences of six successful algebra teachers at rural South Georgia high schools. The researcher interviewed algebra teachers in rural South Georgia to understand "the lived experience" and the "meaning

they make of that experience" in the high school math classroom (Seidman, 2013, p. 9). The researcher conducted qualitative interviews with the teachers in person in their own classroom (Creswell, 2014). Document data included Georgia Milestones EOC scores, Student Growth Model data, and teachers' lesson plans incorporating IXL. The researcher analyzed these data to support the determination and selection of successful algebra teachers.

Limitations

As a former mathematics teacher, interviewing participants who currently teach algebra may be a challenge, but the researcher planned interview questions with the challenge in mind (Seidman, 2013). The researcher practiced bracketing by intentionally setting aside experiences teaching mathematics and suspending beliefs regarding IXL to have a fresh perspective based on data collected from the participants (Ary et al., 2019). For example, planned interview questions were not leading nor assumptive (Seidman, 2013). The participants had the opportunity to share their experiences without prompting or interruptions (Seidman, 2013). If participants made statements such as, "You know what I mean…" or "But, I don't have to explain that to you…" the researcher asked the participant to elaborate and explain what they assumed the researcher already knew. Seidman also suggested exploring assumptions and seeking clarity about events and experiences and not letting the participants assume anything is known. The researcher's background or attitudes may affect data analysis; therefore, reflexivity was practiced clarifying the bias (Ary et al., 2019; Creswell, 2014).

The research for this study was conducted during the COVID-19 national pandemic, which had an effect on teaching strategies and student achievement. Meeting with teachers, and even finding teachers who agreed to participate, was a challenge. The participants in this study were high school algebra teachers in rural South Georgia high schools. High school algebra

teachers in other areas of Georgia, or the U.S., may experience different outcomes with IXL in their classrooms. Data collected from teachers in different subjects or in different areas of the U.S. or the world may be different and offer a broader range of results.

Special Challenges

The timing of this research proved to present problems. During the planning process for this study, the world changed due to the COVID-19 pandemic. This study's criteria for participants were written, but when the time came to put the plan in action the researcher realized one criterion was no longer acceptable. Before the pandemic, Georgia Milestone Assessments were administered and reported annually by GaDOE. Student Growth Models displayed students' assessment data and teachers' bubbles indicated progress and student learning. When schools closed due to COVID-19 in 2020, students did not take the Georgia Milestones, so no data were reported. Schools slowly reopened the following school year and Georgia Milestones were administered in 2021; however, scores were not published in the Student Growth Models. The most recent data available is from 2018-2019 school year.

The original criterion was:

> Participants must have high student achievement rankings for at least three years. For this study, a teacher with high student achievement had at least 70% student growth and 70% student achievement on the Algebra I Georgia Milestone EOC as indicated on the GaDOE's Student Growth Model for three years. Obtaining 70% student growth and student achievement is the minimum requirement indicating effectiveness.

The new criterion is:

Participants must have acceptable student achievement rankings as measured by their Student Growth Model. For this study, the principal will determine acceptable student achievement.

Definition of Terms

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

College and Career Ready Performance Index (CCRPI) - CCRPI is a school accountability measure employed to satisfy the requirements of the ESSA (GaDOE, 2020b).

Every Student Succeeds Act (ESSA) - ESSA is a law that provides guidelines and requirements to ensure students and schools are successful (U.S. Department of Education, n.d.).

Flipped classroom - In flipped classrooms, students learn independently before class and the teacher supports them during class (Bergmann & Sams, 2012).

Georgia Milestone Assessments - Georgia Milestone Assessments are summative assessments required for Georgia public elementary, middle, and high school students (GaDOE, 2020). Data from Georgia Milestone Assessments are used to determine students' preparedness for their next year in school, college, or career (GaDOE).

Georgia Standards of Excellence - The Georgia Standards of Excellence are standards presented by the GaDOE to establish a consistent framework for students to learn (GaDOE, 2021a). Teachers use the Georgia Standards of Excellence to guide instruction and content is assessed on Georgia Milestone Assessments.

High student achievement - For this study, each high school principal will determine which teachers have high student achievement. Due to the COVID-19 pandemic, Milestone Assessment data has not been reported in two years by SLDS and the Student Growth Model.

International Society for Technology in Education (ISTE) - ISTE is a membership organization dedicated to inspiring educators around the world to innovate teaching and learning through technology (ISTE, 2021).

Integration of Technology - For the purposes of this study, technology is more thoroughly defined as integration of technology.

IXL - IXL is a personalized learning resource introduced online in 2007 by IXL Learning (IXL, 2021).

National Center for Educational Statistics (NCES) - NCES is a federal entity that collects and analyzes educational data (NCES, 2021).

National Education Association (NEA) - NEA is an organization made up of educator members who work for justice and excellence in public education (NEA, 2021).

Personalized learning - Personalized learning incorporates teaching, technology, and student collaboration to tailor lessons that meet each student's needs (Howton, 2021).

Program for International Student Assessment (PISA) - PISA, a division of the Organization for Economic Co-operation and Development (OECD), administers assessments to 15-year-old students around the world to measure knowledge and skills in reading, mathematics, and silence (OECD, n.d.).

Statewide Longitudinal Data System (SLDS) - SLDS is provided by the GaDOE to communicate student achievement to stakeholders (GaDOE, 2020c).

Student achievement - Student achievement is a measure evaluating how well students perform against a standard at a particular point in time (Douglas-McNab, 2013).

Student Growth Model - GaDOE (2020a) designed the Student Growth Model to provide stakeholders with information on student progress. The model describes the amount of growth

each student demonstrated in comparison to other students with comparable achievement levels across the state. The Student Growth Model is a graph consisting of bubbles on four quadrants; each quadrant representing a measure of growth and student achievement. Growth percentiles range from 1 to 99; higher percentages indicating higher academic growth.

Successful algebra teacher - For the purposes of this study, a successful algebra teacher is a veteran educator who teaches algebra in a rural South Georgia high school, is considered efficacious by the principal, and has high student achievement.

Veteran teacher - For the purpose of this study, a veteran teacher is an educator who has taught for a minimum of five years in a rural South Georgia public school.

Chapter Summary

Georgia students continue to score poorly on Georgia Milestones mathematics assessments, which indicates students are not prepared for the next step, whether it be the next grade, college, or career (GaDOE, 2019). The purpose of this qualitative study was to explore the life and career experiences of successful algebra teachers and their perceptions of effective use of IXL in the mathematics classroom. A goal of the researcher was to identify the best IXL implementation strategies used in mathematics classrooms and to determine key factors for students mastering mathematics content, as perceived by successful algebra teachers.

As a former mathematics teacher, current student achievement in mathematics is alarming. It is disheartening for teachers and administrators to work tirelessly educating students, only to see them fall short of meeting learning objectives as evidenced by statewide assessments. The findings in this study may lead educators, administrators, and district leaders closer to the answer. The next chapter includes a review of the literature on student achievement, factors

affecting learning, technology in education, an overview of personalized learning, and a review of IXL.

Chapter II

Introduction

Each year, schools graduate students who are low achievers in high school mathematics (NCES, 2018). Teachers work to prepare students for careers through education, but Georgia high school students fall short on state mandated mathematics assessments (GaDOE, 2019; Yu & Singh, 2018). After years of costly school improvement efforts, including the recent $4 billion Georgia Race to The Top Grant, Georgia's high schools have failed to significantly improve school-wide student achievement (GaDOE, 2019). High school math scores on the 2019 Georgia Milestones Assessment were below the national average (GaDOE, 2019).

The problem of underachieving mathematics students is not confined to one region in the U.S. (GaDOE, 2019). Low achievement in mathematics is a problem across the nation, as indicated by NCES and PISA. In addition to national and international assessments, Georgia high school mathematics students also consistently score poorly on Georgia Milestones assessments in Algebra I and Geometry.

Through this qualitative study, the researcher explored the life and career experiences of successful algebra teachers and their perceptions of effective use of an online learning platform, IXL, in the mathematics classroom. IXL implementation strategies used by successful algebra teachers may help determine key factors for students mastering mathematics. Experiences and perceptions of successful algebra teachers in rural South Georgia may provide relevant data to answer the following research questions:

Research Question 1: What are the life and career experiences of successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 2: What are the best implementation strategies as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 3: What are the external and internal key factors for students mastering mathematics content as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Findings from this research may improve implementation of IXL in Georgia high school mathematics classrooms, as well as in classrooms across the state and country. Districts may more effectively plan relevant professional development opportunities for teachers based on the findings. Educational institutes, such as universities, colleges, RESAs, and Boards of Education may use the findings to improve programs and to create policies. The ultimate goal was to increase student achievement and improve the use of IXL with mathematics instruction in the classroom.

There is a gap in the literature regarding instructional strategies to improve student achievement in high school mathematics. Cox (2015) advocated for further research to learn more about "the dynamics among instructor, students, and math content" to improve learning outcomes (p. 283). Through this study, the researcher may unearth strategies and best practices utilized by successful high school mathematics teachers, thus contributing to the literature by bridging gaps in professional practices and student achievement.

The Review of Literature

Literature reviews provide documentation of the importance of the study and set a benchmark for comparing results (Creswell, 2014). Galvan (2006) argued the literature review provides "a *comprehensive* and *up-to-date* review of the topic" while the author demonstrates

knowledge of the topic being studied (p. 13). The purpose of this qualitative study was to explore the life and career experiences of successful algebra teachers and their perceptions of effective use of IXL in the mathematics classroom. The literature in this chapter concerns student achievement, factors that influence learning, and instructional programs utilized by educators.

The conceptual framework for this study lays the foundation for better understanding the phenomena of how high school students learn mathematics and the role technology plays in the process. The National Council of Teachers of Mathematics (NCTM) maintained students must build new mathematical knowledge through problem solving (NCTM, 2021). The idea that mathematical knowledge builds upon already developed concepts is consistent with the constructivist theory of learning. Isik (2018) found technology in the classroom can "support [a] constructivist approach by activating [an] individual's prior learning" (p. 705). Thus, teachers may assign IXL to algebra students to activate prior learning while practicing previously learned concepts. Kearsley and Shneiderman (1998) posited engagement theory is consistent with the constructivist approach, as students remain engaged in the learning activity and peers to construct new knowledge. IXL may keep algebra students engaged in their learning while constructing new knowledge through the online resource.

Experiential Knowledge

Maxwell (2013) cautioned ignoring researchers' own experiences "about settings or issues they have studied or plan to study; this can seriously impair their ability to gain a better understanding of the latter…" (p. 45). My experiences as a mathematics teacher, digital learning specialist, and Director of Digital Learning and Media Services led me to study the use of an online resource in mathematics classrooms. I taught 7th grade mathematics, 8th grade mathematics, and Algebra I at a rural South Georgia middle school for 10 years before

transferring to a high school as the Digital Learning Specialist. After six years, as Digital Learning Specialist, I was promoted to Director of Digital Learning and Media Services for the district. During the decade I taught mathematics, I worked diligently to ensure my students learned concepts, were prepared for their assessments, and were ready for the next grade. Regardless of my efforts, I always had students who did not pass the standardized state assessment nor show much growth in mathematics. Rather than celebrate my successful students, I was disheartened by the few who did not perform as well.

The year I transferred to the high school as the Digital Learning Specialist, the high school won a substantial grant from the Governor's Office of Student Achievement and the focus was on blended learning in mathematics classrooms. In my new position, I worked closely with the math department during the three-year grant period as we incorporated technology and blended learning in Algebra I and Geometry courses. The high school mathematics teachers shared their concerns about students' achievement in mathematics. Their angst and frustration when students were unsuccessful resonated with me. As I talked with the school principal, we discussed how some teachers consistently had higher scores, and how we considered those teachers successful. This conversation piqued my interest and led me to this proposed study. I wondered if the use of IXL in the successful teachers' classrooms affected student achievement. I hope the results from this study lead to positive changes that affect student achievement locally, as well as in the region and state.

Student Achievement

There are many ways to define, quantify, and measure student achievement in education. For this study, the definition of student achievement is a measure evaluating how well students perform against a standard at a particular point in time (Douglas-McNab, 2013). Students in the

U.S. demonstrate mastery of content on state mandated standardized assessments. In Georgia, the mandated standardized assessments are Georgia Milestones (GaDOE, 2020). Georgia Milestones Assessments scores are on a scale from one to four, with four being the highest score, indicating the student mastered the assessed standards (GaDOE, 2020). States hold school districts accountable for student achievement, which has been the norm for decades (GaDOE, 2020).

In 1965, President Lyndon B. Johnson signed the Elementary and Secondary Education Act (ESEA) into law (Paul, 2018). ESEA mandated funds be used for teachers' professional development activities, instructional materials for the classrooms, resources for educational programs, and improvement of parental involvement. The U.S. Department of Education added six amendments to ESEA, called titles, from 1965-1968 in an attempt to improve education for low-income students. The titles also provided funds for school libraries, preschool programs, and educational programming during summer. Professional development, educational research and training, The Bilingual Education Act, and Education of the Handicapped Act were all products of ESEA titles.

President Richard Nixon signed additional ESEA amendments into law in 1969 (Frankenberg & Taylor, 2015). These titles funded programs for refugee children, those in low-rent public housing, and children with disabilities (Frankenberg & Taylor; Paul, 2018). President Ronald Reagan wanted to reduce federal regulations of Title I so Congress passed the Education Consolidation and Improvement Act in 1981 (Education Consolidation and Improvement Act, 1981). Through the years, more amendments passed to direct funding towards bilingual students, females, and Native Americans (Paul, 2018). In 1988, the Hawkins-Stafford Elementary and Secondary School Improvement Act was written to increase parent involvement in schools,

expand evaluation requirements, and encourage innovation and improvement to educational programs (Library of Congress, 1988).

President Bill Clinton's administration worked to pass Improving America's Schools Act (IASA) in 1994 (U.S. Department of Education, 1995). Passing IASA gave more control to local schools while requiring student progress and accountability. The new act set high standards for all students including those with a low socio-economic status, students in the Migrant or Indian Education programs, and those who are bilingual. IASA directed funds towards professional learning for teachers, principals, and other school staff to improve student achievement. Through IASA, state and local school districts consolidated and administered federal funds for the first time. IASA also promoted an increase in family involvement to support a safe learning environment.

President George W. Bush reauthorized ESEA with the No Child Left Behind Act (NCLB) in 2001 (U.S. Department of Education, 2004). The NCLB Act increased accountability for schools, gave parents a choice of schools, allowed states more flexibility in the use of federal funding, and committed to every student reading by third grade. Each state held schools accountable for all groups of students by annual testing and progress objectives. School districts that did not meet adequate yearly progress (AYP) had to enact measures to help them meet their goals. Districts that met AYP were eligible for State Academic Achievement Awards.

In 2015, President Barack Obama reauthorized ESEA with the Every Student Succeeds Act (ESSA) (U.S. Department of Education, n.d.). Through ESSA, schools were required to prepare students for college and careers by adopting college and career-ready standards. States communicated statewide assessment data measuring student progress with educators, families, students, and communities. The government expanded preschools through funding to increase

access. The state held schools accountable for low graduation rates and when students were not making progress.

Through the years, presidential administrations have worked to influence reform and improve student achievement (Education Consolidation and Improvement Act, 1981; Frankenberg & Taylor, 2015; Library of Congress, 1988; Paul, 2018; U.S. Department of Education, n.d.; U.S. Department of Education, 1995; U.S. Department of Education, 2004). Currently schools aim to meet the standards and expectations of ESSA, originally introduced by President Obama's administration (U.S. Department of Education, n.d.). The government holds states and school districts accountable for student achievement and student growth. The following section details how state agencies measure student achievement as a step towards accountability.

Measures of Student Achievement

Countries around the world measure student achievement differently. The PISA measures achievement of fifteen-year-old students around the globe (NCES, n.d.). PISA assesses achievement and knowledge in reading, mathematics, and science. First administered in 2000, the assessment rotates emphasis on content subjects every three years, although all content is included on each test for every administration. The most recent assessment in 2018 focused on reading; and students in 80 countries participated.

In the U.S., the National Assessment of Educational Progress (NAEP) reports states' results in mathematics, reading, science, and writing after administering a standardized test to fourth and eighth grade students (NCES, 2021a). Each state also has accountability measures in place, such as state-mandated standardized tests (National Research Council, 1999).

Standardized testing is not a new phenomenon in the U.S., as educators have been administering standardized tests for over a century.

Measures of student achievement have evolved in the U.S. In the early 1900s, Harvard President, Charles Eliot, convinced colleges to begin requiring applicants to take a common college entrance examination for admission (National Education Association [NEA], 2021a; Smithsonian, n.d.). The college entrance examination set a common standard for high schools as they prepared students for higher education (Smithsonian, n.d.). In 1908, Henry Goddard adapted Alfred Binet's and Theodore Simon's The Binet and Simon Tests of Intellectual Capacity intelligence test, which became popular in the U.S. (Benjamin, 2009). Over the next few years, testing in education became more common and educators began administering numerous achievement tests to students, in addition to intelligence tests (NEA, 2021a).

By the end of 1920, there were almost half a million standardized tests published in the U.S., including the Scholastic Aptitude Test (SAT) (NEA, 2021a; Public Broadcasting Service [PBS], 2014). The SAT was adapted from Army IQ tests by Carl Brigham as a directive from the College Board (PBS, 2014). In 1926, high school educators administered the SAT to students for the first time (PBS, 2014). A new testing organization introduced the American College Testing (ACT), which rivaled the SAT, in 1959 (PBS, 2014). Today, most colleges still require students to submit SAT and/or ACT scores when applying for admission (College Board, 2021; The Princeton Review, 2021).

Researchers developed the standardized assessment Iowa Test of Basic Skills (ITBS) in 1935 to measure students' content knowledge (Frey, 2018). Widely known and used in the U.S., educators continue to administer and use data from the ITBS for students in grades kindergarten through grade eight (Frey, 2018). The ITBS, a norm-referenced test, compares results between

individuals in reading, language arts, mathematics, science, and social studies (Burkett, 2018; Mercer Publishing, 2021).

In addition to the norm-referenced test, educators in the U.S. have also administered criterion-referenced exams. Criterion-referenced tests differ from norm-referenced in that the tests measure each student's results compared to the curriculum or criteria (Burkett, 2018). Students in third through eighth grades in Georgia completed the Criterion-Referenced Competency Test (CRCT) until the end of the 2013-2014 school year (GOSA, n.d.). Educators used the data collected from the CRCT to determine student achievement in mathematics, language arts, science, and social studies (GaDOE, 2013). Educators assessed high school students with End of Course Tests (EOCTs) and the Georgia High School Graduation Test (GHSGT) (GOSA, n.d.) The EOCT, also retired in 2014, measured student achievement of students in two courses of each core subject: math, science, social studies, and language arts (GaDOE, 2013). In 2015, the GaDOE ceased administering the GHSGT to students who entered 9th grade before 2011. The Georgia Milestones replaced the CRCT and the GHSGT in Georgia beginning in the 2014 school year (GaDOE, 2020).

Georgia educators administer the Georgia Milestone Assessments as one component used to measure student achievement (GaDOE, 2019). The Georgia Milestones are state-mandated standardized tests administered to public school students beginning in the 3rd grade. Educators use data from Georgia Milestones to hold schools and teachers accountable, as well as to measure and report student achievement to stakeholders.

Georgia Milestones

Georgia began requiring schools to administer the Georgia Milestones Assessment System to students in the 2014-2015 school year, after discontinuing the administration of the

CRCT in 2014 (GaDOE, 2019; GOSA, n.d.). Schools administer the Georgia Milestones Assessments to students beginning in third grade (GaDOE, 2019). Georgia Milestones Assessments consist of End of Grade (EOG) assessments through eighth grade and End of Course (EOC) assessments in high school subjects (GaDOE, 2020). The State of Georgia mandates Georgia Milestones Assessments in compliance with federal law to provide information about student achievement in the core content areas of English language arts, mathematics, science, and social studies (GaDOE, 2020).

The Georgia Milestones assesses student achievement and mastering of Georgia standards in the assessed courses in four categories, or levels of achievement (The Governor's Office of Student Achievement [GOSA], n.d.a.). The top level is Distinguished Learners, indicating students in this category "demonstrate advanced proficiency" in the content, are prepared for the next grade, and are on track for college and career readiness. The next level down in achievement is Proficient Learners, indicating students "demonstrate proficiency" in the content. Students with this score are also prepared for the next grade level and on track for college and career readiness. Developing Learners is the next level, indicating students can "demonstrate partial proficiency" in the content. Students with the Developing Learner score require additional support to be prepared for the next grade level content and to get on track for college and career readiness. The lowest achievement level is Beginning Learner, indicating students "do not yet demonstrate proficiency" in the content area. Beginning Learner students require substantial support to be prepared for the next grade and to get on track for college and career readiness.

Schools administered Georgia Milestone Assessment EOC tests in the two mathematics courses Algebra I and Geometry (GaDOE, 2020). Table 1 displays Algebra I and Geometry

scores from 2018 and 2019 for all Georgia high schools as published by the GaDOE (GaDOE, 2019).

Table 1

Spring End of Course Georgia Milestones Scores

Georgia Milestone Assessment	Number of Students Tested	Mean Scale Score	Percent Beginners	Percent Developing	Percent Proficient	Percent Distinguished
Algebra I, 2018	106,329	514	28.4	33.6	26.9	11.1
Algebra I, 2019	106,106	516	27.4	31.5	29.4	11.7
Geometry, 2018	84,531	512	30.8	30.3	28.7	10.2
Geometry, 2019	84,692	515	29.1	30.1	30.0	10.9

Note. Data from GaDOE (2018, 2019).

The data shown in Table 1 indicate the majority of Georgia high school mathematics students scored as Developing Learners on the Algebra I and Geometry Georgia Milestones Assessments (GaDOE, 2018; GaDOE, 2019). The least number of students earned the highest score, Distinguished Learner, for the mathematics assessments (GaDOE, 2018; GaDOE, 2019). The low scores indicate students require additional support to be prepared for the next grade level content and to get on track for college and career readiness (GOSA, n.d.a.).

The Algebra and Geometry Georgia Milestone EOC tests provide students with information about their achievement and readiness for the next mathematics course (GaDOE, 2020). Data from the EOC indicate learning and mastery of the Georgia Standards of Excellence,

which is the framework for content taught (GaDOE, 2020). Schools administer the Algebra and Geometry EOC Milestone Assessments on a computer, which includes technology-enhanced items, multiple choice questions, constructed response items, and norm-referenced performance ranges (GaDOE, 2020). For example, the Algebra I Milestone EOC is broken down into four categories or domains: equations, expressions, functions, and Algebra connections to statistics and probability (GaDOE, 2020d). The equations category is approximately 30% of the assessment, expressions is 20%, functions is 35%, and statistics and probability is 15% (GaDOE, 2021b). Of the 50 assessment items on the Algebra I Milestone EOC, there are 42 items worth one point, including selected-response and technology-enhanced items (GaDOE, 2021b). Eight items are technology-enhanced items worth two points each (GaDOE, 2021b). After the student submits the test, each category is calculated and then combined for the final score (GaDOE, 2020). Data from the Georgia Milestones are included in the Student Growth Model, another method of accountability for schools (GaDOE, 2020a).

Student Growth Model

The GaDOE's Student Growth Model describes the amount of growth students demonstrated in comparison to students with similar achievement across the state of Georgia (GaDOE, 2020a). The Student Growth Model consists of a graph with four quadrants and bubbles on the graph indicate student growth and achievement (GaDOE, 2020a). Students' performance on the Georgia Milestone Assessments places them in a percentile range from 1-99, with 99 being the highest percentile, indicating higher academic growth (GaDOE, 2018a; GaDOE, 2020a). Bubbles in quadrant one indicate learners had higher achievement and higher growth (GaDOE, 2020a). Quadrant two displays learners with higher achievement and lower growth (GaDOE, 2020a). Bubbles in quadrant three indicate learners had both lower

achievement and growth (GaDOE, 2020a). Finally, learners with bubbles in quadrant four had lower achievement but higher growth (GaDOE, 2020a). Educators aim to have all bubbles in quadrant one, indicating their students had both higher achievement and growth for the school year (GaDOE, 2020a). According to the GaDOE (2020a), all students, regardless of their achievement or academic level, have the opportunity to show growth on the Student Growth Model by showing improvement on the Georgia Milestone Assessments.

The GaDOE created the Student Growth Model to provide stakeholders valuable information regarding students' academic achievement and progress (GaDOE, 2020a). Educators have access to the Student Growth Model through the Statewide Longitudinal Data System (SLDS) while the public can access it on the GaDOE website. The data from the Student Growth Model contribute to GaDOE accountability measures for schools and affect them directly.

Effect of Student Achievement on Schools

The NCES is a department of the U.S. Department of Education tasked with assessing students across the nation with the National Assessment of Educational Progress (NAEP) since 1969 (NCES, 2021b). The assessment measures what U.S. students know in most subjects and NCES administers the NAEP across the nation (NCES, 2021b). Educators, parents, policymakers, stakeholders, and researchers use results to assess programs and make decisions about improving education in the U.S. (Gorman, 2010). NCES provides the results as scale scores and achievement levels on The Nation's Report Card (Gorman, 2010). The Nation's Report Card includes assessment results for students attending public schools, private schools, Bureau of Indian Education schools, and Department of Defense schools in the U.S. (Gorman, 2010). State Profiles are available online for users to view a state's performance over time and a comparison of achievement between states (Gorman, 2010). NCES uses the data in The Nation's

Report Card to communicate student achievement, hold states accountable, and provide information to policymakers as decisions are made regarding education (NCES, 2021b).

In Georgia, the GaDOE evaluates public schools with the College and Career Ready Performance Index (CCRPI) (GaDOE, 2020b). CCRPI scores are on a scale of 0 to 100 and measure achievement, progress, closing gaps, readiness, and graduation rate at high schools. The GaDOE calculates CCRPI annually and measures the extent to which students are prepared for the next school year. The performance of student subgroups, school climate, and financial efficiency status of schools are also reported by CCRPI. The State of Georgia CCRPI in 2018 was 76.6 and 78.8 in 2019.

CCRPI is a school accountability measure employed to satisfy the requirements of the ESSA, which replaced NCLB and reauthorized ESEA (GaDOE, 2020b; U.S. Department of Education, n.d.). The GaDOE designed CCRPI to provide information and data on a school's progress in preparing students for college or career after high school (GaDOE, 2020b). Rather than implementing quick fixes, schools use CCRPI to implement improvements that may result in long-term, sustainable, positive results (GaDOE, 2020b). The GaDOE used CCRPI to identify progress made and progress needed in schools, identify schools that need support, provide data for school improvement plans, and to communicate student performance with the public and stakeholders (GaDOE, 2020b). GaDOE reported these uses of CCRPI improved student outcomes, communicated goals and increased collaboration with stakeholders, and provided support for schools (GaDOE, 2020b).

GaDOE (2020b) set five goals to support CCRPI and increase students graduating ready for college or career. The first goal is to increase achievement by moving all students to a higher level of growth. The second goal of CCRPI is to make progress in closing achievement gaps by

improving achievement and graduation rates for all students and all subgroups. The third goal is to increase literacy and numeracy for all grade levels and to show growth on ELA and mathematics achievement. The fourth goal is to increase graduation rates, regardless of the time it takes to graduate. Students may graduate in four years or in a five-year adjusted-cohort, if needed. The fifth and final goal of CCRPI is to increase student college and career readiness. Students must graduate from high school prepared to enter college or the workforce with the tools needed to be successful.

The CCRPI framework consists of five components: achievement or content mastery, progress, closing gaps, readiness, and graduation rate (GaDOE, 2020b). Content mastery includes the achievement scores from the Georgia Milestones Assessments in English Language Arts, mathematics, science, and social studies. The achievement scores are scaled based on content mastery and schools can earn 0, 0.5, 1, or 1.5 points, depending on the level of mastery. The progress component utilizes the Student Growth Percentiles to describe the amount of growth students demonstrate in comparison to academically-similar students in English Language Arts and mathematics. Students have low, typical, or high growth earning 0, 0.5, 1, or 1.5 points depending on their level of growth. English Learners may earn additional points for CCRPI by making progress towards English language proficiency.

The closing gaps component, represented by improvement flags, demonstrates academic achievement (GaDOE, 2020b). A red flag earns 0 points, indicating performance did not improve. A yellow flag indicates some progress, earning 0.5 points. A green flag indicates the target was met and earns one point. Economically Disadvantaged, English Learner, and Students with Disabilities subgroups earn an additional 1.5 points when a 6% improvement target is met. There are five readiness indicators for high schools, which are relevant to this study. The

indicators are literacy, student attendance, accelerated enrollment, pathway completion, and college and career readiness. The final high school component of CCRPI is graduation. The graduation component utilizes the adjusted cohort graduation rate, which is the number of students who graduate with a regular high school diploma in four or five years, divided by the number of students in the adjusted cohort for the graduating class.

GaDOE reports CCRPI annually on a scale of 0-100, which increases understanding and interpretation for stakeholders (GaDOE, 2020b). Included in the CCRPI report is also the School Climate Star Rating and the Financial Efficiency Star Rating. Schools earn up to five stars indicating positive school climate, per-student spending, and overall student performance. CCRPI identifies the lowest 5% of Georgia schools as Comprehensive and Targeted Support and Improvement schools, which the GaDOE and GOSA support. Schools must perform their way out of the Comprehensive and Targeted Support and Improvement School status by meeting explicit criteria outlined in the Redesigned College and Career Ready Performance Index.

Student achievement in mathematics is lower than the average CCRPI score in Georgia (GaDOE, 2020e). Content mastery is a component of CCRPI and measures student achievement (GaDOE, 2020e). The content mastery score for Georgia's high school students in 2018 was 61.83, which is an average of the Algebra I score of 59.06 and Geometry score of 64.61 (GaDOE, 2020f). In 2019, the content mastery score for Georgia's high school students increased to 64.00, with an Algebra score of 61.21 and Geometry score of 66.89 (GaDOE, 2020g). These low content mastery scores indicate students are not prepared for the next year of mathematics (GaDOE, 2020e). The low scores also negatively affect each high school's CCRPI (GaDOE, 2020g). Thus, better understanding factors that influence learning that increases achievement may improve content mastery scores and CCRPI.

Factors that Influence Learning

External

Many factors affect student achievement and influence learning. In a mixed methods study, Jones (2012) investigated parental achievement, parental and community involvement, school morale, teacher quality, student peer groups, and resources to determine the impact each had on student achievement. After reviewing test scores, survey data, participant interviews, and observing classrooms, Jones found students were successful when external and internal stakeholders collaborated. Successful students also had a strong value base and were motivated to succeed. Jones concluded home and community environments had a strong influence over students' success.

Parental involvement had a positive impact on student achievement (Cole, 2017; Hara & Burke, 1998; Hill & Craft, 2003; Marcon, 2019; Stephenson & Baker, 1987). Parental involvement with early elementary students is crucial in supporting students transitioning from home into a school setting (Cole, 2017). Topor et al. (2010) found a statistically significant association between parent involvement and student achievement. Increased parent involvement led to a positive student-teacher relationships, resulting in students' high achievement test scores and improved performance in the classroom (Topor et al., 2010). Smokoska's (2020) results in a quantitative study indicated a positive correlation between parents signing weekly grade reports and parents communicating via telephone with the school. However, there was not a significant correlation when parents checked grades and read notes, including emails and texts, from the school (Smokoska, 2020). Haug and Wasonga (2021) found student achievement was most impacted by parental involvement and the school learning environment.

School climate, morale, and the learning environment affect student achievement (Haug & Wasonga, 2021; Jones, 2012). The results of a quantitative study confirmed a strong relationship between a school's climate and its students' achievement levels (Schindler et al., 2016). Schindler et al. (2016) also found secondary schools had a lower quality school climate than elementary schools. Konald et al. (2018) found schools with an authoritative school climate had higher student engagement and higher academic achievement. Konald et al. concluded there was a strong association between school climate and academic achievement. Greenway (2017) also found a strong positive relationship between school climate and student achievement. Suggestions from Greenway to improve school climate included improving school discipline, attendance, and interpersonal relationships.

Hattie (2012) proffered feedback was one of the top influencers of student achievement. Hattie and Timperley (2007) defined feedback as information provided by someone or something in response to the recipient's performance or understanding. Feedback is effective and powerful when it links to learning, is included in classroom teaching strategies, and is clear, purposeful, and meaningful (Hattie & Timperley, 2007). Feedback should also help students connect their prior knowledge to what they are learning (Hattie & Timperley, 2007). For example, a teacher, peer, or book can provide understanding and clarity through feedback to a student learning a new concept. Feedback is most effective in education when it clears up students' misconceptions rather than total misunderstandings (Hattie & Timperley, 2007). Hattie and Temperley also found feedback is most impactful when teachers give students specific and challenging goals on assignments that are not too difficult.

Before providing feedback to students, teachers should begin with effective instruction and teaching strategies (Hattie & Timperley, 2007). Teachers should consider answering one or

more of the following questions in feedback to students: “Where am I going? (What are the goals?), How am I going? (What progress is being made toward the goal?), and Where to next? (What activities need to be undertaken to make better progress?)” (Hattie & Timperley, 2007, p. 86). The amount of feedback given in classes has been difficult to document, however, (Hattie & Timperley, 2007). Teachers should also consider how to deliver the feedback to students (Hattie & Timperley, 2007). Assessments of student learning provide opportunities for teachers to offer feedback while students improve their skills and increase knowledge to meet learning goals.

Teachers who required student reflection then offered feedback may improve student learning and increase achievement (Hattie & Timperley, 2007). Students improved their learning and achievement through formative assessments and specific feedback from teachers (Baliram & Ellis, 2019). Baliram and Ellis (2019) argued teachers should instruct students to think and reflect upon what they have learned in a class lesson, and then communicate either orally or in writing to the teacher. Constructive feedback given to the students based on their reflections may improve learning, but the feedback should be content-specific and personalized (Baliram & Ellis, 2019).

Gentrup et al. (2020) posited teacher feedback to students may be the most important strategy used to improve student learning and achievement. Hattie and Timperley (2007) argued feedback is powerful for student learning when used during teaching. Frequent feedback provides students with an idea of how they are performing and is a tool students can use to learn from mistakes and improve skills (Gentrup et al., 2020). Teachers should offer feedback to students at the appropriate level to ensure understanding of the concepts being taught (Hattie & Timperley, 2007). Feedback at the appropriate level can lead students to better comprehension, engagement, or development of strategies to better process information being learned (Hattie &

Timperley, 2007). McPartlan et al. (2020) found students learn which sources offer positive feedback and tend to accept it more readily than negative feedback. For example, elementary students rated parents as giving more positive feedback than peers, so they found parental feedback more valuable (McPartlan et al., 2020). Regardless, the feedback needs to be clear and timely and include purposeful and meaningful connections (Hattie & Timperley, 2007).

Internal

Many internal factors affect student learning. Internal factors are those within each student, brought to the particular learning situation (Frankfurt International School, n.d). Research indicates students are more motivated to learn when they perceive their teacher is supportive (Yu & Singh, 2018). Students with a positive self-efficacy can also improve achievement (Multon et al., 1991; Yu & Singh, 2018). Self-efficacy is the belief a person possesses the ability to be successful (Yu & Singh, 2018). Several studies found a positive relationship between students' self-efficacy and their performance, motivation, and engagement (Alivernini & Lucidi, 2011; Green et al., 2004; Hampton & Mason, 2003; Multon et al., 1991).

Students have numerous distractions, which may affect their achievement negatively. Video games, texting, friends, family, and work require time and can distract students from their studies (Malik & Terry, 2021). Malik and Terry (2021) conducted a quantitative study of 9th grade students and found a correlation between non-educational video gaming and texting in relation to how students perceive school. The results of the study also indicated a strong correlation between time spent playing video games and school attendance. The more hours students spent playing video games the less they felt well while in school.

While video games, texting, friends, family, and work may interest students, their education or classes may not. Student interest is an important motivational factor in education

(Wigfield & Cambria, 2010). Students who are interested in the subject they are studying are more likely to engage in learning activities at school (Yu & Singh, 2018). Students' educational self-efficacy, prior knowledge, and teachers' strategies can have an effect on student interest (Yu & Singh, 2018).

In a quantitative study conducted with undergraduate college students, Sheffler and Cheung (2020) investigated the effects of peers' mindsets on students' learning and achievement. The researchers concluded students who interacted with peers embracing a growth mindset found tasks more important, useful, and valued the experience more than students who interacted with peers embracing a fixed mindset. Burke and Sass (2008) found significant peer effects in the classroom, which differ for students of different abilities. Lower-performing students demonstrated the most positive impact from interacting with higher-ability peers while high-ability students experienced a negative impact from interacting with low-ability students (Burke & Sass, 2008). Poldin et al. (2016) found significant positive peer effects through the academic achievement of study partners. Students' grades improved when they studied with higher-achieving peers (Poldin et al., 2016).

Students' motivation and engagement may affect student achievement. Baier et al. (2018) found teachers with strong content knowledge and enthusiasm, which motivates students, are significant predictors of instructional quality. Kunter et al. (2013) found enthusiastic teachers had positive effects on students' motivation. Teachers with high professional content knowledge offered better learning support, which increased student motivation (Kunter et al., 2013). Research also indicates students are more motivated when they feel confident and trust their teacher (Baier et al., 2018; Kunter et al., 2013).

Lavrijsen et al. (2021) found student intelligence was a strong predictor of achievement and student motivation increased achievement, even beyond intelligence. Motivation affects students' daily class work and may lead teachers to consider student effort while grading (Lavrijsen et al., 2021). Likewise, Parsons et al. (2018) found students were more engaged in tasks in which they could collaborate with peers, learn new concepts, and had their teacher's support.

Internal factors are those students possess within themselves (Frankfurt International School, n.d). Research indicates there are numerous internal factors, which may affect student learning. Student motivation, self-efficacy, and engagement are the most common factors in research (Alivernini & Lucidi, 2011; Green et al., 2004; Hampton & Mason, 2003; Multon et al., 1991; Yu & Singh, 2018). Each student's interest in the content may impact student motivation and engagement (Wigfield & Cambria, 2010). Distractions, such as friends, texting, and video games, are a problem for many students in school (Malik & Terry, 2021). If students are not interested in the academic content the teacher presents, they may not be motivated or engaged in the learning process and turn their attention to any distractions (Malik & Terry, 2021; Wigfield & Cambria, 2010; Yu & Singh, 2018). Student intelligence is also a strong internal factor affecting achievement in education (Lavrijsen et al., 2021). Students with less intelligence can improve learning with peer tutoring in the classroom and after school (Parsons et al., 2018).

Factors that Influence Learning of Mathematics

External

Teachers are an external learning factor affecting students' learning of mathematics. Teachers who make real-world connections in class can increase student engagement in mathematics (Sawatzki & Sullivan, 2018). Presented with everyday real-world financial

problems, students can connect with the content actively and successfully complete activities (Sawatzki & Sullivan, 2018). Siegler et al. (2012) indicated students' knowledge of mathematics is vital for educational and financial success in their futures. Connecting mathematics with a context the student can relate to and understand is *realistic mathematics* (Budinski & Milinkovic, 2017). Realistic mathematics may help students perceive real-world mathematical problems as useful because of the context in which it is encompassed (Matthews, 2018). It is crucial elementary students fully understand the real-world context to which mathematics problems relate (Budinski & Milinkovic, 2017). An example relating the research to high school mathematics is: a student saving money for a truck may see the value in learning how to determine the final cost after tax. The student desires a vehicle, understands they must save enough to pay for it, and will learn how to determine the required tax as part of the final cost. Matthews (2018) shared students who do not have the opportunity to apply what they learn in mathematics class to the real world may lack motivation to learn.

When using real-world examples in mathematics class, teachers may face dilemmas (Sugimoto et al., 2017). Dilemmas require a decision with no right or wrong answer, which can be uncomfortable for some (Sugimoto et al., 2017). Sugimoto et al. (2017) explained teachers may have to determine if a real-world connection is aligned with the mathematical goal(s) or standard(s) of the lesson and adjust. Siegler et al. (2012) found early understanding of fractions and division with fractions impacted students' achievement in high school mathematics. Connecting fractions and division of fractions to real-world problems may present teachers with dilemmas in the classroom as they determine the best way to teach the content (Siegler et al., 2012; Sugimoto et al., 2017).

Cox (2015) indicated professors teaching developmental mathematics courses at a community college focus more on the math rules than on concepts. Students often receive a rule sheet and professors encourage them to refer to it while working out problems rather than to think and problem solve to find the solution (Cox, 2015). Widmaier (2004) argued one must give meaning to material, which is a constructivist theory point of view. Students can make their knowledge with creation and choice as the professor facilitates the learning in a constructivist manner (Xyst, 2016). Professors who want students to memorize rules, rather than make knowledge to understand the rules according to the constructivist theory, may experience low student achievement in their courses (Cox, 2015; Widmaier, 2004; Xyst, 2016).

Student achievement increases when teachers offer students high levels of critical feedback on work (Hattie & Timperley, 2007; Kearney & Garfield, 2019). Kearney and Garfield (2019) contended for teachers to give high levels of critical feedback on mathematical content, the teacher must be proficient and competent in the content. Fyfe and Rittle-Johnson (2016) found elementary-aged students who received immediate feedback on mathematics problems increased their problem-solving performance and decreased their use of incorrect strategies (Fyfe & Rittle-Johnson, 2016; Hattie & Timperley, 2007).

Internal

Several school-related variables affecting mathematics achievement are academic engagement, perceptions and attitude, and knowledge of the role of mathematics in a future career (Singh et al., 2010). Singh et al. (2010) found students with positive attitudes towards mathematics were high achievers in mathematics class. Highly motivated students who worked through difficult problems independently had high self-efficacy in mathematics (Skaalvik et al., 2015). Student motivation greatly affected academic achievement (Yu & Singh, 2018).

Motivated students were more likely to engage, take challenges, and work through difficult math problems (Yu & Singh, 2018). Students who perceived themselves as weak mathematics students sought help from the teacher when working on difficult problems rather than persisting through solving the problem alone (Shaalvik et al., 2015). Developmentally appropriate interactions in the high school classroom leads to increased student motivation and achievement (Allen et al., 2011).

Kearney and Garfield (2019) suggested the perception students and teachers have of each other affects student learning and achievement. In the middle school grades, students who perceived their teachers cared for them were more motivated and performed better in class (Kearney & Garfield, 2019). Teachers who believed their students could perform well had higher achieving students, including students who had previously been low performing (Kearney & Garfield, 2019). Thus, when teachers believed in students' abilities, and when students believed they had high math abilities, students performed well (Kearney & Garfield, 2019).

The internal factors affecting student learning in general are similar to those affecting mathematics achievement. Student motivation, self-efficacy, engagement, and interest have a direct effect on student achievement in mathematics, as well as other subjects (Alivernini & Lucidi, 2011; Green et al., 2004; Hampton & Mason, 2003; Multon et al., 1991; Singh et al., 2010; Skaalvik et al., 2015; Wigfield & Cambria, 2010; Yu & Singh, 2018). Identifying and acknowledging learning factors may lead to a better understanding of students' needs and improving their educational experiences.

Technology in the Classroom

Technology has been evolving for decades and educators could take better advantage of it to improve education (Mishra et al., 2009). Educators once believed the talking picture, or

movies, would transform education. Then, educators used overhead projectors, digital slides on the computer, and the internet, which were revolutionary to education. Technology is constantly changing, and educators must be "skilled beyond basic usage" to use it effectively for instruction (Mishra et al, 2009, p. 49). Teachers may participate in professional learning to learn about the uses of new technologies and how to apply them in their classrooms (Mishra et al., 2009).

Technology can help facilitate the constructivist classroom, influence teaching and learning, and support a more student-centered learning environment (Muir-Herzig, 2004). Technology has encompassed myriad aspects of life including work, school, and play (Lim et al., 2013). In the last 20 years, schools' technology investments have increased more than a hundredfold as companies create new technologies and they become available (Lim et al., 2013). The media and the public pressure schools to ensure teachers use technology in classrooms to prepare students for work in the technology-filled world (Lim et al., 2013).

In an effort to support and encourage technology use in schools, the International Society for Technology in Education (ISTE) developed and published standards. ISTE is a membership organization dedicated to inspiring educators around the world to innovate teaching and learning through technology (ISTE, 2021). They also work to promote "good practice and solve tough problems in education by providing community, knowledge and the ISTE Standards" as described in their mission statement (ISTE, 2021a, para. 5). The ISTE standards are a framework designed to move educators towards "rethinking education and empowering learners" (ISTE, 2021b, para. 1). ISTE standards are available for students, educators, education leaders, coaches, and computational thinking. For the purposes of this study, the focus will be on the ISTE Standards for Educators.

The seven ISTE Standards for Educators guide educators towards empowering learners. According to ISTE (2021b), the Standards for Educators promote collaboration with other educators and lead educators to rethink the way they teach content in the classroom. The first standard encourages educators to remain learners by exploring and applying pedagogical approaches made possible by technology, sharing the knowledge in local and global learning networks, and continuously reading research supporting improved learning outcomes. Standard two details avenues for educators to lead others while supporting student empowerment and success with technology. Educational teacher leaders should advocate for equitable access to technologies and look for ways to meet the needs of all students (ISTE, 2021b). The third standard focuses on educators inspiring students to be positive and responsible digital citizens. Educators can create experiences for students to demonstrate positive, socially responsible behavior online and establish a learning culture that encourages curiosity while scrutinizing online resources to ensure accuracy and dependability. Students should learn about intellectual rights, intellectual property, and how to keep their data safe online (ISTE, 2021b).

Standard four encourages collaboration between colleagues and students to learn and solve problems (ISTE, 2021b). Educators should have dedicated collaboration time with colleagues to create learning experiences with technology (ISTE, 2021b). Collaboration should also occur with students while learning to use technology resources (ISTE, 2021b). Student learning experiences may be expanded with collaborative tools, by meeting with experts, other educators, and students online virtually. Through a virtual platform, students can learn from others regardless of their location in the world. The fifth standard indicates educators can use technology to design lessons for students that are personalized and authentic, encouraging independent learning. Educators must be facilitators in students' learning with technology to

ensure students take ownership of their learning goals and outcomes (ISTE, 2021b). The teacher must manage the use of technology and encourage students to use a design process and computational thinking to solve problems innovatively (ISTE, 2021b). The final standard requires teachers to use student data to drive instruction. Students can use technology to demonstrate competency in alternative ways and complete formative and summative assessments. Teachers should offer timely feedback to students and use the data to inform instruction (ISTE, 2021b).

Technology in the classroom can be a powerful tool to enhance student learning and support a constructivist approach (Clark, 2006; Kaya, 2015). Schacter and Fagnano (1999) asserted learning by design and project-based learning have been effective methods aligned with the constructivist theory. Students who learn by designing something learn to use critical thinking skills and judgement (Schacter & Fagnano, 1999). Technology can play a strong role in a constructivist approach to learning mathematics.

Teachers can use technology in the classroom with students to improve learning. Murphy (2016) posited technology can engage students in learning and improve computational skills, reduce anxiety, increase student motivation, and assist students in gaining a deeper understanding of the content. Hegedus et al. (2015) investigated the use of SimCal with advanced algebra students in two large studies. The researchers determined "both studies demonstrated significant impact on student learning" with technology in the classroom, regardless of demographic factors or learning level (Hegedus et al., 2015, p. 203). Students in a high school geometry class, who participated in Frazier's (2020) action research, enjoyed a 25-point average increase in achievement when using self-paced technology to learn in the classroom, indicating personalized learning improves student achievement.

Personalized Learning

For this study, personalized learning is incorporating teaching, technology, and student collaboration to tailor lessons that meet each student's needs (Howton, 2021). Teachers design their lessons with students' interest in mind to facilitate deeper learning (Howton, 2021). Personalized learning is a strategy adopted by educators to engage students in their learning while attempting to close the achievement gaps in schools (Hughey, 2020). When students are involved in their learning, they become more motivated and improve their academic achievement (Allen et al., 2011; Hughey, 2020; Lavrijsen et al., 2021; Parsons et al., 2018; Skaalvik et al., 2015; Yu & Singh, 2018).

Phan (2020) conducted a qualitative study and found students collaborated to learn, were engaged with each other and the content, asked questions, used technology to learn, and took ownership of their learning. Teachers participating in the study observed students answering peers' questions and being proactive in the classroom while learning. For example, one teacher reported student collaboration was powerful and facilitated peer discourse, which typically did not happen between the students and teacher.

In a quantitative study with college student participants, Abedi et al. (2021) provided assignments to participants in an experimental group based on their cognitive styles and gave them control over their learning. Participants in the control group received standard assignments. After analyzing data from exams and two questionnaires, the researchers found personalized learning had a significant improvement in content mastery, engagement, and learning.

Fazal et al. (2020) investigated the relationship between personalized learning and student achievement in middle schools. The teachers in the classrooms used technology, teaching, and learning strategies with students (Fazal et al., 2020). Researchers collected data

through classroom observations, student focus groups, teacher interviews, and a difference-in-difference regression analysis on a standardized assessment over a two-year period (Fazal et al., 2020). The results of the study indicated a positive impact on student achievement, even on student groups who traditionally struggle, such as special education students (Fazal et al., 2020). Research conducted in a high school had similar results when students used self-paced curriculum online twice a week in class (Frazier, 2020). Students participating in personalized learning were engaged and showed improved academic achievement (Abedi et al., 2021; Fazal et al., 2020; Frazier, 2020 Phan, 2020).

Review of IXL

IXL is a website originally offering curriculum for grades K-12 and supported math education (IXL, 2021). Currently, IXL offers curriculum for math, language arts, science, social studies, and Spanish (IXL, 2021). The mission of IXL centers on the use of technology to improve learning for all and unlocking students' curiosity, creativity, and desire for knowledge in thoughtful and innovative ways. Students practice mathematics on IXL, get immediate feedback, and never see the same question twice. IXL personalizes student learning with individualized guidance and real-time analytics (IXL, 2021a). Teachers have access to IXL Real-Time Diagnostic and actionable analytics to help them guide students in their learning and use of IXL to meet learning goals (IXL, 2020b).

The IXL Real-Time Diagnostic tool provides information to teachers about what their students know and how to help students improve (IXL, 2021c). The IXL Real-Time Diagnostic tool reports the grade level proficiency in math for each student and then creates an action plan for each student. IXL assists teachers in personalizing action plans and differentiating instruction

to fill each student's knowledge gaps to improve learning. IXL frequently fine-tunes students' results and action plans providing students continue to complete diagnostic questions each week.

Each Georgia Standard of Excellence for mathematics is available in IXL, which can reinforce lessons taught in class (IXL, 2021d). There are an unlimited number of practice questions in IXL, representing each state standard. Each question has links at the bottom of the screen for students who are unsure about how to solve the problem. The links direct the student to a simpler practice reinforcing the foundation of the original problem. During the practice, teachers can immediately discover which standards students are struggling with after accessing the IXL Analytics standards center.

Sanders (2019) studied the impact of IXL on high school students' mathematical skills. The researcher attempted to answer the following research questions:

> What is the context, as it relates to student ability and skill levels, within District C that warrants a program to improve mathematics instruction?; What is District C doing to address the context aimed at improving mathematics instruction?; To what extent are District C teachers using the IXL program with fidelity?; and What is the impact of the IXL program on improving high school student math skills? (Sanders, 2019, p.7)

Sanders (2019) surveyed and interviewed 10 teachers, interviewed six administrators, observed classrooms, and examined student achievement data to answer the research questions. Sanders used Stufflebeam's CIPP model to evaluate the IXL program and its impact on high school students' mathematics skills. The survey results were analyzed and a *t*-test was performed which showed a statistically significant difference in Algebra I EOC scores before and after IXL was implemented. Interviews with teachers and administrators provided qualitative data for the

study. The researcher found IXL had a positive effect on improving mathematics student achievement, but teachers needed more training and support on the use of IXL.

Sullivan (2020) surveyed elementary and middle school teachers to determine how IXL was implemented in their mathematics classrooms. One research question drove the study by asking "How do middle-grade teachers at a rural school utilize IXL in the classroom?" (Sullivan, 2020, p. 5). The researcher analyzed the survey data to determine IXL is useful for teachers and students and most teachers implemented IXL the same way in their classrooms. Teachers used the program to supplement mathematics practice after teaching a lesson. Sullivan recommended additional research be conducted with more participants to produce more thorough data. The researcher also recommended a study to determine how to implement IXL in the mathematics classroom.

Donnelly (2021) evaluated the effectiveness of IXL in raising middle school students' mathematical achievement on the New York State Math exam. Donnelly concluded IXL has a positive impact on student achievement when teachers motivate students to work hard; use IXL data and provide support, re-teaching, and remediation to students who need it; and prepare students for standardized testing by providing complex questions for them to answer.

Chapter Summary

In this literature review, the researcher explored student achievement, factors that influence learning, technology and personalized learning in the classroom, and IXL. Since 1965, the federal government has mandated, amended, and added new laws in an effort to improve student achievement and hold schools accountable (Educational Consolidation and Improvement Act, 1981; Frankenberg & Taylor, 2015; Library of Congress, 1988; Paul, 2018; U.S. Department of Education, n.d.; U.S. Department of Education, 1995, U.S. Department of

Education, 2004). Educators measure student achievement through standardized tests across the globe, nationally, and locally within each state (NCES, n.d.; National Research Council, 1999).

There are many factors affecting student learning in mathematics courses and in general. Parental support and involvement, teacher feedback, and school climate has a positive impact on student learning (Cole, 2017; Greenway, 2017; Hara & Burke, 1998; Hattie & Temperley, 2007; Hattie, 2012; Hill & Craft, 2003; Jones, 2012; Konald et al., 2018; Marcon, 2019; Schindler et al., 2016; Smokoska, 2020; Stephenson & Baker, 1987; Topor et al., 2010). Technology in the classroom can also have positive effects on student learning (Clark, 2006; Frazier, 2020; Hegedus et al., 2015; ISTE, 2021; Kaya, 2015; Muir-Herzig, 2004; Murphy, 2016). ISTE developed and published standards to move educators towards "rethinking education and empowering learners" as they use technology in the classroom (ISTE, 2021). Teachers can use IXL in the classroom to personalize learning, give students immediate feedback, and improve student achievement (Fyfe & Rittle-Johnson, 2016; Howton, 2021; IXL, 2021; IXL, 2020c; Kearney & Garfield, 2019). In this proposed study, the researcher will explore the life and career experiences of successful algebra teachers, their perceptions of effective use of IXL in the mathematics classroom, and the key factors for students mastering mathematics content. The researcher sought to identify the best IXL implementation strategies used in mathematics classrooms and to determine key factors for students mastering mathematics content, as perceived by successful algebra teachers.

Chapter III

METHODOLOGY

Achievement in high school mathematics is crucial to the success of students as they advance through their education and prepare for careers (Yu & Singh, 2018). However, most Georgia high school students are not high-achievers on state-mandated mathematics assessments (GaDOE, 2019). Students learn to think analytically, learn problem-solving skills, and improve reasoning skills through mathematics courses (Cardino & Ortega-Dela Cruz, 2020). Educational technology used in the classroom may play an integral role in increasing student achievement, (International Society for Technology in Education [ISTE], 2021).

The purpose of this qualitative study was to explore the life and career experiences of successful algebra teachers, their perceptions of effective use of IXL in the mathematics classroom, and the key factors for students mastering mathematics content. The researcher sought to identify the best mathematics classroom strategies for IXL implementation, and to determine key factors for students mastering mathematics content, as perceived by successful algebra teachers. The experiences and perceptions of successful algebra teachers in rural South Georgia provided data relevant to the research questions for this study.

Research questions for this study signify what the researcher intended to learn, help to keep the researcher focused within the realm of the study, and provide a framework for how to conduct the study (Maxwell, 2013; Miles & Huberman, 1994). The following research questions guided this qualitative study, clarified the problem of mathematics achievement, and specified the variables and population (Ary et al, 2019).

Research Question 1: What are the life and career experiences of successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 2: What are the best implementation strategies as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 3: What are the external and internal key factors for students mastering mathematics content as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Each of the following sections of this chapter includes details about the methodology applied in this study. In the design and rationale section, the researcher provides an overview of the design and methods used in this study. In the next section, the researcher provides an explanation and description of the research setting. Next, the researcher describes the role she will play during the research and identifies personal biases and how she will manage those biases. Following the role of the researcher section are the sampling procedures and participant selection methods utilized in this study. Next, data collection procedures and data analysis are explained. Finally, issues of trustworthiness, reliability, and ethical procedures conclude the methodology chapter.

Research Design and Rationale

The researcher selected a qualitative method for this study to explore and better understand "the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2014, p. 4). Through a phenomenological point of view, the researcher strived to learn what the participants experienced and how they interpreted the world around them (Merriam, 2002; Patton, 2015; Seidman, 2013). Interviews with individuals provided insight into the "meaning of peoples' experiences in the context of their lives" (Seidman, 2013, p. 20). Using a phenomenological approach, the researcher explored the life and career experiences of successful

algebra teachers, their perceptions of effective use of IXL in the mathematics classroom, and the key factors for students mastering mathematics content. The researcher interviewed six successful veteran high school algebra teachers who used IXL in the classroom about their perceptions of IXL implementation, effective IXL strategies, and student achievement factors. Through analysis of data collected from a series of interviews with participants and documents provided, the findings may contribute to and expand upon existing literature on student achievement in mathematics and the role technology may play.

Some researchers consider phenomenology an approach that weaves into all qualitative research (Merriam, 2002). However, the phenomenological approach uses "its own 'tools' or inquiry techniques that differentiate it from other types of qualitative inquiry" (Merriam, 2002, p. 7). After data collection, the researcher focused on the structure of the participants' experiences and made complex meanings out of the data (Merriam, 2002). Focusing on the essence of the participants' experiences led the researcher to "inquire into its nature or meaning" (Ary et al., 2019, p. 409; Creswell, 2014). The researcher's goals as a qualitative researcher were to identify effective IXL implementation strategies used in algebra classrooms and determine key factors for students mastering mathematics content, as perceived by successful algebra teachers. Gaining a better understanding of the experiences math teachers who implement IXL successfully may increase student achievement and improve the use of IXL with mathematics instruction in the classroom. The researcher acquired information from successful teachers who shared their experiences and perceptions of IXL implementation strategies and factors affecting students' learning of mathematics, which the researcher described in rich detail (Merriam, 2002).

Setting

The setting for this research was rural South Georgia, where Southwest Georgia Regional Educational Service Agency (RESA) serves participants' schools. The Governor's Office of Student Achievement (GOSA) considers each participant's school a rural and high-need high school (GOSA, n.d.b.). The researcher selected this setting for several reasons. First, South Georgia students' Milestone scores are not optimal. While achievement varies between schools, algebra scores in these schools are consistently below the state average. Through this study, the researcher hoped to uncover effective strategies used in algebra classrooms, which may improve South Georgia high schools' Milestone scores. Second, the participating high schools subscribed to IXL and the algebra teachers used the program in their classrooms. Purposefully selecting participants who used IXL in their algebra classrooms provided data needed to identify effective strategies and key factors affecting student achievement, as perceived by the participants.

Role of the Researcher

There are different roles a researcher should consider when planning a study (Ary et al., 2019). For this study, the researcher's role was an observer. The researcher did not know five of the six participants and the interactions were limited to interviews. The researcher was the primary instrument of data collection through interviews and document reviews then coding and analyzing the data. Through this process, there was potential for bias, which may affect the study's results. The researcher practiced bracketing by setting aside her own experiences of teaching mathematics to gain a fresh perspective of the participants' experiences and thoughts (Ary et al., 2019).

Proposed Sampling Technique

This study took place in rural South Georgia high schools with interviews and a review of documents. The selection process to determine the participants consisted of a sampling logic, and it "generalize[d] to some population of interest" which was successful algebra teachers in rural South Georgia high schools (Maxwell, 2013, p. 78). Employing non-random, purposeful sampling while selecting participants led to obtaining information that was particularly relevant to the research questions and goals and best led to answers for the research questions (Maxwell, 2013). Purposefully selecting six participants based on teaching experience, success, and the use of IXL was necessary to collect information-rich data (Patton, 2002).

The selected participants were successful high school algebra teachers who had high student achievement rankings as measured by their Student Growth Model. For this study, each high school principal determined acceptable student achievement and recommended the eligible participants. The participants also used IXL in their classrooms. The researcher used these criteria to purposefully select six participants who "best help[ed] the researcher understand the problem and the research question[s]" (Creswell, 2014, p. 189). The researcher began the process of selecting six participants by first contacting rural South Georgia superintendents and high school principals via email to determine which high schools' math departments utilize IXL. The superintendents and high school principals were from districts served by the Southwest Georgia RESA. From this data, the researcher identified high school principals at schools using IXL and corresponded with them to solicit names of their successful algebra teachers who used the program.

Once the researcher identified qualifying teachers, she contacted each teacher's district to obtain approval prior to communicating with the potential participants (see Appendix A & B).

After receiving district permission, the researcher emailed each teacher to introduce the purpose and procedures of the study and to invite them to participate (see Appendix C). The email included a statement informing participants their participation was strictly voluntary and they may withdraw at any time without penalty. When the teacher agreed to participate, the researcher contacted the participant by email to schedule the first interview and answer any questions.

Data Collection Procedures

Triangulation is a method researchers use to test validity of research and requires the implementation of multiple methods or data sources in qualitative research (Carter et al., 2014; Patton, 1999). The researcher conducted interviews, reviewed document data, such as field notes and researcher memos, and observed the teachers' settings to gather and triangulate case data (Patton, 2002). Using multiple triangulation methods strengthens a study as the researcher tests for consistency among the data (Patton, 2002).

For this study, the researcher used triangulation to validate credible interview and document data in an attempt to thoroughly understand the lived experiences and strategies used by successful teachers implementing IXL in the algebra classroom (Patton, 2002). The researcher conducted multiple methods of data collection to triangulate data including interviews and the review of document data (Carter et al., 2014; Patton, 2002). The researcher interviewed participants at different schools to produce data triangulation (Carter et al., 2014; Patton, 2002). Interview data may confirm what the documents and data convey, thus triangulating the data. In addition to interviewing participants at different schools, the researcher also triangulated data by attempting to include diverse participants in both gender and race, depending on participant eligibility based on criteria requirements. While on campus for each participant interview, the

researcher observed the school campus, classrooms, and overall environment. The researcher used the observation notes to triangulate the data from interviews and documents.

Interview and document data provided necessary data illuminating the perspectives and experiences of successful algebra teachers at rural South Georgia high schools. The researcher interviewed teachers to better understand "the lived experience" and the "meaning they make of that experience" in the high school algebra classrooms and their lives (Seidman, 2013, p. 9). The researcher conducted qualitative interviews with the teachers in person in their own classrooms (Creswell, 2014). Qualitative documents such as the participants' Georgia Milestones Assessment scores, TKES evaluations, and the Georgia Standards of Excellence indicated quality of instruction (Creswell, 2014).

Audio files and transcriptions of interviews in their entirety were saved on an external hard drive. As well, the researcher saved scanned notes taken during the interviews on an external hard drive. A tangible file was maintained with the printed transcription of the interviews and the notes taken during the interviews, used as a backup resource for the digital copies.

Interviews

The researcher conducted interviews with each participant at least two separate times. The first interview set a baseline of life and teaching experiences while the second interview allowed participants to revisit the details and reflect (Seidman, 2013). If more data were needed, the researcher scheduled a third interview. Interviews with each teacher were at a time convenient for the teacher in their classroom (Seidman, 2013). The participant and researcher sat in a location free of distractions, and each interview lasted approximately 60 minutes (Seidman, 2013). Recording each interview digitally "preserve[d] the words of the participants" (Seidman,

2013, p. 117). The researcher prepared open-ended questions, attached in Appendix D, designed to prompt the participants to talk about each of the research questions (Creswell, 2014).

During the interviews, the researcher used a digital recorder and took detailed notes in a notebook. The notebook was used to write additional questions needed during the interview, researcher observations, clarifications for the transcribing process, and was a backup source of information in case the digital recording got damaged (Patton, 2002). Through the interview questions, the researcher asked teachers to provide details about the "actions and events" during the planning and implementation of IXL in algebra classrooms in the rural South Georgia high schools (Maxwell, 2013, p. 103). After each interview, the researcher reflected and journaled on the process (Patton, 2002).

Documents

Documents used "to corroborate and augment evidence from other sources" included participants' TKES evaluations, Student Growth Models, the school's CCRPI rating, Georgia Standards of Excellence, and the Georgia Milestones scores (Yin, 2018, p. 115). Yin explained the review of documents helps verify information in interviews, corroborates information and details, and inferences can be made. Stake (1995) indicated documents may also "serve as substitutes for records of activity that the researcher could not observe directly" such as each teacher's Georgia Milestones scores (p. 68).

Researcher Memos

Maxwell (2013) described researcher memos as any writing a researcher does other than field notes, transcribing interviews, or coding data. The memos are ways of writing down ideas and thoughts to "facilitate reflection and analytic insight" (Maxwell, 2013, p. 20). Throughout the interviews and document review, the researcher wrote memos to capture initial thoughts or

reactions, questions, ideas, or other notes during the process. The researcher's reflexivity provided an opportunity for researcher biases to be identified as well as any other validity concerns.

Data Analysis Procedures

The researcher analyzed collected data from interviews and documents to draw conclusions about the perspectives and experiences of the successful algebra teachers in the identified rural South Georgia high schools. The researcher discovered trends by "reducing and organizing the data" and looking for patterns (Ary et al., 2019, p. 456). The process began with dividing the qualitative research into three phases: data generation, managing data, and analysis (Hogan et al., 2009). After generating the data, the researcher organized and analyzed the responses. A case record was written to combine and organize the large amount of data into one primary resource (Patton, 2002).

Ary et al. (2019) described three stages of analyzing qualitative data: "familiarizing and organizing, coding and reducing, and interpreting and representing" (p. 456). First, the researcher read the transcripts and listened to the recordings from the interviews several times. While reading the transcripts, notes and memos, called a reflective log, was kept for review. Next, the researcher reviewed the notes and reflective log and made a list of the different themes throughout the analysis process, all before creating a coding plan. Maxwell (2013) explained coding is the basic strategy used to categorize data in qualitative research. Finally, the researcher created a list to include each data source, and organized files for easy access and safekeeping (Ary et al., 2019).

Through a process of coding, the researcher chunked the data (Ary et al., 2019). Coding the data helped "to organize and group similarly coded data into categories or 'families' because

they share some characteristic" (Saldana, 2016, p.10). Through sorting the data, the researcher identified themes and assigned a self-explanatory code to each theme (Ary et al., 2019). The researcher used a word cloud to enhance the coding technique and provide a visual of potential codes and themes. The data was not only labeled, but also linked to each other (Saldana, 2016).

Categories emerged from the codes and, typically, the frequency of each code or category correlates to the value of the coded data (Ary et al., 2019). The researcher organized and refined the categories, identified patterns and relationships among the data, and created major themes. Contiguity-based relations emerged from connections between themes (Maxwell, 2013). The researcher recoded the data "with a more attuned perspective using first cycle methods again, while second cycle methods describe those processes that might be employed during the second (and third and possibly fourth…) review of data" (Saldana, 2016, p. 12). The codes became more refined with each recode.

Finally, the researcher interpreted and represented the data (Ary et al., 2019). In doing so, the researcher communicated the findings and explained what is already known and now supported by data, what was thought to be known "and eliminate[d] misconceptions," and "illuminate[d] new insights and important things" about the study (Ary et al., 2019, p. 466).

Issues of Trustworthiness

Validity is "the correctness or credibility of a description, conclusion, explanation, interpretation, or other sort of account" (Maxwell, 2013, p. 122). Validity is dependent upon the skill, competence, and rigor of the researcher (Patton, 2015). Because the researcher was the instrument, one must work to ensure credibility with rigor and minimal distractions (Patton, 2015). In the next sections, the researcher will describe threats to validity in this study and identify ways to rule out each specific threat (Patton, 2015).

Credibility

Patton (2002) recommended researchers use multiple methods, known as triangulation, so different types of data can "provide cross-data consistency checks" (p. 556). The researcher applied triangulation throughout the research process by using methods triangulation and data triangulation (Patton, 2002). The researcher used these methods to validate the qualitative analysis while also identifying inconsistencies in the findings (Patton, 2002). The researcher conducted interviews and reviewed documents to triangulate the methods of data collection. To triangulate the data, the researcher conducted interviews with six participants from various rural South Georgia high schools. Participants from different backgrounds and in different schools offered a diverse range of perspectives and reduced the risk of systematic biases (Maxwell, 2013). While visiting the different schools for each interview, the researcher observed the school, classrooms, and the overall environment. The researcher recorded observation notes for use during data analysis.

Following Seidman's (2013) advice, the researcher attempted to conduct multiple interviews with each participant over a three-week period, depending upon participant availability. The follow up interview, conducted from one to three weeks after the previous interview, allowed the participant "to account for idiosyncratic days and to check for the internal consistency of what they say" (Seidman, 2013, p. 27). Interviewing six participants afforded the researcher the opportunity to connect and compare their experiences with teaching algebra and using IXL, make sense of their experiences, and work towards validity (Seidman, 2013).

The researcher conducted member checks by requesting feedback from the study participants (Maxwell, 2013; Merriam, 2002). Ary et al. (2019) recommended the researcher not only ask participants to review field notes or recordings, but also interpretations. Maxwell (2013)

believed member checks are the most important method to ensure data were not misinterpreted and there are no biases from the researcher.

Transferability

"Transferability is the degree to which the findings of a qualitative study can be applied or generalized to other contexts or to other individuals or groups" (Ary et al., 2019, p. 445). Thick descriptions allow other researchers to determine if the findings can be transferred to their own research (Ary et al.; Merriam, 2002). Thick descriptions are highly detailed accounts of participants so readers can determine if their situations are similar and if they can transfer the results (Ary et al., 2019; Merriam, 2002). In this study, the researcher collected rich data through interviews to provide thick descriptions (Ary et al., 2019; Maxwell, 2013; Merriam, 2002). The participants taught at different schools; therefore, there was diversity in the participants and interviews, resulting in a greater range of situations maximizing variation (Merriam, 2002). Selecting diverse participants who successfully teach algebra and use IXL in rural South Georgia high schools increased the transferability to others who use technology in their mathematics classrooms in rural areas, and potentially beyond.

Dependability

Dependability of qualitative research is the consistency of the results in a study, and the degree to which the results may be generalized to other settings (Ary et al., 2019). One strategy to ensure dependability of the research is the use of audit reviews (Ary et al., 2019; Merriam, 2002). The explanation of planned methods, how the sample will be selected, how data will be collected and analyzed, and how validity and reliability will be addressed, makes up the audit trail (Merriam, 2002). The researcher kept memos throughout the study to record thoughts, reflections, questions, issues, decisions, and ideas for transparency and as a component of the

audit trail (Merriam, 2002). Patton (2002) also recommended recruiting an expert in the field to audit the research to ensure dependability.

Data triangulation is another strategy to ensure dependability of research (Ary et al. 2019). The researcher triangulated data in this study by interviewing multiple participants, reviewing various documents and artifacts from participants, and keeping detailed researcher memos, including observations of the participants' settings (Patton, 2002). Triangulation of data sources may reduce "systematic biases and distortion during data analysis" (Patton, 2002, p. 563). This strategy increased dependability by including multiple sources of data.

Confirmability

Confirmability in qualitative research refers to the researcher's objectivity and neutrality (Ary et al., 2019). To ensure confirmability, the researcher maintained an audit trail for the duration of this study, triangulated methods, and requested a peer to review the collected data (Ary et al., 2019).

According to Merriam (2002), reflexivity is a strategy used by researchers to critically self-reflect as the instrument in the research. Reflexivity controls biases in the research and confirms the findings (Ary et al., 2019). The researcher referred to reflexivity while designing and implementing the study, conducting analysis, and during application (Ary et al., 2019). After data collection and analysis, the researcher practiced reflexivity by reflecting and working to identify any personal biases (Ary et al., 2019). During the self-reflection, the researcher referred to the researcher memos kept during the study. "Reflexivity makes it less likely (though it does not guarantee) that the researcher will impose his or her own perspectives" (Ary et al., 2019, p. 445). The researcher was also aware of their own subjectivity. The researcher identified her own subjectivity and remained aware of biases during the research (Peshkin, 1991).

Ethical Procedures

In order to protect participants' rights, the Institutional Review Board (IRB) approved all research involving humans prior to conducting research, in Appendix E (Ary et al., 2019). The principles of the IRB were followed to protect the participants. The researcher protected participants from physical or mental harm, informed the participants of the purpose of the study and their right to give or withhold consent, and protected the participants' privacy by assigning pseudonyms.

Participants were required to sign a consent form to be compliant with the IRB or, if exempt, participants will give verbal consent (Seidman, 2013). The informed consent signed by each participant contained the following: explicit explanation and invitation to participate in the study, the possible risks, the participants' rights, the benefits from participating, an explanation of how the participants' identity will remain confidential, an explanation of how the results and data will be used, and contact information for the researcher and the IRB.

Participants were given the opportunity to be interviewed and feel comfortable declining, if they so choose (Seidman, 2013). The researcher informed the participants of the study and invited them to be involved in the research voluntarily. The researcher listened to recorded interviews to ensure participants were doing most of the talking and not the interviewer. The researcher refrained from asking leading questions and sincerely and actively sought "participants' perspective on their experience" (Seidman, 2013, p. 141).

The researcher took great care to keep the data from interviews and observations confidential by using "false names or code numbers to keep track of what information came from whom without revealing identities" (Ary et al., 2019, p. 61). The researcher maintained "rigorous

and systematic data collection procedures" to limit biases while remaining objective (Patton, 2002, p. 545).

Considering confidentiality, the researcher stored the data during the research period on an external hard drive (Patton, 2002). The external hard drive was protected under lock and key in a filing cabinet, along with the researcher memos and field notes written in a notebook. At the conclusion of the study and after the dissertation is submitted and accepted by the university, the data was destroyed to protect the participants.

Summary

The methods planned for this phenomenological qualitative study enabled the researcher to better understand the experiences and perspectives of six successful algebra teachers in rural South Georgia. The researcher employed qualitative data collection methods with a purposeful sampling of participants who met the criteria for this study. The researcher interviewed each participant at least twice using prepared, open-ended questions to better understand their lived experiences. Participants' identities were protected throughout the process to protect integrity of the study. Data was analyzed by coding and chunking. During the study, the researcher remained aware of threats to trustworthiness and researcher biases. Ethical measures were recognized and followed during the study to protect the participants and the research conducted.

Chapter IV

PARTICIPANTS

By interviewing six participants, researchers may better understand "the lived experience of other people and the meaning they make of that experience" (Seidman, 2013, p. 9). The participants' stories and experiences are from their point of view while guided by phenomenological interview questions (Seidman, 2013). Established criteria for purposefully selecting six participants for this study were:

1. Participants must be high school algebra teachers in rural South Georgia.
2. The participants' principals must consider them to be successful.
3. Participants must have acceptable student achievement rankings as measured by their Student Growth Model. For this study, the principal will determine acceptable student achievement.
4. Participants must use IXL in their classrooms. IXL is a web-based personalized learning resource introduced in 2007 by IXL Learning (IXL, 2021).

Through individual interviews with each participant, the researcher learned about their lives, careers, experiences, thoughts, and ideas. The lived experiences of the participants served as the basis for understanding their perceptions and the meaning they make of their experiences while teaching mathematics. The stories each participant shared led to a better understanding of the phenomena being studied. The participants' names have been changed to pseudonyms to protect their identities and keep their participation confidential.

Cora

Cora and I planned to meet after school one afternoon in her classroom. As I pulled into the small parking lot and walked to the front office, I noted parking was limited. Cars were lined

up on the two-lane highway in front of the rural school while parents sat waiting for students to be released. The building was red brick with white trim and looked like it was built decades ago, although it was clean, neat, and well-maintained.

Upon entering the front lobby, I checked in with the secretary. Since I was a few minutes early, I took a seat on a wooden bench to wait for the students to be dismissed. Welcoming pillows donned the bench and informative signs were posted around the lobby. I observed the secretary interacting with different personnel in the office. It felt like a positive environment. A student left school early through the lobby and gave me a friendly smile. My first impressions of the school and personnel were positive.

After waiting a few minutes, Cora came to the lobby to greet me, and we walked to her room. She explained how the school housed all 9th grade students and was separate from the high school. The 9th grade campus had been renovated and each hall was dedicated to a different content area. There were other buildings I could see from the window for band, fine arts, and other elective subjects. The grounds were tidy, and custodians were busy emptying trash cans and sweeping. As Cora talked about her school, she appeared friendly and knowledgeable and had a fun personality. I believed she had a good sense of humor and was possibly a little sarcastic.

In Cora's classroom, there were 31 student desks, a teacher desk in the back of the room, and another teacher desk in the front of the room with a table and set of chairs next to it. I also saw a Chromebook charging cart plugged into the wall in the back corner of the room. I sat in one of the chairs at the table, and Cora sat at her teacher desk so we could face each other and talk. While getting settled, I commented on the interactive board mounted over the dry erase whiteboard. She explained they were installed a week earlier, and it was the very first interactive

board they had ever had in their classrooms. This surprised me, as most districts in the state have had interactive boards in their classrooms for several years. At the time, Cora insisted she preferred the dry erase board and hated to see the interactive board on her wall. The way she fussed over the new technology made us both laugh as we realized what she was saying made her sound set in her ways. Our conversation flowed easily as we settled down to begin the interview.

I asked Cora to tell me about her childhood, and she smiled fondly. Cora was raised in rural South Georgia in a home with her mother, father, and older sister. Her father was a minister and her mother was a teacher. Her mother began teaching business education when schools were still segregated. Once schools were integrated, she transferred to a different district to continue her career of educating students for 20 more years. After retiring from public education, her mother taught at a local college for several years.

Cora and her sister were raised to believe education was a priority and not optional. She elaborated by sharing proudly, "I had a good mama, good daddy. They were the kind that, you know, you gonna be something or else. School was a requirement." Their parents did not allow poor behavior or grades in school, so they worked hard to meet their expectations. Cora labeled herself a nerd and took pride in her learning and good grades. When explaining how her mother set high expectations, Cora said while laughing quietly, "She's the kind of mama that was, 'Oh, you made a 92. Where are the other eight points at?'" Her parents did not make excuses nor accept failure.

I asked Cora about her elementary school experience, and she shared two memories she considered to be traumatic. She remembered feeling sick and throwing up all over her teacher's shoes one day. She also remembered losing her first tooth in kindergarten while she was on the

playground. After reminiscing about the two memories still haunting Cora, her eyes lit up as she talked about a teacher she loved. Her second-grade teacher stood out among her other teachers. She explained, “We made homemade applesauce and I remember she had a book tree.” According to Cora, this teacher took time to build relationships with her students and learned what motivated them. She also pointed out, “Making applesauce, I’m sure, wasn’t at the time of QCC standards, but that just made it stick and she cared.” Cora appreciated this teacher who she felt exceeded expectations in teaching her students. When I asked her about a negative elementary school experience, she paused to think and said, “Overall school was just, it was good. I was one of them that did what I was supposed to. If you had to use the term teacher’s pet [that was me].” Cora clearly loved school and her teachers.

Middle school was also a positive experience for Cora. She remembered her math teacher, in particular, because of the way she made Cora feel. She knew this teacher cared, not only about the content, but about students. Cora reflected on being one of the only Black girls in class and that she felt it did not really matter. She thoughtfully shared, “We lived life, we field-tripped, we went to the State Capitol, we just [lived it up].” Cora added, “I was a big girl and still, you know, everybody loved everybody.” She elaborated by explaining how she was friends with both White and Black students. She felt she fit in well with her classmates and was accepted for being smart, regardless of her skin color.

In high school, Cora thrived academically and enrolled in college courses through dual enrollment. She remembered having a geometry teacher who she believed was ineffective, which later inspired Cora to teach math. She recalled the teacher required Cora and the other students to memorize the unit circle with no explanation. Cora said with disdain, “I just sat there thinking, ‘Honey, there’s got to be a better way.’” Cora did not appreciate how her teacher taught the unit

circle and wanted to learn more about it. As well, this negative experience served as a catalyst for her pursuit of math teacher certification.

As a high school student, she believed she wanted to be pharmacist or physical therapist. After high school, she enrolled in college as a chemistry major and worked toward that goal for 2 years. For several different personal reasons, Cora and her new husband relocated to a different state and some of her course credits did not transfer to her new college. After some soul-searching, she decided to change her major to education because it was the fastest route to a college degree and she moved back to her hometown.

Upon graduation, Cora was offered a teaching position at a middle school. She really wanted to be at the high school, so she felt she "got bamboozled probably a little bit." She laughed as she told me how she quickly accepted the job teaching middle school because she was worried no high school math positions would be available. Cora explained, "The middle school principal at the time used to work at the high school with my mama." He convinced Cora to teach middle school math. Cora believed the principal offered her the middle school teaching position based on her mother's reputation. She taught there for 2 years before transferring to the high school.

Cora learned from veteran teachers who mentored her during the early years of her career. She also recalled her student teaching mentor who "was wonderful." She relied on her mother's expertise and would collaborate with her sister, who taught in another town. Cora was thankful her sister used the same online gradebook because Cora felt comfortable calling her to ask questions. The math teachers at her school were close-knit and supported each other. Cora grew as a teacher and leader over the years. She was the current department chair and former

Teacher of the Year at her school and had no plans to leave. She loved teaching her students and being in the classroom.

Cora shared that the best feeling for her as a teacher was when students mastered a concept. She earnestly explained, “The reward of helping somebody know something [is great]. When they get that lightbulb and it’s like, ‘[Wow]! They’ve got it.’ That part is good.” The way Cora talked about student learning was both thoughtful and insightful and her passion for the profession and her students were palpable.

Conversely, Cora found motivating students and preventing cheating were battles. Students had access to apps and websites that gave answers to math problems. Cora noted with sadness in her voice, “They don’t want to know anything; they’re missing the thirst for knowledge.” She also shared, “A lot of them walk in the door defeated, just based off past experiences.” Cora believed, before the school year starts, many students perceive themselves as incapable of mastering math concepts. Cora said she accepts this as a challenge and believes effective teachers work to win the students over and convince them they can learn. She advised, “Life is all about what you make of it. Your attitude. Do your job.” Thus, she wanted both students and teachers to do their best.

Cora’s love of her students was evident as she discussed how she teaches algebra and her teaching philosophy. She wanted her students to be successful and worked hard to help students achieve their goals. Her classroom management style and her expectations allowed students to achieve success if they worked hard. Cora acknowledged internal and external factors can affect student learning, but she helps them work to overcome the challenges.

Edith

Edith and I had a difficult time meeting in person. We scheduled an in-person meeting at her school, but Edith had to cancel due to a last-minute work conflict at the same time. A new date and time were set, only to be postponed when her son fell ill and needed medical assistance. Once Edith was available for an interview, we decided to video conference online in a Zoom meeting rather than meet in person. The video conference allowed her the freedom to meet in any location in case she had to go home to her son. The second interview was the following week, scheduled the day before Edith and her son were set to travel to a hospital in Atlanta for testing. Although I offered many times to find another participant, Edith graciously insisted she wanted to participate.

During the first interview with Edith, I learned quickly she was a veteran teacher who had years of experience teaching math, an aptitude for leading others, and she romanticized her earlier years. I enjoyed learning about her life experiences. Edith was born and raised in Americus, Georgia until her family moved to Atlanta, Georgia for her father's new job when she was 15 years old. She learned about work ethic from her parents and was proud of their accomplishments. Edith shared her father "started out as a lineman with the telephone company and moved up to supervisor. He audited 49 of the 50 states." Edith's mother was a stay-at-home mom until Edith was in junior high. After moving to Atlanta, Edith said her mother "worked in a bank and was a cashier. She moved up to the head cashier teller." Their work ethic made an impression on Edith, who later demonstrated many of the same principles of work ethic in her own professional life.

Edith described her childhood as "good" and her relationship with her parents as "normal." She said after school she went home and did her homework while her mother was

there to help her with anything she needed. She smiled as she shared how her father took them "camping all the time and played ball and went to football games on Friday nights" as a family. Edith had a sister who was 18 months younger and she said they "fought like cats and dogs growing up." She laughed as she thought about growing up with a younger sister but was thankful they grew close as adults.

Elementary school was a positive experience for Edith. She recalled her mother dropping Edith off for her first day of kindergarten and being weepy. She laughed when she said, "My mom didn't want me leaving, going to school, and so she cried. When I went in, I was like, 'Go away woman, I'm here and I want to do school!'" She remembered her friend crying to go home and the teacher had to run chasing him as he tried to leave with his mother.

Once Edith stopped giggling, she admitted she was always the "teacher's pet." She fondly remembered three elementary teachers. She enjoyed the activities they planned and how those teachers made her feel. She recalled one teacher who always had a sweet smile on her face and how she gave them ice cream in class. Another teacher read *Where the Red Fern Grows* with her class and gave them strawberry candies after lunch, which Edith loved.

Edith's memories of middle school were not as pleasant as her elementary school memories. She recalled one teacher with "eagle eyes" who terrified her. She said, "A friend was trying to get me to help her [on a test], and I about gave in. Mrs. Downer just looked at me." She did not attempt to help her friend because she was so scared. The teacher also taped chewing gum to students' wrist if they were caught with it in their mouths and made them run laps at lunch. However, Edith said, "You didn't mess with her, but she was one of my favorites." Edith concluded, "Middle school was yuck and there were awkward times." Edith felt she did not always fit in with others. Regardless, she was a member of the BETA club and Honor Society.

Edith's favorite high school teacher was one who challenged her most. She taught geometry and gave Edith her first B on a project. While she explained how she "had mono and was one day late turning in" her project because she was at home sick, her voice went up an octave and she seemed irritated by it still. She lost three or four points on the project due to her work, but late points dropped the grade to an 86. Edith was devastated. This experience made her work harder in class and she discovered she enjoyed putting in extra effort to learn. After that year, Edith's family moved to Atlanta, and she enrolled in a much larger school. She became less social and ate lunch alone. She elaborated by sharing, "I just didn't talk to anybody all day for about a year. I just did my work and left, so it was kind of depressing." Although she felt less connected at her new school and found less enjoyment in it, Edith worked to graduate a year early from high school.

After high school graduation, she moved back to Americus to attend college and was reunited with her old friends there. Yet, once Edith began college, she lost touch with her friends because they were still in high school, and she enjoyed college life. Edith began college thinking she would be a pharmacist because her mother encouraged that career path. However, she found out quickly she did not like chemistry. After 2 years of college life and little focus on studying, Edith's parents moved her back home to Atlanta.

Edith enrolled at Kennesaw State University and majored in mathematics with a minor in computer science. She said after a few weeks, she "didn't really care for calculus, especially at 7:00 in the morning." The next semester she had the same realization with computer science. Finally, her parents had a stern discussion with her about declaring a major she could follow through with and finishing college. She told them, "I want to do education! And they were like, 'Fine! Just get a degree and get out of school!'" She admitted to me, however, she really wanted

to quit college, join the Air Force, and pilot fighter jets. She shared her "mom definitely wouldn't go for that" so she did not pursue it. Edith laughed as she explained how her mother also did not want her to be a teacher, but it was safer than flying pilot jets for the Air Force.

After graduating college, Edith became a teacher. She laughed as she fondly remembered walking down the hall at school and other teachers would ask to see her hall pass. Edith said she was young and looked like a student and she liked that. She enjoyed having fun with her students in her early career years by doing hands-on activities and taking them outside to learn. However, she said she believed she cannot have fun with students anymore. Edith elaborated by saying, "I feel like I'm constantly barking at them to do this, do that because we have tests and you gotta have the score, and you have too many failing. You just don't have time to do the fun stuff." It was evident Edith felt the mounting pressures from administration put a damper on fun in the classroom.

Edith did not have any official mentors as a new teacher. She was thankful for friends who taught with her and encouraged her to join Georgia Council of Teachers of Mathematics (GCTM). She said, "I was going to Rock Eagle every year and got to make contacts with people that way." When she moved to another school she said, "I was placed with the scary teacher as my teammate." She laughed as she described her as a "lady older than I am and she had red, fire engine red, hair. She just demanded respect and you do what she said do!" When she stopped laughing, she told me they became best friends and were always together, even after school hours. Edith appreciated how this teacher listened to her ideas, tried them in the classroom, and then brainstormed how to make it better next time.

Edith's list of teaching committees and leadership roles during her career was extensive. She sponsored numerous clubs, was math department chair, served as the district math coach,

coached cheerleading, and worked for GCTM. Edith also was on the conference board for GCTM, was the Director of Publicity and Promotions, served as the region representative, was secretary of the executive board, and was the current president at the time of the interview. She also worked with GaDOE and served on the Georgia Advisory Council for Mathematics. Edith's experiences shaped her into the teacher and leader she became, but she admitted she was ready to retire. She shared, "I have enough time saved up that I can retire in December. My 30 years are actually up the end of May, but I can retire in December." When I asked her if retiring in December was her plan, she confirmed it was. She explained, "If I'm not passionate about it, they're not going to be passionate about it. As you can tell right now, I'm not passionate about it." She believed her lack of passion for teaching affected her students and their learning and knew retiring was the appropriate thing to do.

The experience I had with Edith scheduling an interview is testament to the type of teacher she was at school. She spent her career working hard for students, both in teaching and in leadership roles for the district and state. When she met challenges, she did not shy away. Edith pushed through, learned during the experience, and worked harder to be an effective teacher.

Tom

I had an appointment to meet with Tom in his classroom after school. I left a little early because I had never been to his school and was unsure of the location. As I got closer to the school, I realized it was located in a low-income neighborhood and next to a cemetery. While the surroundings were not pristine, the aging school building appeared to be well-maintained and clean.

Upon entering the school's lobby, I was greeted by a secretary behind a temporary plexiglass shield sitting on the counter. She called for Tom on the intercom, who appeared in the

office shortly after. We walked through an outdoor courtyard to his building. There were gates between buildings with padlocks. I felt safe, but it was a reminder the school was in an undesirable location in town.

Tom's classroom appeared neat and organized. His students' desks were arranged facing the interactive panel mounted at the front of the room. Tom's desk was in the back corner of his classroom in front of a tall window. He had pictures of his family displayed and a firefighter's helmet on top of a bookshelf behind his desk. I felt at ease as I settled into a student desk he had turned to face his desk, where he sat.

Tom was raised by both parents, along with a younger sister and brother. His parents owned a skating rink in town, so his family spent much time there working. Tom's parents also worked for the school system while running the skating rink. His father drove a bus in the mornings and afternoons and his mother was a paraprofessional in a kindergarten class. Tom smiled when he said, "We were super close. I was the oldest [child] so, I feel like I'm the favorite." He laughed and then admitted, "But my siblings beg to differ!" Tom said in a more serious tone referring to his parents, "I look up to both of them, for sure." His family had a close relationship which had a deep impact on Tom's life.

He loved elementary school, particularly kindergarten. Tom thought for a second before he shared his mom was a paraprofessional at the elementary school, so the teachers treated him well when he was there. He said he "was like the baby person at the school" implying the teachers babied him since they knew his mother. We both laughed after Tom shared his favorite things to do were to color pictures and take naps.

Tom's favorite elementary school teacher was a family friend. He smiled as he said, "She just kind of took me in like I was one of her own. At the time, I was getting braces, so, she would

heat up my soup because I couldn't eat hard foods." Tom said she was the best teacher he ever had because she built a relationship with him. When asked about a negative elementary school experience, Tom did not hesitate. He quickly remembered the time he got caught cheating in 5th grade. The teacher sent him to the office, his mother was called, and he got yelled at by the STAR Sergeant. The STAR Sergeant, he explained, "was a judge here in town and we had one on campus. He pulled me out of the cafeteria in front of everybody in the cafeteria. He took me outside and yelled at me and got face-to-face with me." Tom said he never cheated again. When asked if the consequences deterred him from cheating, he said, "100%." That experience was burned in Tom's memory and deterred him from cheating throughout his education.

Classes in Tom's middle school *looped*, which meant the students and teachers stayed together for 6th, 7th, and 8th grades. Tom had a good relationship with the teacher who taught both English and social studies, and he professed she was his favorite. He recalled, she "took me under her wing and made sure I behaved and kept me on the straight and narrow through middle school." Tom also remembered one hands-on activity he did in another class. The teacher used sparkling grape juice and raisins to create a sewer model and the students had to work with it to solve a problem.

Tom was terrified to start high school. He remembered being a 9th grader walking around the building with seniors and being scared. Tom smiled as he remembered having older friends on his baseball team who told him, "If anybody messes with you, you come tell me." He admitted no one bothered him and high school was not as scary as he anticipated.

Once he got settled into the routines of high school, Tom had a positive experience. It was in high school Tom realized he had an aptitude for math. He shared, "Didn't know I was going to be a math teacher. But I truly enjoyed math throughout [high school]." His favorite high

school teacher pushed him to work hard, but it was a college professor who convinced him to teach math.

Tom was involved in numerous extra-curricular activities and sports, including baseball, Junior Key Club, and the Fishing Club. When Tom was 16, he became a volunteer firefighter and remained a volunteer. Tom also met his future wife in high school. She lived in North Georgia but came to his hometown to visit her aunt. They met at his family's skating rink, fell in love, married, and had children.

Throughout high school, and during his first year of college, Tom wanted to be a firefighter. As a college freshman, Tom realized he could remain a volunteer and still pursue another career. He was undecided on a career path and was taking core classes, Math 1101 and College Algebra. He said he did not apply himself in his college math courses, but still made decent grades. His college professor saw his potential but was frustrated with the little effort he put forth. Tom recalled with a smirk, "The teacher approached me, kept me after class, and I was going, 'What did I did now?' but she said, 'What do you want to do?' and I said, 'I want to teach,'" Tom told her he wanted to be a PE teacher and she encouraged him to consider teaching math. After the professor talked with Tom, he said, "From that point forward I pursued it." He decided he wanted to be a math teacher. Tom transferred to a different college to major in math education, inspired by a professor at his new college. He shared, "She had a positive influence on my teaching career" because she was "super bright" and a great teacher. He said he still thinks of her and her effective teaching style and tries to emulate that in his own math classes.

After college graduation, Tom was hired to be a long-term substitute in his current school district. A teacher left halfway through the year, so Tom said he found himself teaching "for half a year, gifted and honors, as a long-term sub." Tom smiled when he told me he loved his

students and built good relationships with them that year. He explained how one of those students joined the Navy and played football for them. Another went to South Carolina, played football, was a Graduate Assistant coach, and is now back in his district coaching high school football.

Tom loved his time as a long-term substitute. He was thankful for the opportunity, too, because he was able to build a reputation as a skilled teacher. Tom explained by saying, "As that half of a year ended, the principal came to me and said, 'We have a 9th grade math position that's unfilled'" and he gladly accepted the offer. Eleven years later, at the time of the interview, he was still teaching in that 9th grade classroom and was the current math department chair. Tom credited his success to his field experience mentor when he was student teaching. He laughed when he said, "He kind of threw me in and let me teach the majority of the time!" Tom remembered, "Loving every single second of it. He was supportive. Anything that I needed he was there." Tom appreciated the support his mentor teacher gave him and credited it with helping him grow professionally.

As department chair, Tom experienced leadership roles which piqued his interest. He said thoughtfully, "I wasn't 100% sure if I wanted to get into leadership. I thought I'd just want to be a classroom teacher for the next 20 years." He loved teaching math but explained, "With me getting into being a department head, having more interactions with administration and all, I feel like that's kind of steering me into the leadership role." This new interest in leadership had Tom considering graduate school for an educational leadership degree. In addition to serving in a leadership capacity as math department chair, Tom also coached varsity softball. He loved the relationship he and his family had with the softball players. He had a sparkle in his eye when he described how his daughters "run the bases, ride the three-wheeler with me while I drug the field,

and the [softball players] would take pictures with them." The relationships he and his family have built with the students were incredibly meaningful and valuable to Tom.

Tom's experiences throughout his life and career centered around the relationships he built with those around him. His teachers saw potential in him and encouraged him to pursue his goals. Tom's mentor teacher trusted him to teach, supported him, and helped him become an effective teacher. The school administration appointed Tom department chair and appeared to be preparing him for even more leadership roles. The way Tom talked about his students indicated his affection for them. He prided himself with working to build relationships and trust with them. Tom undoubtedly took his job seriously and worked to reach all students and to be an effective math teacher.

Sybil

Sybil and I planned a time after school to meet in her classroom. She taught down the hall from Tom, who is also her older brother, so I was familiar with the school's location. As she escorted me into her room from the front office, I saw her student desks were facing forward, but grouped in pairs. Her room was decorated with positive quotes on posters and colorful decorations. Her desk was in the corner of the room in front of a window. She wheeled a chair from across the room so I could sit near her desk. Sybil smiled throughout the interview, had a sweet disposition, and was a pleasure to interview.

The interview began as she told me about her family. She grew up living with both of her parents, her older brother, and a twin brother. Sybil beamed when she said her family was very close and they "all ate dinner together at the dining room table every night." Her parents were supportive of her, and Sybil said they were "always top notch." She shared her parents owned the local skating rink in town and it was large part of her childhood. Her family spent every weekend

there working together. In addition to owning and running the skating rink, Sybil's mother was a paraprofessional at an elementary school before going back to college to be a teacher. She was still a kindergarten teacher in the same district at the time of the interview. Her father drove a school bus for insurance purposes while owning and running the skating rink. Sybil described her hometown by using three F's: Family, Football, and Farming. She added while laughing, "Everybody knows everybody. That might not always be the best thing." Then, she paused and said sweetly, "Everybody's tight knit. Like, if one person needs prayer, we all pray for that one person." Sybil's sincere love of her hometown was evident in her description of both her childhood and the current day.

Sybil's memories of elementary school revolved around taking naps in pre-kindergarten and learning her multiplication facts in 3rd grade. She thought for a moment and remembered a teacher who stood out. Sybil said, "I think what I liked most about her is, she seemed just like my mama." She smiled and added, "She took care of us, and I knew that she loved us." Sybil explained the teacher stood out in her memory because of the way she made her feel. Conversely, Sybil had another memory of a teacher pulling her up off the floor during naptime and the action broke her arm. She said it was traumatic for her and she still does not like to be around that teacher to this day.

In middle school, Sybil and her twin brother had separate classes for the first time. She was forced to make new friends, and it was initially hard for her. She explained, "We've always been in the same classes until middle school. We went to different teams and that was a big, emotional thing for me. I didn't want that to happen, I wanted to stay together." She smiled and admitted when she thinks back, she knows it was for the best. She was forced to become more independent.

Sybil appeared happy as she described her favorite middle school teacher stating she was "just fabulous!" She was Sybil's English teacher, but she spent time teaching the class etiquette rules. She hosted a dinner and taught them to sit at the table. Sybil thoughtfully added, "I don't know how she related that to standards, but she was fabulous!" Sybil described a painful experience she had with her 6th grade math teacher. She asked the teacher what Pi was and said, she "felt like I was ridiculed for not knowing what that was." Sybil said she still remembers how she felt and hoped to never make a student feel ridiculed for asking a question in class.

Sybil said she was a cheerleader in high school and was also in Family, Career and Community Leaders of America (FCCLA), was manager of the soccer team, sung in choir, and helped with the Special Olympics. She said her goal was "to be top 10 in my class. I really wanted to be Valedictorian or Salutatorian, but I got number three [in my class]." She said she knew being third in the class was wonderful, but she was still disappointed in herself. She beamed and said enthusiastically, "I got to give a speech at graduation, the whole tassel turning speech. That's like a huge highlight!" Sybil's math teachers were her favorites in high school. She said, they "connected with us a lot and made the learning fun." She added, "It was ok if you didn't know something because the teachers would come help you." They were supportive and encouraging unlike a history teacher she had. She recalled, the teacher "wasn't super warm and bubbly and I need a warm and bubbly, nurturing environment." Sybil, who was warm and bubbly, did not thrive in classrooms with teachers who did not connect with students.

Sybil said she always wanted to be a teacher growing up until she got to high school. That's when she decided to pursue a career as a genetic engineer, then changed her mind again and wanted to be a pediatrician. She wanted to be a pediatrician because she loved kids, then

realized her “heart has always been teaching and math” so she majored in education. She remained at home and commuted to college to earn her bachelor’s and master’s degrees.

In 2017, after graduating with her bachelor’s degree, Sybil got a job teaching 9th grade mathematics in the same school where she student taught. She described her first-year teaching as a learning experience. Sybil remembered asking questions when she needed help and eagerly listening. She laughed and said, “Please! Give me all the tips! Help me!” Sybil thought she probably was assigned a mentor but got the most help from a former teacher turned co-worker. She guided Sybil and offered a helping hand, when needed.

Sybil started a new committee at her school, the Sunshine Committee. She said spiritedly, “It’s actually just getting started, so, I’m super excited to bring sunshine to everybody!” Sybil had already put “little inspirational notes in places, like the bathroom.” She wanted the faculty to feel loved and appreciated. She also helped decorate parade floats and coached middle school cheerleading. The previous year ended her term as math department head, and she said learned much about teaching in that position of leadership.

Sybil’s positive demeaner shined through as we talked about her life and career experiences. Her passion for teaching and her love for her students were obvious. Sybil’s family played a huge part in her life and their support carried her through school. Her desire to make the world better was apparent and she hoped to have a positive effect on her students and colleagues, serving as a role model in her school community.

Daisy

Daisy and I agreed to meet in her classroom one afternoon. As I pulled into the parking lot, I noticed the administrative building had several pods connected to it. The school layout looked interesting from the outside and I was eager to see what the inside looked like. Several

people were standing in the front office and greeted me as I walked in. I introduced myself and stated my purpose, and Daisy was there waiting on me. She was very welcoming, and she showed me the way to her classroom.

Upon leaving the front office, we had to walk through the cafeteria to reach her pod. She explained each content area was housed in a pod connected to the cafeteria. She laughed and admitted it takes students, guests, and new teachers time to remember their way around the school. As we entered her classroom, my first impression was that it was small and cluttered. Desks crowded the area and supplies were scattered around the room. An interactive panel was at the front of the room, still on and displaying notes for the day. I noticed motivational posters on the wall and a few pictures of Daisy's family on a bookshelf. Daisy suggested I sit in the student desk directly in front of her teacher desk, where she sat. I moved a calculator and pencils to another desk and then we got started with no small talk.

Daisy shared she grew up in a home with her mother, father, brother, and sister. Her mother was a preschool teacher and Daisy's father was an accountant in town. Their relationship was positive, and her parents were involved in her life while she was growing up. Daisy, the baby of the family, also had close relationships with her older siblings.

Daisy had fond memories of attending preschool at Busy Bear and playing on the "really awesome playground" each day. After preschool, she attended elementary school through 5th grade. She remembered loving field day and her 4th grade teacher. Daisy could not recall any specific events which made this teacher her favorite. After thinking for several seconds, Daisy said, "I think probably just how she made me feel in class." Daisy remembered she loved this elementary teacher because she did not yell, and she created a pleasant environment. Daisy

recalled, “She valued all of her students.” Daisy shared her appreciation of her teacher for the classroom culture she established as well as how she made her students feel in class.

After being promoted to the middle school, Daisy quickly discovered how to study. Daisy shared, “I guess [the classes] became more rigorous.” She liked the challenging classes and did not mind doing homework and studying after school. Her favorite middle school teacher was her history teacher. He also coached basketball and he worked to know his students outside of the classroom. Daisy remembered, “I felt he liked me as a person outside of the classroom.” She said she played tennis and he took the time to get to know the tennis team and build relationships with them. Daisy laughed as she countered with, “I remember some bad teachers, but nothing too negative.” She felt elementary school was more enjoyable, but middle school was an overall positive experience.

Daisy’s class was the first cohort to begin an honors program created in her school system. Her class began the new program when she was in 9th grade and some of the classes were in a different building. Students in the program left their high school’s main campus and walked to a building across the street for the classes. Daisy adored her AP Psychology teacher in the new program. She explained, “She was my favorite because her class was very fun, she spent no time yelling or anything. I really enjoyed the content! She treated everyone well. She never made anybody feel bad.” Daisy explained how the teacher was involved in several extracurricular activities at the school, which was an opportunity for her to build relationships with her students. Her math teacher also stood out in her memory. Daisy’s math teacher told her she was a strong math student and encouraged her to pursue math as a career. In addition to academics, Daisy played tennis, was involved in Fellowship of Christian Athletes, gained membership in the Honor Society, and was active in her church. She also volunteered with

Habitat for Humanity, Special Olympics, and Salvation Army. Daisy described herself as a good student with an attitude, responsible, and a little quirky.

Despite wanting to be a veterinarian growing up, Daisy majored in Psychology in college. She was inspired by her favorite high school teacher to be a counselor. However, Daisy did not enjoy her first year at the University of Georgia, so she moved back to South Georgia and transferred to Valdosta State University. In the transition, Daisy changed her major several times. She remembered telling herself, "You have got to do this! Like, you have to figure out what you're going to do." She recalled sitting in a math class and having an epiphany. She thought, "I love math. I remember thinking how easy math was for me and then I had this moment where I was like, 'It's not that easy for most people.'" Daisy realized she should use her love of math to help others enjoy and understand math. She decided to change her major for the last time and become a teacher.

Daisy's first teaching position was at a large high school when she was 24 years old. She remembered being intimidated by the size of the school and how close in age her students were to her. She was thankful the school had a curriculum for her to use and she worked hard to be an effective and engaging teacher. She said, "I remember trying so hard to be so prepared and have everything ready. I wanted to just do everything by the book." She applied what she learned in college to help her survive the first year. Her mentor teacher during student teaching made an impact on Daisy's career. She also had a mentor teacher at her new high school and her math department supporting her during her first year. She remembered, "I really liked who I worked with. That probably made a huge difference." She was awarded New Teacher of the Year for her system during her first year, which she was proud of. Daisy's support system helped mold her into the teacher she was at the time of the interview.

After 2 years, Daisy transferred to her current school to teach math. She was on the school's leadership team and helped with National Honor Society. Daisy loved being a teacher. She said, "It is one of the most rewarding jobs that there is. I love teaching high school because you get to see kids go from kids as ninth graders to adults as twelfth graders and completely transform and become new people." Daisy thought building relationships with students was also a perk of the job. She smiled when she said she sees "them in the workforce outside everywhere I go. Fast food; one of my students is working there and every grocery store I go to; one of my students is working there." She believed students loved seeing her outside of school. She said, "They are metaphorically begging for someone to be there for them and show them what it means to love them."

Daisy knew students came from different backgrounds and needed stability and support in their lives. She explained:

> So many of these kids come to school dealing with things that I've never had to deal with. You would hope nobody ever has to deal with. It's scary how many of them really do. It's a large percentage, and they just need consistency and predictability and stability. Those are the things that they haven't had.

She felt her purpose in life was to be a teacher and provide support for students. Daisy said, "To provide that for them is a relief to me and to them." She believed her students needed her and she wanted to be there for them, both to teach them math and to help them in life.

Daisy admitted teaching was often stressful. She explained since the COVID-19 pandemic, teachers at her school get two planning periods each week. That was not enough time for Daisy to plan lessons, grade papers, and get everything else accomplished. She said, "I want to do my job well, but I don't have a lot of time." Daisy had a husband and two children, so she

did not have ample time after school to work. Student discipline was also a stress trigger, although Daisy said she had good classroom management. She said sometimes discipline was an issue in her classroom, but when she reminded herself she was dealing with high schoolers, she was able to handle it effectively.

Daisy's high school experience influenced her life. She learned how to be an exemplary teacher by having exemplary teachers, role models, and mentors. The relationships she built with her teachers were special and she wanted to pass that on to her students. She worked to teach students math but also to support them in life. She felt her purpose was to make students feel loved and safe, which can make a significant difference to high school students.

Anna

Anna requested to meet in her classroom during first period, which was her planning period. I once worked in her school, so I was familiar with the building and layout of the classrooms. As I walked to her class, several tardy students rushed by me to get to class. The halls were clean, well-maintained, and mostly empty as teachers began their classes. Anna's classroom was vacant when I arrived, so I waited for her in a student desk near her teacher desk. The room had brightly painted cabinets and welcoming décor on the wall. I noticed a vase of flowers on a student desk and later learned it was a memorial for a student who died earlier in the year. The vase remained on that student's desk to honor her memory.

Once Anna arrived, with coffee in hand, she settled at her teacher desk and was ready to begin. She shared she was the oldest of five siblings and spent most of her teenage years helping to care for them. Her father was the youth minister at a church and her mother stayed at home until Anna was older. Her mother enrolled in college when Anna was 14 and graduated with a degree in Deaf Education and Interpreting. While her mother was in school and when she began

working, Anna cared for her siblings. There were 13 years between Anna and her youngest sibling, so she stayed busy helping with homework, cooking meals, and cleaning up around the house. Anna also had an after-school job, so she learned responsibility at a young age.

Anna expressed she did not have a happy home life. Anna was close with her mother, but her relationship with her father was difficult. She shared, "Even still to this day we don't talk a whole lot. We all live in the same town, but we have a lot of different viewpoints about just life in general." Anna's relationship with her father remained estranged and her mother lost her trust after an incident when Anna was older. However, Anna's relationships with her siblings have grown stronger. She smiled as she said, "My middle brother [and I] are like best friends. We talk, I'd say, every other day." Only one sibling, her sister, lives in town, and they stay in touch with each other regularly.

Anna seemed to enjoy sharing her elementary school experiences. She laughed when she said, "I loved school, like I loved math of all things! But most kids loved math when they were little." She moved to Ohio during elementary school and was upset when her school closed for a snow day. She shared, "I got mad when we would have snow days because I loved school!" Anna laughed loudly as she remembered chasing a boy at recess and making him kiss her in kindergarten. She giggled as she told how she asked her friends several different times to hold him against a wall so she could kiss him.

After Anna stopped laughing, she described her favorite teacher in elementary school. She said, "She was super sweet. She genuinely felt like every kid in that room was her kid. It was unique because she never had kids." This teacher also planned memorable lessons. Anna recalled a Native American from a nearby reservation coming to visit the class. Later in her elementary years, Anna transferred to a private school with a strict dress code. She remembered getting in

trouble once for showing her knee while playing basketball. Anna perceived the dress code violations as the most negative memories she had of elementary school.

In middle school, Anna transferred to a public school. She said those years were very hard on her and she had suicidal thoughts. Anna shared, "I thought about it a lot. I never tried and I never really talked to anybody about it until my 8th grade year." She made a friend who was also struggling, and they supported each other. Anna never told her parents or an adult. She worked through her emotions and eventually stopped having the thoughts. Anna remembered having effective and ineffective teachers in middle school. Some she believed loved their students and others simply put notes on the board and did not teach.

In high school, Anna said she, "started becoming my own. I mean, I had a lot of friends, I did really good freshman, sophomore, junior year." Anna let her grades slip when she was a senior, even receiving an F in one class. She remembered the teacher calling her house on a Saturday about her grades. At the time, Anna was annoyed by it, but she said she now realized how incredible it was. The gesture indicated to Anna that she really cared about her students. Anna's chorus teacher was special, too. Anna had her from 8th through 12th grade. She recalled, "She saw potential in me. Like, if she was absent, her lesson plans would have for our class that I was going to teach the class that day." Anna smiled as she told of other ways the chorus teacher encouraged and supported her.

Anna explained she spent much time working to avoid being at home. She made sure to say she was not physically abused or mistreated, but she said she did not grow up in a loving atmosphere. When she needed clothes, she had to buy them. When her family went out to eat, her parents would pay for her siblings, but Anna had to pay for her own meal. She said, "It was very normal where I had to fend for myself. I learned responsibility, but I just worked all the

time." Anna was also involved in clubs and was class president of her freshman and sophomore years. She said she was somewhat timid in high school, "and probably a dork." She laughed and said she has come a long way since then and has grown a backbone.

After high school, Anna received a scholarship to attend a local university. She really wanted to attend a college in Oregon but could not afford the tuition or the move. At first, Anna did well in college but after the first semester she struggled. She looked embarrassed when she said, "You know, college, you don't have to go to class every day. So, sometimes if you miss two days a week, that was your week! I ended up just failing because I didn't get everything done." Her poor grades resulted in losing her scholarship and dropping out of college.

Anna continued to work and met her future husband. Once they were married, her new mother-in-law arranged for Anna to meet with a representative from the financial aid office at the local university. Anna did not realize she could apply for and receive financial aid beyond the scholarship she lost. Her mother-in-law encouraged Anna to go back to college and finish her degree. Anna worked and attended classes for 2 years before graduating with a middle school education degree. She said, "I liked the math in middle school, and I remembered that middle school was really hard for me. I thought maybe if [students] would just have a nice, loving [teacher] it wouldn't have been so bad." Anna was excited to be that teacher and was hired, but not for middle school. Her first job was at the high school where she taught for 1 year, then she transferred to the middle school. She taught middle school math for 7 years before requesting a transfer back to teaching high school math.

Anna survived her first years teaching with support of a few mentor teachers. She appreciated help from behavior specialists in her district, a mentor from RESA, and her mother-in-law, who taught math. Anna also depended on teachers around her for support and advice as

she began her career. She shared, “I’m a big collaborator. I had a team person in the 7th grade team and he and I would collaborate a lot and bounce ideas off of each other. We both mentored each other.” Anna was not afraid to seek advice when she needed it and enjoyed working with others.

Anna’s support system in her adulthood influenced her decision to become a teacher. With encouragement from her new husband and mother-in-law, Anna had the support she needed to finish college and pursue her dream. Struggles from Anna’s childhood molded her into the person she is today, and she said she uses those experiences to relate to her students. She shared, “Anytime that you feel like a kid, who maybe didn’t try, all of a sudden decides, ‘I’ll try, even if I fail’ and you kind of latch onto that. You’re like, ‘That’s it!’ and I’m like, ‘Look at you go!’” Anna remembered what it was like not having many supportive adults in her life growing up and sought to be that for her students. Anna avowed she wants her students to learn math and know she cares for them.

Chapter Summary

Six participants shared their life and career experiences during two phenomenological interviews. Each participant taught algebra in a rural South Georgia high school and used IXL with their students. According to van Manen (2016), “the phenomenological interview is used as a means for exploring and gathering experiential material” (p. 314). The six participants openly shared experiences about their adolescence, experiences in school, and their career journeys. Through their stories, the phenomena of how students learn and the role an online resource, IXL, played in the process was revealed. The profiles of each participant provided details of their lives and established their points of view. In Chapter V, the researcher provides themes and descriptions of the findings uncovered through data analysis of the participants’ interviews.

Chapter V

RESULTS

High school mathematics achievement is crucial to the success of students as they advance through their education and prepare for careers (Yu & Singh, 2018), but most Georgia high school students are not high achievers on state mandated mathematics assessments (GaDOE, 2019). The purpose of this qualitative study was to explore the life and career experiences of successful algebra teachers, their perceptions of effective use of IXL in the mathematics classroom, and the key factors for students mastering mathematics content. Purposeful sampling was utilized to identify six successful algebra teachers in rural South Georgia high schools. Findings from this research related to the following research questions:

Research Question 1: What are the life and career experiences of successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 2: What are the best implementation strategies as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 3: What are the external and internal key factors for students mastering mathematics content as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Six participants were selected from four high schools in Southwest Georgia RESA's region. Employing non-random, purposeful sampling while selecting participants led to obtaining information that was particularly relevant to the research questions and goals (Maxwell, 2013). Purposefully selecting participants based on teaching experience and success with improving student achievement was necessary for the researcher to collect information-rich

data (Patton, 2002). The six algebra teachers participated voluntarily and were provided an Informed Consent upon acceptance of the invitation (See Appendix C). Participants were given pseudonyms to protect their identities so they may remain anonymous. Table 2 includes each participant's demographic profile.

Table 2

Participant Demographic Profiles

Pseudonym	Age Range	Gender	Years of Teaching Experience
Anna	30-35	Female	12
Cora	40-45	Female	18
Daisy	25-30	Female	5
Edith	50-55	Female	29
Sybil	25-30	Female	5
Tom	30-35	Male	11

Through a series of two interviews, the researcher collected data from each participant. The researcher developed an interview protocol for each interview and "search[ed] for meaning and understanding" from the participants regarding the implementation of IXL in algebra classrooms and student achievement in mathematics (Merriam, 2002, p. 178-179). Each interview took place in the participant's classroom, lasted between 45 and 60 minutes, and was audio recorded to capture an accurate account of the participant's thoughts (Seidman, 2013). While on campus for each interview, the researcher observed the school building and classroom. A transcriptionist converted each recording to text, then the transcripts were shared with the appropriate participant to ensure accuracy and allow for member checking (Seidman).

Discussion of Themes

As noted by Creswell (2014), phenomenological researchers analyze significant statements from participants to generate meaning. During the interview process, the researcher memoed and began reviewing transcripts to prepare for analysis (Creswell). Once all interviews were conducted and transcribed, the researcher immersed herself in the data and began reading the data "to reflect on its overall meaning" (Creswell, p. 197). The researcher organized the data by chunking participant statements on a spreadsheet and employed descriptive coding (Saldana, 2016). After initial review and analysis, the researcher assigned general categories and additional codes to the data. This step was part of the process of "going from a holistic perspective to individual parts and back to a holistic look at the data" (Roberts, 2010, p. 160). Table 3 includes the list of original codes used to analyze participant data and preliminary categories assigned.

Table 3

Initial Coding

Code	Code Description	Category
SF	Supportive family	Experiences & Perspectives
M	Mentors	
RT	Relationships with teachers as a student	
RS	Relationships with students as a teacher	
C	Collaboration	Teaching Strategies
BI	Best IXL strategies	
P	Pros of IXL	
RS	Relationships with students as a teacher	
MOT	Student motivation	Internal Factors
V	Student values or value system	
MK	Mathematical knowledge	

T	Technology use	External Factors
PE	Peers	
TE	Teachers	
L	Life choices	
F	Family	

After reviewing the transcripts, memos, and codes a third time, the researcher identified four consistent themes throughout the data: (1) relationships, (2) motivation, (3) IXL strategies, and (4) integration of technology. The researcher reviewed and subcoded the data for a better understanding and analysis and to confirm the findings (Saldana, 2016). Additionally, the researcher organized the data on a new spreadsheet according to research question which allowed her to make meaning of the data (Creswell, 2014). Table 4 displays an example of the coding organization, including quotes from participants.

Table 4

Themes, Subcategories, and Supporting Commentary

Theme	Subcategories	Supporting Commentary
Relationships	*Relationships with Teachers*	"My favorite elementary teacher…Ms. Barber. I think she was my favorite…she made me feel in class."
	Relationships with Students	"Making an impact on one of their lives [is the best], even if it isn't math related."
	Relationships with Mentors	"He made an impact on me when I student taught. I use a lot of my teaching from those days."
	Relationships with Colleagues	"We collaborate, talk about pacing, upcoming tests, quizzes, and we look at each of them."
	"She was amazing…she treated everyone well, she never made anyone feel bad…she just made everyone feel good!"	

Motivation	*Motivating Students*	"I feel…these kids just don't care…they know they're going to be pushed through the system."
	Life Choices	"I think a lot of [our problem] is decisions students make outside of school."
	Teachers	"If [students] trust you, you got them, and then they'll work for you."
	"Every year…[students say] 'I'm not going to be good at math.'…being able to change that mindset is just wonderful."	
IXL Strategies	*Best IXL Strategies*	"Watch students as they work so you can see why they're missing [problems] and help them immediately."
	Pros of IXL	"[IXL] tells them immediately if they got [the problem] right or wrong and specifically tells them exactly how to get it right."
	IXL to Motivate	"I tell them they have to get a SmartScore of 80. For most students that pushes them to actually make 80 points, which is a 100 in the gradebook."
	"Students need guidance…walk around and help them though [IXL problems]."	
Integration of Technology	*Negative Attributes*	"There's always a cell phone going off. Notifications that buzz. And, of course, smart watches!"
	Positive Attributes	"I love [IXL]…since so many of my students have such a wide array of levels."
	"[Students] can get a Chromebook…work on IXL…lessons tailored to each student."	

Relationships

Students' relationships may affect their learning (Burke & Sass, 2008; Poldin et al., 2016; Sheffler & Cheung, 2020; Yu & Singh, 2018; Zee et al., 2021). Participants in this study indicated three different types of relationships made an impact on them and on their students.

The varying relationships discussed in this section are relationships with students, relationships with mentors, and relationships with colleagues.

Relationships with Students

Students were more motivated to learn when they perceived their teacher was supportive (Yu & Singh, 2018). Zee et al. (2021) posited elementary aged students' relationships with their teachers were one of the most significant elements affecting student learning. Participants in this study each cited relationships between students and teachers were crucial to student learning. Participants' relationships with their own teachers, while students, molded them and inspired their love of students. Each participant recalled at least one teacher who made them feel special.

When thinking of a former teacher, Sybil shared, "I think what I liked most about her is she seemed just like my mama." Sybil further explained, "She took care of us and I knew that she loved us!" The relationship between Sybil and her teacher made a positive impact on her life and was impressed in her memories. Sybil also had a strong bond with her parents and siblings. She shared her family ate dinner together each night at the table when she was an adolescent and now that she and her siblings are grown, they continue to talk often. Sybil said she and her husband live three minutes from her parents and their relationship was important to her. She said, "Everybody's just a text or phone call away. We all live here in town…[we're] super supportive." Relationships with her parents, siblings, and teachers were vital to Sybil. Sybil built relationships with her own students and reaped the benefits when she made "an impact on one of their lives, even if it's not even math related." Sybil's positivity and love of students were evident as she described building and cultivating relationships.

Participants' experiences of school, indeed, indicated positive relationships with teachers were a factor in student learning. Edith shared a memory of her kindergarten teacher, "I learned

so much and she always had a sweet smile on her face." Edith said she loved school, enjoyed learning, made good grades, and described herself as the "teacher's pet." She noted one of her favorite memories of school was how a teacher made her feel and it "really had nothing to do with school." While learning was important to Edith, her relationships with her teachers were what resonated most.

Building relationships with students was a priority to participants in this study. Cora believed students needed to know they could talk to and trust their teacher. Cora believed when teachers build a relationship, students will work in class. She said, "When they don't have somebody at home that's giving [positive] motivation or giving you those values so that you feel that internally, you got to get it from somewhere, somebody." She warned if students are not receiving positive motivation from teachers, they could fill the void with negativity from someone else. She ended her comments with, "[We] got to make them care somehow." Cora argued it is a teacher's calling and duty to motivate and teach students, and it often begins with building a relationship. Cora proudly opened her cabinet door to display her "closet of children" which consisted of dozens of pictures of students. Cora explained that the students "bring pictures of when they were a baby" as well as current pictures they wanted to give to her. Some of the pictures had notes that read, "To My Mama Smith," reminding Cora her students loved and trusted her. Cora believed building relationships with students was the most effective way to motivate them.

Tom believed building relationships with his students was one of the most important aspects of his career. He said,

> Education is important, don't get me wrong. But the relationship you build with a kid, if you take that kid and turn them in the clear opposite direction and make them behave and try to be something in life, I've ultimately done my job as an educator.

Tom asserted relationships with students can spark a desire to learn from within and that students who did not receive support from family or other teachers may be yearning for attention. Tom said it was rewarding to witness students improve drastically over a school year. He recalled how some students started the year feeling defeated in math but over time he watched them begin to achieve and want to learn.

Teachers are in the position to build relationships with students and make them feel safe and loved while learning. Daisy proffered out, "It's like they are metaphorically begging for someone to be there for them and show them what it means to love them." Although Daisy had a strong, loving relationship with her parents, she benefited from a positive relationship with a teacher when she was in middle school. She explained the basketball coach was her social studies teacher and he worked to build relationships with his students. Daisy said, "I felt like he liked me as a person outside of the classroom." She explained how he attended her tennis matches and encouraged her to achieve. The relationship beyond the classroom was valuable to Daisy as student.

Anna remembered her chorus teacher fondly. She had the same chorus teacher from 8th through 12th grade and they developed a strong bond. Anna said, "She saw potential in me. If she was absent, her lesson plans for our class were that I was going to teach the class that day. I would get up on the piano and we would do vocal warmups…" The relationship Anna had with her chorus teacher built confidence in her and encouraged her to achieve and be a leader.

Relationships with Mentors

Each participant spoke of their relationship with a mentor in their early career years. Cora and Daisy both described a very positive student teaching experience. Cora said she "had a great student teaching experience. She was wonderful and [I learned] everything I [know now] from her." Cora's mentor, when she was a student teacher, guided her through the teaching process and taught her how to be an effective teacher. Daisy considered her mentor teacher when she student taught to be "phenomenal." She added, "I feel like I'm so lucky to have had her as a [mentor] teacher because I honestly attribute that to me as a teacher. I was able to witness [great teaching] from the very beginning." Daisy explained although she had good teachers in school, learning from her mentor teacher really demonstrated how to be effective.

Tom's relationship with his mentor during his field experience was pivotal. He said, "He knew what I could do and knew what I was capable of…He said do this and we'll rock and roll!" Tom's mentor teacher gave him the opportunity for hands-on learning by preparing him before class and then allowing Tom to lead and teach. Tom recalled, "I loved every second of it! He was supportive, anything that I needed, he was there…" Tom knew if he needed support or had a question about a lesson, his mentor teacher would provide assistance, but his mentor let Tom take charge. Tom's relationship with his mentor was built on trust.

Edith had a mentor teacher who was intimidating initially but became important to her over time. Edith shared how they were like "oil and water" at first but grew to be trusted colleagues and friends. She explained how they would plan lessons together, collaborate and share ideas, review lessons they taught, and then talk more on the phone at home. Their relationship made an impact on Edith as she became a veteran teacher.

Sybil's former 9th grade math teacher was her mentor when she became a teacher. Their relationship transformed into a professional one and Sybil believed she helped her to learn and become an effective teacher. Anna had several mentors but credited her mother-in-law as the one who made the most significant impression. Anna explained how her mother-in-law was a professor of mathematics at the local university and taught high school math at the local school. She had decades of experience and Anna felt comfortable collaborating with her. Anna believed relationships enabled her to learn from her mentors to become a more effective teacher.

Relationships with Colleagues

The International Society for Technology in Educators (ISTE) promotes collaboration with other educators to consider effective pedagogy (ISTE, 2021a). The fourth standard of the ISTE Standards for Educators encourages dedicated time for collaboration between colleagues. Each participant in this study confirmed their district required weekly collaboration and felt it was beneficial to student learning and helped build relationships between colleagues. Cora shared, "We plan our work together, we give the same work, grade the same assignments…" She explained how each teacher may have a unique assignment or lesson, but ultimately, they teach the same standards, at the same pace, and give common assessments. Through collaborative meetings, participants cultivated relationships and trust with their colleagues. Cora proudly shared, "We're family…[we're] together in the building, and I actually like these people. I've been on cruises with some of [them], we eat out together…it's easier when you can work with somebody you're comfortable with." Building relationships with coworkers during collaboration was important to the participants.

Sybil's colleagues met at least once a week, but sometimes two. She said, "We collaborate, talk about pacing, upcoming tests and quizzes, and we look at [the data from] each

of those, as well." Sybil's relationships with the math teachers were strong and she enjoyed collaborating with them. As department head, Tom said he worked closely with the math teachers building relationships. He also worked closely with the administration at his school and was a liaison for the math department. The relationships he built not only benefited the teachers, but also the students and school community as a whole.

Although Daisy worked in a different school district than the other participants, she also attended multiple meetings each week. Daisy shared, "We meet constantly, but they're not super structured." She explained they met to plan lessons, determine needed materials, and to build units for algebra. The frequent meetings between algebra teachers built relationships, trust, and friendships. Anna met collaboratively each week with the algebra teachers in her school. She stated, "We're big on collaboration. I lead the discussion, usually, and we talk about our data and test questions…" She added they shared materials, lesson plans, activities, and notes as well. Participants in this study indicated relationships between the teachers allowed for open communication and collaboration, which may improve student learning.

Motivation

Motivation is an important factor in student learning (Allen et al., 2011; Baier et al., 2018; Kunter et al., 2013; Lavrijsen et al., 2021; Yu & Singh, 2018). However, participants in this study expressed motivating students was a challenge. Edith shared, "They've got to have a desire to want to [learn] and want to do better." She elaborated by explaining how most of her students do not have life goals and are not interested in exploring career options. She said, "They're not motivated by each other. I mean, they're not even motivated by candy." Edith was discouraged by the lack of student motivation. Conversely, Sybil saw unmotivated students as a challenge. She explained how students came to her class already feeling defeated. She said,

"Their mindset tells them they're not going to [understand algebra]. I let them see that they can do it! I can change their mindset!" Sybil believed encouraging the students to overcome situations can motivate them to learn.

Cora said each year she had some students in her class who were unmotivated. She said, "The kids have to have that 'I want to' in them. If we knew how to put the 'I want to' in them, we'd all be rich!" Cora offered relationships as a strategy to motivate students. She said, "First, make that relationship with them… 'I know that nobody's at home pushing you and telling you that you can be great, but I'm gonna tell you, you can do this, you gonna be great.'" Cora believed this approach motivated some students to learn in class. Anna shared, "I believe [motivation] comes from that…innate drive that's instilled in you…" However, she thought some of her students did not care about learning and were difficult to motivate.

Tom also believed relationships with students can help motivate them. However, he shared, "I think it all goes back to work ethic. If a kid's not going to work, they're not going to be successful." Tom indicated some of his students were not "active as students" and did not complete their assignments and this lack of motivation and work ethic resulted in poor grades. Daisy said she enjoyed teaching students who were more at risk and not typical "good students." According to Daisy, algebra was not a subject her students typically expressed excitement about. She believed most of her students did not have much interest in learning algebra and they thought the class would be hard, and were, thus, not motivated to learn. Daisy said, "They just need so much love…if you show it to them, they thrive." Participants in this study believed teachers should work to motivate students and encourage learning.

Burke and Sass (2008) found significant peer effects in the classroom. Anna encouraged students to work with peers in class for motivation. She explained, "A student can say the same

exact thing I've said, or slightly different…their peers catch onto it! I let them work in partners a lot…" Anna asserted, as students help each other, they become more motivated to learn. Pan et al. (2020) found students with strong interpersonal relationships enjoyed higher learning outcomes. Cora also believed peers motivated each other in their "circle of influence." She explained some students looked to the "class leaders" and saw they were working, so the students became motivated and completed their work, too. This scenario can also work the other way, as students who aren't working may influence others not to work. Anna said students "become like those they hang around." Daisy's experience was similar, but she offered another perspective. Daisy said, "I have students who have been very low but placed in a phenomenal behavior-wise class. They shocked everybody [by achieving]!" She believed students were motivated by their peers and "morph to their level." Daisy's experience was similar to Burke and Sass's (2008) conclusion that weaker students showed improved learning when paired with higher-ability peers.

The choices students make may have an effect on their motivation and learning. Tom shared how he tried to mentor students who made poor choices but it did not always work. He said, "They're going home and running the streets. You're trying to steer them in the right direction and you're doing everything that you can besides knocking on their door saying, 'Where are they at?'" He lamented about "seeing the negative…seeing kids fail because they just don't care." Tom also thought some students did not care about learning because they had been passed to the next grade without earning the promotion. He believed some students were unmotivated to learn algebra when they made poor choices, or failed their classes, but were passed "through the system" and not held accountable.

Sybil said unmotivated students "hurt her heart." She had students with potential but said some of those students did not "care and they're not willing to care. They're not willing to try!" Sybil admitted those students were difficult to motivate and teach. Anna wondered if the COVID-19 pandemic produced more students who were unmotivated. She explained how the current algebra students were in 7th grade at the time of the COVID-19 pandemic, some did not pass for the year, but were placed in 8th grade anyway. She wondered if those students were "never really strong in math and no one said, 'You have to be strong now.' That pours over into what happens in my room…they don't care." Tom's commentary echoed Anna when he said, "Some of these kids have had a year and a half off of school because they went remote and didn't really do anything." The COVID-19 pandemic and lack of accountability for student learning may have had a negative effect on student motivation.

Lack of prior math knowledge may lower student motivation. Daisy said some of her students failed math in previous grades. She believed failing math caused students to lack confidence in her class. Cora said teachers should support these students even when it was frustrating. While teachers expect students to be prepared for algebra, that is not always the case. Some students come to class without materials or prior content knowledge. Cora said, "I can't *not* help you!" and she expected other effective teachers felt the same way. John et al. (2020) found prior experiences with math affected students' motivation to learn.

Each participant in this study used technology to enhance learning, engage students, and motivate them to learn, as motivated students are more likely to be engaged in their learning (Yu & Singh, 2018). Technology can be used to construct learning, as when IXL is used in the classroom (Clark, 2006; Kaya, 2015; Muir-Herzig, 2004). Sybil said, "[IXL] tells [students] exactly if they got [the problem] right or wrong…if they got it wrong, it tells them exactly how

to get [the problem] right." Immediate feedback from IXL may increase student learning and motivation (Allen et al., 2011; Hattie & Timperley, 2007; Kearney & Garfield, 2019). Daisy suggested teachers monitor students on IXL Live Classroom to offer assistance on problems they miss. She said, students "need guidance…I walk around and help them through [problems] or watch from my computer…to see if they've missed a few in a row and [need help]." The immediate feedback from IXL and the teacher may motivate students more to learn algebra and improve student achievement.

IXL Strategies

IXL is an online resource offering digital curriculum for students in grades K-12 (IXL, 2021). The participants in this study confirmed Sullivan's (2020) research finding IXL should supplement instruction and not be used to teach algebra to students. Teachers could teach a lesson and then assign the skill on IXL for students to complete in class. Daisy said, "[Students] need your guidance…I walk around and help them through [IXL problems]." Lessons in IXL can be used as practice so students get immediate feedback from IXL and their teacher. Sybil said, "[IXL] should not replace a teacher at all. Students need to hear a teacher giving them some instruction. Using [IXL] as that supplemental piece…while still having the teacher…to answer questions [is best]." Cora said she assigned IXL lessons to her students and they worked in class while she "floats the room" helping students when needed. Edith said she liked to assign IXL and work with her students in small groups to answer questions about their IXL assignments.

Each participant said a good strategy to use with IXL is to require students to earn at least an 80 SmartScore on IXL assignments. As students completed problems in IXL, a SmartScore tracked their progress. When students answered problems correctly, they earned SmartScore points, and they lost points for incorrect answers. Participants explained a few points were added

to the SmartScore for correct answers, but more points were deducted when students missed a problem. Sybil said, “Students get so many problems right and then as soon as they get one wrong it decreases their score [a lot] and they’re quite dramatic!” Cora explained her reasoning for requiring an 80 SmartScore, “[They are] not going to get 80 unless they know what they’re doing.” Tom said, “If they get to that 80, they pretty much have that content mastered.” Daisy differentiated by requiring her advanced students to earn a 90 SmartScore on IXL assignments. Each participant held their students accountable by grading the IXL assignments. When students earned an 80 SmartScore, they got 100 in the gradebook, except for Daisy’s advanced students who needed a 90 SmartScore.

Using IXL to supplement mathematics instruction was recommended by all participants in this study. Students learned the skill from the teacher and then practiced on IXL, which engaged them in their studies. When students are involved in their learning, they became more motivated and improved their academic achievement (Allen et al., 2011; Hughey, 2020; Lavrijsen et al., 2021; Parsons et al., 2018; Skaalvik et al., 2015; Yu & Singh, 2018). The participants taught lessons and provided notes to their students for each lesson. Then, students used IXL to solidify learning. Anna said, “I give very scaffolded notes with a picture example and a problem we work out…it usually has steps [to solve the problems].” After completing notes, Anna’s students worked with a partner to complete their IXL assignments. Sybil’s strategy was similar, but she added, “I’ll go around [the room] and offer additional instruction if they need that while they’re working [on IXL]”. Cora also said, “You just let them kind of do what they do and float the room.” All participants believed while IXL was an effective supplement, teachers should teach and remain the primary resource for students.

Daisy believed it was crucial teachers remained engaged with students while they worked on IXL. Sometimes she watched their progress on IXL Live, which displayed each student, the question they are answering, and whether they answered correctly or incorrectly. Other times, Daisy remained active in her class by walking around and tutoring students individually. Daisy said, "I walk around and help [students] through [IXL] because they do not want to miss 20 questions in a row any more than I want them to miss 20 questions!" While Daisy was exaggerating about the number of questions students may miss, she implied students wanted to learn and feel successful.

Three IXL features participants believed to be effective were IXL Live Classroom, IXL Jams, and IXL's Real-Time Diagnostic tool. IXL Live Classroom is a real-time report allowing teachers to track student activity as it happens (IXL, 2022). Participants said they thought it was powerful to watch students work online as a type of formative assessment. Cora said, "I'll assign IXL and while they're working look at the live view…when it is red, I call [the student] up to help them." Tom also monitored student progress on IXL Live Classroom to assess learning. He said, "I can watch them on the IXL live view" and when he observed incorrect answers, he worked with the students individually. Using IXL Live Classroom empowered teachers with students' data instantly, unlike paper worksheets.

IXL Jams is a feature teachers use as a whole class tool and allows the class to work on the same problem together (IXL, 2021e). The IXL Jam can be displayed on the board and simultaneously on student devices. After the IXL Jam, students work collaboratively or independently on IXL assignments. Sybil said she liked to use IXL Jams "when it's a topic that's fairly new…we can all work on the same problem at the same time." Daisy used IXL Jams and said, "It's really effective to go over specific problems from the lesson with students before they

actually start [IXL assignments]…it doesn't go towards their SmartScore…we do the practice problems together." Sybil and Daisy used IXL Jams in class as a resource to reinforce learning before students completed independent work in IXL.

IXL Real-Time Diagnostic was a frequent strategy mentioned by participants in this study. Participants used data from IXL Real-Time Diagnostic to assess student learning while IXL used the data to create a personalized learning path for each student. IXL's Diagnostic uses student input on an IXL assessment to determine each student's grade-level proficiency before creating the learning path and ensures student engagement and involvement in their learning (IXL, 2022a). ISTE's sixth standard supported IXL Real-Time Diagnostic as it recommended educators use technology to ensure students take ownership of their learning goals and outcomes (ISTE, 2021a). Tom explained, "The [IXL Real-Time] Diagnostic score gives us a baseline. As kids progress though the year, you should see that [grade-level proficiency] number increase, maybe even two grade levels!" Tom appreciated the growth his students experienced over time as they used IXL in class.

Cora said the IXL Real-Time Diagnostic was an "eye-opener" for some of her students. She shared, "[It] has been great because of a lot of them say, 'Oh my God! I'm in 4th grade math?!' And, then they can work on what they need to work on to improve their skills and grade level." When Cora's 9th grade algebra students discovered some of their skills were on a 4th grade level, they became alarmed and motivated to learn. Cora printed the IXL Real-Time Diagnostic reports to build data notebooks for each student. She tracked their progress and used the notebooks in student conferences.

Daisy's students completed the IXL Real-Time Diagnostic during the beginning of the year. She said, "I liked that! The [IXL Real-Time] Diagnostic provides personalized

recommendations for each student; lessons for them to work on outside of the standards I'm teaching in class." The lessons improved student learning for Daisy's students as they increased their grade-level proficiency. Each participant indicated the IXL Real-Time Diagnostic was a valuable feature of IXL, affording a personalized learning opportunity for their students.

Timely feedback is crucial to student learning (Fyfe & Rittle-Johnson, 2016; Hattie & Timperley, 2007). Clear, purposeful, and meaningful feedback is powerful when linked to learning (Hattie & Timperley). Feedback is most effective when it cleared student confusion on how to solve problem (Hattie & Timperley). Frequent feedback provides students with valuable information on their learning and can be used to improve skills (Gentrup et al., 2020). IXL offers immediate feedback to students after each problem solved. When students miss a problem, IXL provides a detailed explanation of how to solve the problem correctly. Students who get a problem correct receive an immediate affirmation from IXL.

Sybil said immediate feedback from IXL was its best feature. She explained, "It aligns well with everything we teach and the feedback is great [for student learning]!" Cora said she loved "that you have feedback, instant feedback." Daisy wanted her students to practice on IXL because "its like a digital worksheet that gives instant feedback." Participants agreed feedback from IXL is timely and necessary for student learning.

Integration of Technology

The seven ISTE Standards for Educators guide educators towards empowering their learners with technology (ISTE, 2021a). While discussing technology, each participant in this study alluded to ISTE standards unknowingly. Standard four encouraged collaboration between students to learn (ISTE, 2021a). Anna said she regularly paired students to work on IXL together in class to promote learning and motivation. Sybil said, "They usually do a lot of partner

work…very rarely do they have to do anything by themselves." Cora's, Edith's, and Tom's students had the option to work with peers, as well. Daisy and Sybil said they often used IXL Jams in class for review. Daisy explained, "[IXL Jams are] really effective to go over specific problems from a lesson with students…[students] still have to do the whole [IXL] lesson, but we've just done practice problems together [through IXL Jams]." Sybil said she liked to use IXL Jams "when it's a topic that's fairly new…we can all work on the same problem at the same time." After working through a problem together, Daisy and Sybil said their students worked on IXL lessons independently or with a partner.

Participants in this study used student data generated from IXL to inform their instruction. In standard seven, ISTE (2021a) recommended data driven instruction, and students can use IXL to demonstrate mastery or lack of proficiency. Daisy reviewed IXL data at the end of units to determine which standards needed to be reviewed more heavily before the summative assessment. She said, "If [the students] got an 80 [SmartScore] in 20 questions, they have a good understanding of [the standard]." Daisy explained if students answered numerous questions and had a lower score in IXL, it indicated those students did not master the standard and needed a review.

Anna used student data from the IXL Real-Time Diagnostic to determine what students knew about each specific standard. She also reviewed students' IXL scores and said if they made at least an 80 SmartScore she believed they knew the content for that skill. Anna planned her lessons around the data from IXL. Tom also considered students as mastering content when they scored an 80 SmartScore on IXL assignments. He said, "…if they get to that 80 [SmartScore] they pretty much have that content mastered." Cora used data from the IXL Real-Time Diagnostic to determine which skills to review in class. Sybil used data to inform her instruction

and added, “I think [an] 80 [SmartScore] is proficiency and to me an 80 [SmartScore] means you pretty much have the concept, and you get it.” The participants believed when students scored an 80 SmartScore on a skill in IXL, they were proficient and did not need additional instruction on that standard. Teachers who used IXL to drive instruction were using student data to inform instruction as suggested by ISTE in standard seven (ISTE, 2021a).

Standard five of the ISTE standards states educators can personalize learning with technology (ISTE, 2021a). Edith shared her students completed the IXL Real-Time Diagnostic to get personalized lessons tailored to each student’s need. She said her students worked in small groups to remediate after the IXL Real-Time Diagnostic assessment. Cora said her students practiced differentiated lessons and skills on IXL “because everybody’s working at their own pace” and on their own personalized path. Cora explained, “If someone walked in [my class] and looked to see what we were doing, you may see kids on three different things because everybody’s working at their own pace.” A benefit of IXL is that it differentiates learning for students according to their individual skill levels.

Daisy said she loved IXL was “differentiated to each student. [The lesson] is based off of whether or not they got the previous question correct.” Daisy appreciated how IXL personalized learning to each student based on how they answered each question on IXL assignments. Tom explained, “[IXL] has an unlimited number of questions. If the kids take it seriously and get one wrong, they can look at the explanation at the end…it benefits them tremendously.” The immediate feedback and adaptive technology within IXL personalized student learning to meet their needs. Research indicates students who participate in personalized learning are more engaged and demonstrate improved academic achievement according to recent studies (Abedi et al., 2021; Fazal et al., 2020; Frazier, 2020; Phan, 2020).

Malik and Terry (2021) found some technology can distract students in the classroom. Likewise, participants believed technology is sometimes a distraction in their classrooms. Cora believed she was competing with students' cell phones. She said, "I'm not a cell phone. I can't hold your attention like that. We fight the battles…students aren't focused on [schoolwork] because they want to look at their phones." Cora elaborated by explaining students were constantly distracted by applications on their phones, such as various social media platforms. Anna said technology "is a huge distraction" for her students. She said, "There's always a cell phone going off…just notifications that buzz, or something on their smart watches…" Anna believed it was hard to keep students' attention in class while they were distracted by personal technological devices.

Students also used technology to cheat in class. Sybil said, "Students try to utilize apps on their phones to give them the answers instead of actually doing the work." Anna also complained about cell phone applications students used to cheat in math class. While cheating was not a new educational issue, cheating with technology has become a new battle in the classroom. Cora explained, "They'll try to slide a phone or open another tab [on their Chromebook]…" to cheat, so she required students to work out problems on notebook paper to turn in. Cora elaborated by saying her students complained about working out the problems on paper and said, "They're missing the thirst for knowledge." She believed technology was draining students' desire to learn. She said she tells her students, "There's a computer for [solving math problems] but what if it isn't working? What if you need to know something in your brain?" Cora said it was important for students to learn and know how to problem solve without technology.

Chapter Summary

In this chapter, the researcher presented findings from a series of interviews with six successful high school algebra teachers in rural South Georgia. The researcher collected and analyzed interview and facility observation data to find themes among the participants' experiences teaching algebra and using IXL in the classroom. The six participants taught in four different high schools and were of different ethnicities and genders which led to the researcher collecting information-rich data (Patton, 2002).

After thorough data analysis, four themes emerged: (1) relationships, (2) motivation, (3) IXL strategies, and (4) integration of technology. These themes from participants' experiences were supported by existing literature. Findings in this study also underscored gaps in the existing literature. The researcher will discuss the conclusions and implications of this study in Chapter VI.

Chapter VI

CONCLUSION

Georgia Milestones Assessment scores in recent years indicated Georgia high school students were not prepared for the next grade level content in mathematics (GaDOE, 2019). Results from the Georgia Milestones indicated most students scored in the second lowest rank, developing learner, and the least number of students scored the highest rank, distinguished learner, on the Algebra I and Geometry Milestones (GaDOE, 2019). Low scores on the Algebra I and Geometry Georgia Milestones suggest most students did not have the mathematical knowledge to be successful in subsequent courses (GaDOE, 2020).

The education sector is rapidly changing with technological advances. Gravemeijer et al. (2017) asserted mathematics is crucial for students as they apply and compete for jobs that technology or machines could perform. Students' skills will differentiate them from competition, both human and technological, and mathematics is necessary in the changing world (Gravemeijer et al., 2017). Educational technology resources are abundant, and teachers should use them to improve student learning (Gravemeijer et al., 2017). IXL is an educational technology resource teachers can use to increase student learning and achievement (IXL, 2021).

High school mathematics achievement is crucial to the success of students as they advance through their education and prepare for careers, but most Georgia high school students are not high-achievers on state mandated mathematics assessments (GaDOE, 2019; Yu & Singh, 2018). The purpose of this qualitative study was to explore the life and career experiences of successful algebra teachers, their perceptions of effective use of IXL in the mathematics classroom, and the key factors for students mastering mathematics content. Six participants' interviews generated information about their lives and careers, producing rich data about IXL use

in the classroom and factors affecting student learning. The findings may provide valuable information to school leadership regarding the use of technology in the classroom and related professional learning. The research questions for this study were:

Research Question 1: What are the life and career experiences of successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 2: What are the best implementation strategies as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Research Question 3: What are the external and internal key factors for students mastering mathematics content as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Purposefully selected participants were high school algebra teachers in rural South Georgia; whose principals considered them to be successful; with acceptable student achievement rankings as measured by their Student Growth Model; and who utilized IXL in their classrooms. For this study, the principal of each high school determined acceptable student achievement rankings for each participating algebra teacher. The researcher modified Seidman's (2013) three-series interview model and interviewed each participant in person twice. The interviews generated rich data about their lives and careers, their perceptions of the best IXL implementation strategies, and key factors they perceived as having an effect on students learning mathematics. The researcher conducted multiple methods of data collection to triangulate data (Carter et al., 2014; Patton, 2002). In addition to interview data, the researcher observed each school setting and reviewed documents, when provided, and interviewed

participants at different schools. The researcher also triangulated data by including diverse participants in both gender and race.

Once interviews were transcribed, data analysis began as the researcher read them and memoed during the process. Data were chunked, organized by categories on a spreadsheet, and assigned codes (Ary et al., 2019; Saldana, 2016). Through data analysis, the researcher determined four themes from the interviews, observations, and document review: (1) relationships, (2) motivation, (3) IXL strategies, and (4) integration of technology. This chapter includes a discussion of the three research questions and how the results relate to previously discussed literature, the themes revealed in this study, and the study's limitations, implications, and recommendations for future studies.

Research Questions: Summary Discussion

In this phenomenological qualitative study, the researcher examined the lived experiences of six algebra teachers in rural South Georgia who use IXL in their classrooms. These participants were selected because their principals considered them successful in the classroom; because their experiences may shed light on the problem of low student achievement in high school mathematics and add to the body of knowledge around effective mathematics instruction. The researcher used the stories each participant shared to develop a better understanding of the phenomenon. The researcher analyzed the data in three stages: "familiarizing and organizing, coding and reducing, and interpreting and representing" (Ary et al., 2019, p. 456). Chapter V contains themes and findings from this study. The researcher provides responses to this study's guiding research questions through identified themes and existing literature.

Research Question 1: What are the life and career experiences of successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

During the two interviews and analysis, the researcher learned of each participant's life and career experiences as they shared the stories of their childhood, college life, and their classrooms. During the first interview, participants reflected on and shared rich information about their memories of time spent in elementary, middle, and high school, college, and their path to becoming an algebra teacher. In the second interview, they shared their experiences teaching algebra and using IXL in their classrooms. Their stories described their lived experiences and were necessary to answer Research Question 1.

There were many similarities and differences among the participants' stories during the two-part interview series, adapted from Seidman's (2013) interview protocol. The first similarity was all participants were raised in a home with both their mother and father. None had divorced or deceased parents while growing up. All participants except Anna had positive relationships with their parents. Anna reported her relationship with her parents was challenging. She had a stronger bond with her mother than her father but was not close to either as a child nor now as an adult. Participants' relationships with their parents and mother-in-law made up a portion of the data supporting the relationship theme in this study.

Anna's and Cora's parents had the same occupations; their fathers were ministers and their mothers were teachers. Daisy's, Sybil's, and Tom's mothers were teachers as well. Edith's mother stayed at home with her children until they were older and then worked as a secretary and later as a bank teller. Her father was employed by a telephone company as a lineman and was promoted several times until he became a supervisor auditing 49 states. The father of Tom and

Sybil, who are siblings, owned a local business but also drove a school bus to qualify for state benefits. Finally, Daisy's father was an accountant in her hometown. Some of the participants' parents furthered their education beyond high school while some began their careers upon high school graduation. All of the participants' parents remained with their employers for the duration of their careers, with the exception of Edith's mother.

Each participant said they enjoyed school and had positive relationships with their teachers growing up, except Edith. While Edith had positive experiences in elementary and middle schools, she moved to a new town as a teenager and her new high school was much larger than her old one. She had a difficult time making friends and did not embrace the new school. Anna also moved to a new school, but adjusted well and made friends. All six participants were involved in school clubs or extracurricular activities. Some of the clubs and activities included tennis, baseball, cheerleading, band, chorus, Fellowship of Christian Athletes, National Honor Society, Special Olympics, Family, Career and Community Leaders of America (FCCLA), and Key Club. The relationships between participants and their teachers led to a subgroup of the relationship theme.

None of the participants credited their parents for inspiring them to become teachers, except Cora. Cora's mother encouraged her to follow the education path, and teachers and friends of the remaining five participants guided them towards the decision to become a math teacher. With the exception of Anna, all participants had supportive families throughout college. Once Anna married, her mother-in-law encouraged her to re-enroll in college and graduate. Each participant had support and encouragement as they worked to become teachers and the data on their relationships added to that particular theme.

Five of the six participants lived and taught in their childhood hometowns. Daisy moved several hours from her hometown after college to teach algebra for 3 years and then moved back home to teach at her alma mater. Edith taught in Atlanta and in South Georgia throughout her career, but did not return to her hometown of Americus. The remaining four participants taught only in their hometown and none expressed an interest in relocating. All participants, except Edith, said they enjoyed living in their hometowns close to their parents and in-laws.

Each participant attributed their success as an algebra teacher to mentors they had during student teaching and their first years in their own classroom, which led to a subtheme within the relationship theme. Daisy described her mentor teacher as "phenomenal" and said she incorporated strategies she learned as a student teacher in her classroom. Tom said his mentor teacher pushed him to take control of the class and supported him along the way. Cora and Anna had supportive family members who mentored them. Cora's mother and sister gave her advice and offered support when she needed it. Anna's mother-in-law mentored and guided her as she planned lessons. Squires (2019) posited mentors can be helpful to new teachers by sharing advice, success, and failures without judgement.

The principals considered each participant successful and they had high student achievement. Throughout their careers, the participants were leaders in their departments and schools. Cora, Edith, Sybil, and Tom had all been department chairs at one point while teaching algebra. Anna and Daisy led weekly collaborative meetings with algebra teachers in their schools. Edith was the most experienced teacher, with 29 years of service, and held many roles in her school, as well as with GaDOE, and the Georgia Council of Teachers of Mathematics (GCTM). Daisy and Sybil were the least experienced with 5 years of service. Success,

experience teaching, and leading collaborative meetings helped to provide data for the theme and subtheme within relationships.

Although the six participants taught algebra at four different high schools in South Georgia, they had much in common. Their homelives as adolescents were similar and they remained in, or near, their hometown to teach. Each participant credited a mentor for supporting them and molding them into successful algebra teachers. During the interviews, each participant shared stories about motivating students, using IXL in their classrooms, and the use of technology. These stories contributed to all themes in this study, enriched the data, and are explained in the following research questions.

Research Question 2: What are the best implementation strategies as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Each participant in this study used IXL, a digital resource for grades K-12, in their algebra classroom and recommended its use for supplementing student learning. Currently, IXL only offers math and language arts curriculum for grades 9-12 (IXL, 2021). The mission of IXL centers on the use of technology to improve student learning and unlocking their curiosity, creativity, and desire for knowledge in thoughtful and innovative ways (IXL, 2021). Students practice mathematics on IXL, get immediate feedback, and never see the same question twice. Data collected for this research question directly supported the theme for this study.

Each participant recommended teachers use IXL to supplement learning after teaching an algebra lesson. Daisy, Sybil, and Tom said IXL should not replace the teacher nor be used to introduce a new algebra concept. The participants believed teachers should introduce and teach each algebra skill in class then assign IXL for practice to solidify learning and to keep students

engaged in their learning. Keeping students involved in their learning can motivate them and improve their academic achievement (Allen et al., 2011; Hughey, 2020; Lavrijsen et al., 2021; Parsons et al., 2018; Skaalvik et al., 2015; Yu & Singh, 2018). The participants recommended against using IXL for extended periods of time. Daisy suggested students practice algebra on IXL 30 minutes per day, maximum, to avoid burnout. Cora and Edith assigned IXL to their students two or three times each week. Cora found her students grew tired of IXL if she assigned it more often.

The use of IXL in the classroom can be a tool to assist students in constructing their learning, which aligns with the conceptual framework of this study. As Moursund (2007) explained, constructivist learning occurs when students problem solve and think critically, engaging them in their learning. Participants in this study shared their algebra students used IXL to solidify learning after an algebra lesson. Their students constructed their learning as they practiced problems, worked with peers, and received feedback on IXL, suggesting IXL can be used in a constructivist classroom.

Cora and Daisy said teachers should assign skills on IXL and then monitor their students by walking around or watching students' progress on IXL Live Classroom. IXL Live Classroom is a real-time report that displays student activity in IXL as it happens (IXL, 2022). Cora and Daisy believed it was crucial teachers remained engaged with their students while they worked on IXL. Although IXL offers immediate feedback, the participants believed it was important for the teacher to work with students on misconceptions. Sybil and Edith said they walked around the room and worked with students when they had questions about problems. According to Gentrup et al. (2020), frequent feedback can be used to improve skills, which supports Cora's, Daisy's, Sybil's, and Edith's recommendation to remain engaged with students to help them with

IXL assignments. Tom wanted his students to attempt IXL problems individually and problem solve independently but would intervene when they asked questions or became frustrated. He typically monitored students' work via IXL Live Classroom. Tom's strategy is supported by Hattie and Timperley's (2007) research finding feedback is most effective when it ends student confusion on how to solve a problem. Anna encouraged her students to ask their partners for feedback while she watched their progress on IXL Live Classroom. She believed students can benefit from peer tutoring, which is supported by Burke and Sass's (2008) research concluding weaker students improved when paired with higher-ability peers. Additionally, discourse between peers can encourage them to construct their own learning (Clements & Battista, 1990; Lessani et al., 2016), supporting the conceptual framework of this study.

Another strategy each participant used in their algebra classroom was requiring students to earn at least an 80 SmartScore on IXL assignments. A SmartScore tracks student progress as they complete problems in IXL. As students answered problems correctly, they earned SmartScore points, and they lost points for incorrect answers. Each participant believed a SmartScore of 80 was a strong indicator a student mastered the skill in IXL. Daisy required her regular education students to earn an 80, but her advanced students were required to score at least a 90. Each participant held their students accountable for scoring an 80 SmartScore, or 90 SmartScore for Daisy's advanced students, by giving them a 100 in the gradebook.

Each participant believed the IXL Real-Time Diagnostic was a useful strategy to use in the algebra classroom. IXL uses data collected from the IXL Real-Time Diagnostic to create a personalized learning path for each student. IXL's Real-Time Diagnostic uses student input on an IXL assessment to determine each student's grade-level proficiency before creating the learning path and ensures student engagement and involvement in their learning (IXL, 2022a).

The use of prior knowledge within IXL's Real-Time Diagnostic can activate learning (Isik, 2018), which supports the conceptual framework of this study. This strategy is supported by ISTE's sixth standard as it recommends educators use technology to ensure students take ownership of their learning goals and outcomes (ISTE, 2021a). Tom appreciated how the IXL Real-Time Diagnostic provided a baseline for his students' knowledge of the assessed skills. Cora used IXL Real-Time Diagnostic to assess students' skills and to communicate with students about concepts they need to study from previous grade levels. Cora believed the IXL Real-Time Diagnostic results motivated some of her students when they realized they were lacking mathematical skills. Daisy used IXL Real-Time Diagnostic results to ensure her students' learning was personalized to exactly what they needed. Anna said she "fell in love" with the data from IXL Real-Time Diagnostic results and Edith used it to remediate students who needed it.

Research Question 3: What are the external and internal key factors for students mastering mathematics content as perceived by successful algebra teachers who employ IXL as a teaching strategy in rural South Georgia mathematics classrooms?

Participants shared similar responses when asked about their perceptions of internal and external factors. The most prevalent external factors for students mastering mathematics were students' technology, peers, and their teachers. Internal factors included motivation, relationships, and prior mathematics knowledge.

Technology, an external factor for students mastering mathematics concepts, is both an asset and a distraction in the classroom, according to this study's participants. Each participant used IXL in their classroom, as required by the criteria for this study. The participants used IXL to reinforce learning and instructed their students to practice concepts they learned in class, constructing their own learning. Students worked at their own pace and had personalized algebra

questions because of IXL's adaptive technology. As students answered questions correctly, the subsequent questions become more challenging. When students answered questions incorrectly, the level of difficulty decreased to help students learn the foundational concepts. The adaptive questions in IXL personalizes learning for students, potentially keeping them motivated and engaged (Allen et al., 2011; Hughey, 2020; Lavrijsen et al., 2021; Parsons et al., 2018; Skaalvik et al., 2015; Yu & Singh, 2018). Technology used effectively in the classroom is an external factor that can positively impact student learning and support a constructivist approach, as noted by Clark (2006) and Kaya (2015).

In this study, it seems that not all technology improves students learning. Participants described how technological devices in their classrooms were sometimes a distraction to students and interrupted their classes. Anna argued, cell phone and smart watch notifications diverted students' attention. Moreover, all six participants mentioned some students used cell phone applications to cheat. One application uses the cell phone camera to capture a math problem, and then displays the problem's answer. Each participant said they are continuously battling the use of devices for cheating.

Two participants explained how peers affect student learning. Cora and Daisy believed peers have a strong influence on students, both positively and negatively. Cora argued students want peers to accepted them and often conform to behaviors they perceive as being acceptable to peers. Daisy offered examples of negative peer effects, but said she witnessed positive effects, also. Students who historically scored poorly in mathematics were placed in a class with no behavior problems and their grades improved, according to Daisy's experience. Daisy's and Cora's experiences are supported by Burke and Sass's (2008) findings of significant peer effects in the classroom.

Algebra teachers have an effect on students mastering mathematics, according to participants in this study. Sybil found students who did not receive effective mathematics instruction in previous grades came to her class feeling defeated. She said, “I feel like sometimes the instruction they get up to this point definitely affects their success in here.” Cora also believed teachers affect student learning. She advocated for teachers building relationships with students to motivate them to learn. Cora believed if students trust their teacher, they will complete assignments and achieve in class. This belief is supported by Kearney and Garfield’s (2019) finding, students who perceived their teachers cared become more motivated and improved their class performance. Thus, relationships teachers build with their students can be critical.

Additionally, participants believed teachers impact student learning with the use of feedback, both from the teacher and from IXL. This study’s data collected from high school teachers adds to Fyfe and Rittle-Johnson’s (2016) finding, elementary-aged students who received immediate feedback increased their achievement in mathematics. Feedback must be timely and specific (Fyfe & Rittle-Johnson, 2016; Hattie & Timperley, 2007). Students receive immediate feedback from IXL after each question is answered. When the student submits an answer on IXL, they learn if it is correct or incorrect. If it is incorrect, an explanation is displayed on the screen for the student to read. Not only did participants in this study use IXL feedback, they also offered immediate feedback personally to students as they worked on problems. Daisy, Sybil, Cora, and Edith recommended monitoring student progress by remaining active in the classroom or watching their progress on IXL Classroom Live.

Student motivation affects learning (Yu & Singh, 2018), and participants in this study frequently cited motivation as a factor. While Edith believed her students could not be motivated,

other participants shared stories of how they worked to motivate their students. Five of the six participants built relationships with their students, showed them love, and found it motivated most students. Cora believed her students were "missing that thirst for knowledge" while Daisy thought her students were "metaphorically begging for someone to be there for them." With the exception of Edith, all participants experienced building relationships with students helped to motivate them to learn and complete classwork. This high school experience supports and adds to findings of Kearney and Garfield (2019) who stated middle school students who perceived their teachers cared about them became more motivated and improved their learning.

Implications of this Study

This phenomenological qualitative study was conducted to explore the lived experiences of successful high school algebra teachers in rural South Georgia. The purpose was to examine these experiences to identify effective IXL implementation strategies and key factors for students mastering mathematics. After thorough data analysis, four themes emerged and provided a basis for the implications of this study. While this research focused on participants' use of IXL in the classroom, findings have broader implications for several groups.

Only one participant reported receiving professional learning or training on how to effectively use IXL. The remaining five participants learned by using IXL in their classroom or from a colleague who had used it previously. School and district leaders and RESAs may not realize the need for professional learning on digital resources, like IXL. Secondary educational institutions, such as universities and colleges, may not be preparing their education students for classes incorporating technology. Additionally, these groups may recognize the importance of relationships and offer trainings for teachers. The findings from this study may underscore the gaps.

Districts and Schools

Technology has been evolving for decades and educators could take advantage of it to improve student learning (Mishra et al., 2009). Each participant in this study used IXL with passion and believed it improved their students' achievement in algebra. However, only one participant received formal training on how to use IXL in her classroom. The other five participants were self-taught or learned from a fellow algebra teacher. Only one participant had a dedicated staff person at their school to assist with educational technology, while the others had to rely on the availability of a district-wide staff member who served multiple schools.

According to both existing literature and participants in this study, relationships teachers build with students help improve student learning. However, participants' stories of their lives and careers did not include any formal training on building trust and relationships with their students. This characteristic may come naturally to some educators while others need support in that area.

Districts and schools may use the findings from this research to plan and implement professional learning for teachers. The professional learning could encompass strategies for implementing IXL in the classroom as determined by this study and approaches teachers can use to build relationships with students. Also of importance are parameters for using IXL in the classroom. The IXL lessons should be purposeful and engage the students while the teacher is in close proximity offering feedback. Additionally, teachers should limit the time spent on IXL in the classroom to avoid student burnout.

Since educational technology is frequently used by teachers and students, districts may consider increasing staff to support the use of digital resources. The additional support staff could offer individual assistance and professional learning for teachers. As more digital

resources are used, schools may need experts in the building to determine which resources are most effective, to work with teachers to align digital resources with lesson plans, and to answer questions or solve technical issues. In this study, only one participant's school had a dedicated digital learning support staff person, indicating those particular school leaders recognized the importance of digital learning and supported the teachers' use of the tools. Although IXL was the focus of this study, digital learning support staff can assist with implementation of all educational technology and digital resources, not solely IXL.

Educators

The findings in this study revealed educators should prioritize relationships with their students. Each participant recounted relationships with their own teachers, as students, and shared how it made them feel about school and learning. As well, through their educator lens, the participants described how vital their relationships are with students. Thus, educators should build relationships with students to motivate them to learn and may need professional learning to strengthen strategies used to improve relationships.

Educators may need ongoing professional learning on educational technology used in the classroom. New and veteran teachers alike should stay abreast of available digital resources that can be used to improve student learning. When products, such as IXL, are provided by schools or districts, professional learning should be provided to teachers to instruct them on effective implementation strategies. If schools have dedicated digital learning staff on site, they can support classroom teachers in the use of the educational technology, like IXL.

RESAs

Findings from this study indicate professional learning is a necessity for teachers. While school districts may offer professional learning, RESAs could further support their efforts.

RESAs could offer professional learning to schools in their district on building relationships with students and using educational technology. Additionally, RESAs could offer additional supports to schools without digital learning staff.

Experts on building relationships with students could lead professional learning opportunities organized by RESAs. These events would allow teachers in different schools to mingle and network while learning more about relationship-building strategies and educational technology. Through workshops, teachers can learn how to use educational technology effectively with colleagues in their RESA district.

Higher Education Institutions (HEI)

Effective teaching now includes the use of educational technology. Pre-service teachers should prepare to use digital resources when they become teachers in their own classrooms. Findings from this study could be used to communicate needs to HEI leaders to ensure instructors of pre-service teachers are incorporating effective strategies in educational technology into the curriculum. As well, as professors prepare students to become effective teachers, they could also promote best practices while using technology, such as using it purposefully, remaining engaged with students, and limiting the time spent on digital resources.

Limitations of the Study

According to Patton (2015), the researcher must disclose limitations in qualitative research to establish credibility and trustworthiness of the study. The limitations identified can also affect implications of this study and recommendations for future research. This study was limited to the stories shared by six algebra teachers in rural South Georgia. The purposeful sample of six algebra teachers in rural South Georgia was limited in gender and race to one White male and one Black female. The study was limited to high school teachers' experiences of

IXL use only in algebra classes, and did not include additional courses or grade levels. Limitations of this study stemmed from examination of participants' use and perspectives of IXL. The researcher did not study any other digital resources used in algebra classes. Participants taught algebra in high schools belonging to the same RESA district in rural South Georgia. Therefore, transferability to different areas of the country or world, content areas, grades, and more diverse teachers could be a limitation.

Researcher bias was another limitation of this study. As a former math teacher and digital learning specialist, the researcher was heavily involved in using educational technology, planning professional learning, and making decisions regarding the effectiveness of digital resources. Additionally, the researcher had worked with one of the participants. Through reflexivity, the researcher critically self-reflected as the instrument in the research (Merriam, 2002). The researcher also referred to reflexivity while designing and implementing the study and attempted to eliminate biases by practicing bracketing (Ary et al., 2019). During self-reflection, the researcher referred to memos she kept during the study to ensure participant data was accurately used and no assumptions were made.

During research for this study, the world was experiencing the effects of the COVID-19 pandemic, creating limitations. Initially, a criterion for participants was they must have high student achievement with at least 70% student growth and 70% student achievement on the Algebra I Georgia Milestone EOC as indicated on the GaDOE's Student Growth Model for 3 years. Once it became time to solicit participants, the researcher found the Student Growth Models were last updated in 2019, due to COVID-19 and paused Milestone testing. The outdated Student Growth Models prompted a change in the criterion. Thus, the new criterion indicated participants must have acceptable student achievement rankings as measured by their Student

Growth Model. For this study, the principal determined acceptable student achievement. Additionally, teachers could not provide recent Student Growth Models for data analysis.

Recommendations

This phenomenological study adds new information to the current body of literature on IXL implementation strategies and key factors affecting student learning. Six successful algebra teachers in rural South Georgia shared stories of their lives, careers, experiences with implementing IXL, and their perceptions about the key factors affecting student learning. During data collection and analysis, themes emerged, as did recommendations for future research. This study focused only on algebra teachers and their students, limiting the data. Future researchers could expand the study to include high school English teachers, middle school teachers, or elementary teachers. Increasing the sample size of participants may lead to a more diverse population of teachers, further enriching the data. Additionally, because the participants all taught in rural South Georgia, a future study could be conducted in other parts of Georgia, the United States, or the world.

Implementation of IXL was the focus of this qualitative study and it included perceptions of successful algebra teachers. Researchers could duplicate the methodology of this study but focus on a different educational technology resource to compare and contrast the results. This study could also be duplicated to include participants who teach math courses in different grade levels, rather than just those who teach algebra. The researcher also recommends future research within inner city or high poverty schools using IXL to support or add to these findings. Future researchers could conduct a quantitative study to determine the effectiveness of IXL in algebra classrooms. Research could also be conducted to learn more about the recommended use of

educational technology, such as time limits on daily use. Finally, researchers could study the effects of IXL use over an extended period of time to determine effectiveness or student burnout.

The use of technology in the classroom presents some negative student behavior. Researchers could conduct studies on recommended use of technology in the classroom. Additionally, researchers could study cheating with the use of technology and potentially uncover strategies to combat the problem. While cheating is not a new educational issue, technology simplifies it and makes resources more accessible for students.

Final Thoughts

Through interviews with participants, data collection and analysis, and thoughtful synthesis, the researcher developed themes and findings for this study. The most significant takeaway for the researcher was the unanimous emphasis on the importance of developing relationships with their students. While participants' emphasis on relationships was evident at different degrees, each had positive relationships with their teachers and worked to develop them with their students. Participants fondly described former teachers who took the time to love their students. A few participants' stories of their relationships with students brought tears to the researcher's eyes, reminding her teachers have the opportunity to make a remarkable impact on students' lives.

Another noteworthy takeaway from this study was participants' use of IXL to improve student learning. The participants used data from IXL Real-Time Diagnostic to drive instruction and incorporated IXL in their lesson plans. Each participant believed IXL was an effective tool to improve learning. Before the study, the researcher believed technology should not replace good instruction from teachers and findings from this study supports that belief. Teachers remain a vital and necessary part of learning; they are the experts in their classrooms. No participants

believed IXL should introduce and teach students algebraic concepts. However, with effective professional learning, teachers can implement IXL successfully to supplement and solidify student learning, and students can use IXL to practice algebra while the teacher supports their learning.

While the themes and discussion of research questions dive deep into the findings, the researcher's final thoughts include her personal takeaways. The key to improving student learning and increasing student motivation is to build relationships with them. Teachers should demonstrate they care about students' well-being and progress in school. Through purposeful and strategic use of IXL, teachers can support students while they practice algebra online. Teachers should remain engaged with students, offering constructive feedback while they work.

Summary

In this phenomenological qualitative study, the researcher examined the life and career experiences of six successful algebra teachers in rural South Georgia who implemented IXL in their classrooms. Utilizing a qualitative method for this study allowed the researcher to explore and better understand "the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2014, p. 4). Through a phenomenological point of view, the researcher strived to learn what the participants experienced in their lives and careers and how they interpreted the world around them while implementing IXL with their students (Merriam, 2002; Patton, 2015; Seidman, 2013).

In Chapter I, the researcher described the historically low Georgia Milestone scores and mathematics achievement in Georgia, particularly in high school. The problem, purpose, significance, and research questions were followed by the conceptual framework of this study, underpinning the research of IXL implementation in algebra classrooms. The researcher

chronicled the history of student achievement in Chapter II, including measures lawmakers have implemented for accountability. Georgia Milestones and student growth models have effects on schools' CCRPI and potentially their funding. The existing literature referenced in Chapter II highlighted internal and external factors affecting student learning, the history and use of technology in schools, and a review of IXL. In Chapter III, the researcher detailed the methods used in this phenomenological qualitative study, including procedures for data collection, analysis, ensuring trustworthiness, and protecting the ethical foundation of the study. The researcher constructed profiles of each of the six participants in Chapter IV, bringing their stories to life. In Chapter V, the researcher provided explanations of data analysis, including the four themes and findings. In the final chapter, the researcher offered answers to each research question, limitations of this study, implications, recommendations for future research, and a conclusion.

Thorough and methodical data analysis provided findings and answers to this study's research questions and provoked additional researcher thoughts. When planning the research, the researcher had no access to GaDOE's student growth models and did not know 2019 was the last reporting year. This fallacy led the researcher to change required participant criterion and depend on each participant's principal discretion during the study. Two participants shared their student growth models from 2019 with the researcher and the remaining four did not.

Participants in this study provided rich data which were analyzed. From the data, four central themes emerged: (1) relationships, (2) motivation, (3) IXL strategies, and (4) integration of technology. Participants believed positive relationships with students are necessary to improve student learning. Students become more motivated when they know their teachers care about them and want them to learn. Several IXL strategies were shared, and each participant required a

minimum of 80 SmartScore on assignments. Participants believed teachers should remain engaged with students and offer timely feedback when students are using digital resources. The use of technology in the classroom can both improve student learning and distract. Teachers should be purposeful when assigning digital tools and work to minimize distractions from personal technological devices, such as cell phones and smart watches.

The findings from this study support the conceptual framework on which this research was built. While the central phenomena of this research were key factors affecting student learning and the use of IXL in algebra classrooms (Creswell, 2014), the conceptual framework was built to better understand the phenomena of how students learn algebra and the role technology plays in the process (Maxwell, 2013). The National Council of Teachers of Mathematics (NCTM) maintains students must build new mathematical knowledge through problem solving (NCTM, 2021), and a constructivist approach may support the effort (Moursund, 2007). While participants recommended teachers teach new concepts and students use IXL to supplement learning, the practice IXL offers with immediate feedback could help students better construct their knowledge. Allowing students to work collaboratively on IXL assignments provides opportunities for mathematical discourse to co-create knowledge (Clements & Battista, 1990; Lessani et al., 2016). Students practicing on IXL and receiving immediate feedback may remain more engaged in their learning while constructing new knowledge, supporting Kearsley and Shneiderman's (1998) research on engagement theory.

In conclusion, teachers should work to build relationships with students and motivate them to learn. When implementing IXL, teachers should assign skills purposefully and strategically, remaining engaged with the students for the duration of the online practice. The researcher found participants deeply cared for their students and worked each day to improve

learning in their classrooms. Participants in this study are actively improving student achievement through the use of IXL. Recommendations and findings from this study, if implemented with fidelity, can positively impact learners in Georgia, and perhaps, across the nation.

REFERENCES

Abedi, R., Ahmadabadi, M. R., Taghiyareh, F., Aliabadi, K., & Ardakani, S. P. (2021, September). The effects of personalized learning on achieving meaningful learning outcomes. *Interdisciplinary Journal of Virtual Learning in Medical Sciences, 12*(3), 177-187. https://doi.org/10.30476/ijvlms.2021.89371.1072

Allen, J., Pianta, R., Gregory, A., Mikami, A., & Lun, J. (2011, August 19). An interactive-based approach to enhancing secondary school instruction and student achievement. *Science, 333*, 1034-1037. http://doi.org/10.1126/science.1207998

Alivernini, F., & Lucidi, F. (2011). Relationship between social context, self-efficacy, motivation, academic achievement, and intention to drop out of high school: A longitudinal study. *The Journal of Educational Research, 104*(4), 241-252. https://doi.org/10.1080/00220671003728062

Ary, D., Jacobs, L., Irvine, C., & Walker, D. (2019). *Introduction to research in education*. Cengage Learning Inc.

Baier, F., Decker, A. T., Voss, T., Kleickmann, T., Klusmann, U., & Kunter, M. (2018). What makes a good teacher? The relative importance of mathematics teachers' cognitive ability, personality, knowledge, beliefs, and motivation for instructional quality. *British Journal of Educational Psychology, 89*(4), 767-786. https://doi.org/10.1111/bjep.12256

Baliram, N., & Ellis, A. K. (2019). The impact of metacognitive practice and teacher feedback on academic achievement in mathematics. *School Science and Mathematics, 119*(2), 94-104. https://doi.org/10.1111/ssm.12317

Benjamin, Jr., L. T. (2009). The birth of American intelligence testing. *American Psychological Association, 40.* https://www.apa.org/monitor/2009/01/assessment

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day.* ISTE Press.

Budinski, N., & Milinkovic, D. (2017). Transition from realistic to real world problems with the use of technology in elementary mathematical education. *Acta Didactica Napocensia, 10*(1), 53-62. https://eric.ed.gov/?id=EJ1146298

Burke, M. A., & Sass, T. R. (2008). Classroom peer effects and student achievement. *Working Paper Series (Federal Reserve Bank of Boston), 8*(5), 1-46. https://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?vid=18&sid=0165bd2c-1699-44d4-94a8-9c05f27f5219%40pdc-v-sessmgr01

Burkett, T. (2018, January 18). Norm-referenced testing and criterion-referenced testing. *Computer Science.* https://doi.org/10.1002/9781118784235.eelt0351

Cardino, J. M., Jr., & Ortega-Dela Cruz, R. A. (2020). Understanding of learning styles and teaching strategies towards improving the teaching and learning of mathematics. *International Journal on Math, Science and Technology Education, 8,* 19-43. https://doi.org/10.31129/LUMAT.8.1.1348

Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum, 41*(5), 545-547. https://doi.org/10.1188/14.ONF.545-547

Clark, K. (2006). Practices for the use of technology in high schools: A Delphi study. *Journal of Technology and Teacher Education, 14*(3), 481-499. https://www.proquest.com/scholarly-journals/practices-use-technology-high-schools-delphi/docview/200078948/se-2?accountid=14800

Clements, D. H., & Battista, M. T. (1990). Research into practice: Constructivist learning and teaching. *The Arithmetic Teacher, (38)*, 34-35. https://doi.org/10.5951/AT.38.1.0034

Cole, S. A. (2017). *The impact of parental involvement on academic achievement.* (Publication No. 10602196). [Doctoral dissertation, Northcentral University]. ProQuest Dissertations Publishing.

College Board. (2021). *Benefits.* https://collegereadiness.collegeboard.org/about/benefits

Cox, R. D. (2015). "You've got to learn the rules": A classroom-level look at low pass rates in developmental math. *Community College Review, 43*(3), 264-286. https://doi.org/10.1177/0091552115576566

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications, Inc.

Donnelly, S. M. (2021). *A study of the effectiveness of IXL math online software on student achievement in an urban middle school.* (Publication No. 28255659) [Doctoral dissertation, St. John's University]. ProQuest Dissertations Publishing.

Douglas-McNab, E. (2013, February 22). *Achievement vs. growth: What K-12 talent managers need to know.* Education Week. https://www.edweek.org/leadership/opinion-achievement-vs-growth-what-k-12-talent-managers-need-to-know/2013/02

Durksen, T., Way, J., Bobis, J., Anderson, J., Skilling, K., & Martin, A. J. (2017). Motivation and engagement in mathematics: A qualitative framework for teacher-student interactions. *Mathematics Education Research Journal, 29,* 163-181. http://dx.doi.org/10.1007/s13394-017-0199-1

Education Consolidation and Improvement Act, H.R.394. (1981). https://www.congress.gov/bill/97th-congress/house-bill/3941?s=1&r=75

Fazal, M., Panzano, B., & Luk, K. (2020). Evaluating the impact of blended learning: A mixed-methods study with difference-in-different analysis. *TechTrends, 64*, 70-78. https://doi.org/10.1007/s11528-019-00429-8

Frankenberg, E. & Taylor, K. (2015). ESEA and the Civil Rights Act: An interbranch approach to furthering desegregation. *RSF: The Russell Sage Foundation Journal of the Social Sciences, 1*(3), 32-49. https://doi.org/10.7758/RSF.2015.1.3.02

Frankfurt International School. (n.d.). *The factors that influence the acquisition of a second language.* http://esl.fis.edu/teachers/support/factors.htm

Frazier, A. Y. (2020). *The impact of blended learning upon mathematics attitudes and academic achievement: An action research study* [Doctoral dissertation, University of South Carolina]. Scholar Commons.

Frey, B. B. (2018). *The SAGE encyclopedia of educational research, measurement, and evaluation.* SAGE Publications, Inc. https://doi.org/10.4135/9781506326139

Fyfe, E. R., & Rittle-Johnson, B. (2016). The benefits of computer-generated feedback for mathematics problem solving. *Journal of Experimental Child Psychology, 147*, 140-151. https://doi.org/10.1016/j.jecp.2016.03.009

Galvan, J. L. (2006). *Writing literature reviews: A guide for students of the Social and Behavior Sciences.* Pyrczak Publishing.

Gentrup, S., Lorenz, G., Kristen, C., & Kogan, I. (2020). Self-fulfilling prophecies in the classroom: Teacher expectations, teacher feedback and student achievement. *Learning and Instruction, 66*. https://doi.org/10.1016/j.learninstruc.2019.101296

Georgia Department of Education. (n.d.) *Georgia's race to the top (RT3) plan*. https://www.gadoe.org/Race-to-the-

Top/Pages/default.aspx#:~:text=The%20Race%20to%20the%20Top,new%20approaches%20to%20school%20improvement.

Georgia Department of Education. (2013). *Georgia's Criterion-Referenced Competency Tests (CRCTs): Questions and answers for parents of Georgia students in grades 3-8.* https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Documents/CRCT%202013%20Parent%20Brochure%20Final.pdf

Georgia Department of Education. (2018). *Georgia milestones 2017-2018 statewide scores.* https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages/Georgia-Milestones-2017-2018-Statewide-Scores.aspx

Georgia Department of Education. (2018a). *Georgia student growth model: Frequently asked questions.* https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Documents/GSGM/GSGM-18/SGP_FAQ.pdf

Georgia Department of Education. (2019). *Georgia milestones 2018-2019 statewide scores.* https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages/Georgia-Milestones-2018-2019-Statewide-Scores.aspx

Georgia Department of Education. (2020). *Georgia Milestones Assessment System.* https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages/Georgia-Milestones-Assessment-System.aspx#:~:text=Georgia%20Milestones%20is%20a%20single,for%20specified%20high%20school%20courses

Georgia Department of Education. (2020a). *Georgia Student Growth Model.* https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages/Georgia-Student-Growth-Model.aspx

Georgia Department of Education. (2020b). *College and Career Ready Performance Index.* https://www.gadoe.org/CCRPI/Pages/default.aspx

Georgia Department of Education. (2020c). *Statewide Longitudinal Data System (SLDS) Dashboard.* https://www.gadoe.org/Technology-Services/Enterprise-Systems-and-Applications/SLDS/Pages/SLDS.aspx

Georgia Department of Education. (2020d). *Georgia Standards of Excellence.* https://www.georgiastandards.org/Georgia-Standards/Pages/default.aspx

Georgia Department of Education. (2020e). *2018 College and Career Ready Performance Index (CCRPI).* http://ccrpi.gadoe.org/Reports/Views/Shared/_Layout.html

Georgia Department of Education. (2020f). *2019 College and Career Ready Performance Index (CCRPI).* http://ccrpi.gadoe.org/Reports/Views/Shared/_Layout.html

Georgia Department of Education. (2020g). *Accountability.* https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Accountability/Pages/default.aspx

Georgia Department of Education. (2021). *Georgia Student Growth Model.* https://gastudentgrowth.gadoe.org/

Georgia Department of Education. (2021a). *Georgia Standards of Excellence.* https://www.georgiastandards.org/Georgia-Standards/Pages/default.aspx

Georgia Department of Education. (2021b). *Assessment Blueprint.* https://www.gadoe.org/Curriculum-Instruction-and-

Assessment/Assessment/Documents/Milestones/Blueprints/GA_EOC_Algebra1_Blueprint_July_2021.pdf

Gorman, S. (2010). *An introduction to NAEP*. National Center for Education Statistics. https://nces.ed.gov/nationsreportcard/pdf/parents/2010468.pdf

Governor's Office of Student Achievement. (n.d.) *Retired Georgia assessments.* https://gosa.georgia.gov/report-card-dashboards-data/report-card/contents-report-card/retired-georgia-assessments

Governor's Office of Student Achievement. (n.d.a.) *Downloadable data explained – GA milestone assessments.* https://gosa.georgia.gov/ga-milestone-assessments-explained

Governor's Office of Student Achievment. (n.d.b.) *Community partnership grants: High-need, rural school district list.* https://gosa.georgia.gov/document/document/click-here-map-and-list-high-need-rural-school-districts/download

Gravemeijer, K., Stephan, M., Julie, C., Lin, F., & Ohtani, M. (2017). What mathematics education may prepare students for the society of the future? *International Journal of Science and Mathematics Education, 15*(S1), 105-123. https://doi.org/10.1007/s10763-017-9814-6

Greene, B. A., Miller, R. B., Crowson, H. M., Duke, B. L., & Akey, K. L. (2004). Predicting high school students' cognitive engagement and achievement: Contributions of classroom perceptions and motivation. *Contemporary Educational Psychology, 29*(4), 462-482. https://doi.org/10.1016/j.cedpsych.2004.01.006

Greenway, G. H. (2017). *Relationship between school climate and student achievement* [Unpublished doctoral dissertation]. Georgia Southern University.

Hampton, N. Z., & Mason, E. (2003). Learning disabilities, gender, sources of efficacy, self-efficacy beliefs, and academic achievement in high school students. *Journal of School Psychology, 41*(2), 101-112. https://doi.org/10.1016/S0022-4405(03)00028-1

Hara, S. R. & Burke, D. J. (1998). Parent involvement: The key to improved student achievement. *The School Journal, 8*(2), 9-19. https://psycnet.apa.org/record/2003-07880-001

Hattie, J., & Temperley, H. (2007). The power of feedback. *Review of Educational Research, 77*, 81-112. https://doi.org/10.3102/003465430298487

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning.* Routledge.

Haug, M. E. & Wasonga, T. (2021). Understanding how leadership matters: Collective efficacy and student achievement. *Athens Journal of Education, 8*(2), 197-220. https://files.eric.ed.gov/fulltext/EJ1296964.pdf

Hegedus, S. J., Dalton, S., & Tapper, J. R. (2015). The impact of technology-enhanced curriculum on learning advanced algebra in US high school classrooms. *Educational Technology Research and Development, 63*, 203-228. https://doi.org/10.1007/s11423-015-9371-z

Hill, N. E. & Craft, S. A. (2003). Parent-school involvement and school performance: Mediated pathways among socioeconomically comparable African American and Euro-American families. *Journal of Educational Psychology, 95,* 74-83. https://doi.org/10.1037/0022-0663.95.1.74

Hogan, J., Dolan, P., & Donnelly, P. (2009). *Approaches to qualitative research: Theory and its practical application.* Oak Tree Press.

Howton, R. (2021, September 24). *Turn your classroom into a personalized learning environment.* ISTE. https://www.iste.org/explore/personalized-learning/turn-your-classroom-personalized-learning-environment

Hughey, J. (2020). Individual personalized learning. *Educational Considerations, 46*(2). https://doi.org/10.4148/0146-9282.2237

International Society for Technology in Education. (2021). *ISTE.* https://www.iste.org/

International Society for Technology in Education. (2021a). *ISTE.* https://www.iste.org/about/about-iste

International Society for Technology in Education. (2021b). *ISTE Standards for Educators.* https://www.iste.org/standards/iste-standards-for-teachers

Isik, A. D. (2018). Use of technology in constructivist approach. *Educational Research and Reviews, 13*(21), 704-711. https://doi.org/10.5897/ERR2018.3609

IXL. (2017, July 13). *The IXL effect: Measuring the impact of IXL math and IXL language arts in Georgia schools.* IXL. https://www.ixl.com/research/Impact-of-IXL-in-Georgia.pdf

IXL. (2021). *Our Story.* IXL Learning. https://www.ixl.com/company/story

IXL. (2021a). *IXL*. https://www.ixl.com/

IXL. (2021b). *IXL*. https://www.ixl.com/company/ixl

IXL. (2021c). *IXL.* https://www.ixl.com/diagnostic/

IXL. (2021d). *IXL.* https://www.ixl.com/standards/georgia/math

IXL. (2021e). *IXL Group Jam: A Fun Way to Collaborate.* https://blog.ixl.com/2021/09/08/ixl-group-jam-a-fun-way-to-collaborate/#:~:text=IXL%20Group%20Jam%20allows%20teachers,an%20easier%20or%20harder%20question.

IXL. (2022). *IXL.* https://www.ixl.com/help-center/article/6904397/how_can_i_use_the_live_classroom_report#:~:text=In%20the%20Live%20Classroom%20report,a%20tile%20in%20Live%20Classroom.

IXL. (2022a). *The IXL Real-Time Diagnostic.* https://www.ixl.com/diagnostic

John, J. E., Nelson, P. A., Klenczar, B., & Robnett, R. D. (2020). Memories of math: Narrative predictors of math affect, math motivation, and future math plans. *Contemporary Educational Psychology, 60*. https://dx.doi.org/10.1016/j.cedpsych.2020.101838

Jones, J. (2012). *The external and internal educational factors that contribute to student achievement and self-perceptions of urban middle school Title I students* (Publication No. 240) [Doctoral dissertation, Rowan University]. Rowan Digital Works.

Kaya, H. (2015). Blending technology with constructivism: Implications for an ELT classroom. *Teaching English with Technology, 15*, 3-13. https://files.eric.ed.gov/fulltext/EJ1140571.pdf

Kearney, W. S., & Garfield, T. (2019). Student readiness to learn and teacher effectiveness: Two key factors in middle grades mathematics achievement. *Research in Middle Level Education Online, 42*(5), 1-12. https://doi.org/10.1080/19404476.2019.1607138

Kearsley, G., & Shneiderman, B. (1998). Engagement theory: A framework for technology-based teaching and learning. *Educational Technology, 38*(5), 20-23. https://www.jstor.org/stable/44428478

Konold, T., Cornell, D., Jia, Y, & Malone, M. (2018). School climate, student engagement, and academic achievement: A latent variable, multilevel multi-informant examination. *AERA Open, 4*(4), 1-17. https://doi.org/10.1177/2332858418815661

Kunter, M., Klusmann, U., Baumert, J., Richeter, D., Thamar, V., & Hachfeld, A. (2013). Professional competence of teachers: Effects on instructional quality and student development. *Journal of Educational Psychology, 105*(3), 805-820. https://doi.org/10.1037/a0032583

Lavrijsen, J., Vansteenkiste, M., Boncquet, M., & Verschueren, K. (2021). Does motivation predict changes in academic achievement beyond intelligence and personality? A multitheoretical perspective. *Journal of Educational Psychology.* http://dx.doi.org/10.1037/edu0000666

Lessani, A., Yunus, A. S., Bakar, K. A., & Khameneh, A. Z. (2016). Comparison of learning theories in mathematics teaching methods. *PEOPLE: International Journal of Social Sciences, 3*(2), 1285-1297. https://dx.doi.org/10.20319/pijss.2017.32.12851297

Library of Congress. (1988). *Elementary and secondary education: A summary of Augustus F. Hawkins-Robert T. Stafford Elementary and Secondary School Improvement Adments of 1988, Public Law 100-297.* https://files.eric.ed.gov/fulltext/ED347611.pdf

Lim, C. P., Zhao, Y., Tondeur, J., Chai, C. S., & Tsai, C. (2013). Bridging the gap: Technology trends and use of technology in schools. *Journal of Educational Technology & Society, 16*(2), 59-68. https://www.jstor.org/stable/10.2307/jeductechsoci.16.2.59

Malik, A., & Terry, M. (2021). Factors that affect grade nine students in Northern Manitoba, Canada. *Journal of Graduate Studies in Education, 13*(3), 55-65. https://files.eric.ed.gov/fulltext/EJ1306814.pdf

Marcon, R. A. (2019). Positive relationships between parent school involvement and public school inner-city preschoolers' development and academic performance. *School Psychology Review, 28*, 395-412. https://doi.org/10.1080/02796015.1999.12085973

Matthews, J. S. (2018). When am I ever going to use this in the real world? Cognitive flexibility and urban adolescents' negotiation of the value of mathematics. *Journal of Educational Psychology. 110*(5), 726-746. https://doi.org/10.1037/edu0000242

Maxwell, J. (2013). *Qualitative research design: An interactive approach*. Sage Publications, Inc.

McPartlan, P., Umarji, O., & Eccles, J. S. (2020). Selective importance in self-enhancement: Patterns of feedback adolescents use to improve math self-concept. *Journal of Early Adolescence, 41*(2), 253-281. https://doi.org/10.1177/0272431620912487

Mercer Publishing. (2021). *Iowa Test of Basic Skills (ITBS) overview.* https://www.mercerpublishing.com/itbs/

Merriam, S. (2002). *Qualitative research in practice: Examples for discussion and analysis.* Jossey-Bass.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook of new methods.* Sage Publications, Inc.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook.* Sage Publications, Inc.

Mishra, P., Koehler, M. J., & Kereluik, K. (2009). The song remains the same: Looking back to the future of educational technology. *TechTrends, 53*(5), 48-53. https://doi.org/10.1007/s11528-009-0325-3

Moursund, D. (2007, November 11). Constructivism, situated learning, and other learning theories. *University of Oregon.* https://darkwing.uoregon.edu/~moursund/Math/learning-theories.htm

Multon, K. D., Brown, S. D., & Lent, R. W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counseling Psychology, 38*, 30-38. https://doi.org/10.1037/0022-0167.38.1.30

Muir-Herzig, R. G. (2004). Technology and its impact in the classroom. *Computers & Education, 42*(2), 111-131. https://doi.org/10.1016/S0360-1315(03)00067-8

Murphy, D. (2016). A literature review: The effect of implementing technology in a high school mathematics classroom. *International Journal of Research in Education and Science, 2*(2), 295-299. https://files.eric.ed.gov/fulltext/EJ1105104.pdf

National Center for Education Statistics. (n.d.). *Program for International Student Assessment (PISA).* https://nces.ed.gov/surveys/pisa/

National Center for Education Statistics. (2018). *Program for International Student Assessment (PISA).* https://nces.ed.gov/surveys/pisa/index.asp

National Center for Education Statistics. (2021). *National Center for Education Statistics.* https://nces.ed.gov/

National Center for Education Statistics. (2021a). *National Assessment of Educational Progress.* https://nces.ed.gov/nationsreportcard/state/

National Center for Education Statistics. (2021b). *About NAEP.* https://nces.ed.gov/nationsreportcard/about/

National Council of Teachers of Mathematics. (2021) *Process.* https://www.nctm.org/Standards-and-Positions/Principles-and-Standards/Process/

National Education Association. (2021). *About NEA.* https://www.nea.org/about-nea

National Education Association. (2021a). *History of Standardized Testing in the United States.* https://www.nea.org/professional-excellence/student-engagement/tools-tips/history-standardized-testing-united-states

National Research Council. (1999). Assessment of student performance: Standards-based assessment. In R. F. Elmore & R. Rothman, (Eds.), *Testing, teaching, and learning: A guide for states and school districts* (pp. 42-73). National Academy Press. https://www.nap.edu/read/9609/chapter/6

Organization for Economic Co-operation and Development. (n.d.). *Programme for International Student Assessment.* https://www.oecd.org/pisa/#

Pan, L., Zhong, T. T., & Zhang, X. Y. (2020). A study of the effects of school environment, teacher identity, and students' self-efficacy and interpersonal relationship on learning outcomes of students in the universities in Hainan, China. *International Journal of Organizational Innovation, 13*(1), 290-302.

Parsons, S. A., Malloy, J. A., Parsons, A. W., Peters-Burton, E. E., & Burrowbridge, S. C. (2018). Sixth-grade students' engagement in academic tasks. *Journal of Educational Research, 111*(2), 232-245. https://doi.org/10.1080/00220671.2016.1246408

Patton, M. (1999). Enhancing the quality and credibility of qualitative analysis. *Health Sciences Research, 34*(5), 1189-1208.

Patton, M. (2002). *Qualitative research & evaluation methods.* Sage Publications, Inc.

Patton, M. (2015). *Qualitative research & evaluation methods.* Sage Publications, Inc.

Paul, C. A. (2018, April 29). *Elementary and secondary education act of 1965.* VCU Libraries Social Welfare History Project.

https://socialwelfare.library.vcu.edu/programs/education/elementary-and-secondary-education-act-of-1965/

Peshkin, A. (1991). *The color of strangers, the color of friends: The play of ethnicity in school and community.* University of Chicago Press.

Phan, T. (2020). Exercises of voice, choice, and collaboration in a personalized learning initiative. *Educational Media International, 57*, 73-85. https://doi.org/10.1080/09523987.2020.1744859

Poldin, O., Valeeva, D., & Yudkevich, M. (2016). Which peers matter: How social ties affect peer-group effects. *Research in Higher Education, 57*(4), 448-468. https://doi.org/10.1007/s11162-015-9391-x

Public Broadcasting Service. (2014). *History of the SAT: A timeline.* https://www.pbs.org/wgbh/pages/frontline/shows/sats/where/timeline.html

Ravitch, S. M., & Riggan, M. (2017). *Reason & rigor: How conceptual frameworks guide research.* Sage Publications, Inc.

Roberts, C. M. (2010). *The dissertation journey: A practical and comprehensive guide to planning, writing, and defending your dissertation.* Sage Publications, Inc.

Saldana, J. (2016). *The Coding Manual for Qualitative Researchers* (3rd ed.). Sage Publications, Inc.

Sanders, R. J. (2019). *A program evaluation of the impact of the IXL program on high school students' mathematical skills.* (Publication No. 27668269) [Doctoral dissertation, Wingate University]. ProQuest Dissertation Publishing.

Sawatzki, C., & Sullivan, P. (2018). Shopping for shoes: Teaching students to apply and interpret mathematics in the real world. *International Journal of Science and Mathematics Education, 16*, 1355-1373. https://doi.org/10.1007/s10763-017-9833-3

Schacter, J., & Fagnano, C. (1999). Does computer technology improve student learning and achievement? How, when, and under what conditions? *Journal of Educational Computing Research, 20*(4), 329-343. https://journals.sagepub.com/doi/pdf/10.2190/VQ8V-8VYB-RKFB-Y5RU

Schindler, J., Jones, A., Williams, A. D., Taylor, C., & Cardenas, H. (2016). The school climate – Student achievement connection: If we want achievement gains, we need to begin by improving the climate. *Journal of School Administration Research and Development, 1*, 99-16. https://files.eric.ed.gov/fulltext/EJ1158154.pdf

Seidman, I. (2013). *Interviewing as qualitative research.* Teachers College Press.

Sheffler, P. C., & Cheung, C. S. (2020). The role of peer mindsets in students' learning: An experimental study. *The British Journal of Educational Psychology, 90*, 17-37. https://doi.org/10.1111/bjep.12299

Siegler, R. S., Duncan, G. J., Davis-Kean, P. E., Ductwork, K., Claessens, A., Engle, M., Susperreguy, M. I., & Chen, M. (2012). Early predictors of high school mathematics achievement. *Psychological Science, 23*(7), 691-697. https://doi.org/10.1177/0956797612440101

Singh, K., Granville, M., & Dika, S. (2010). Mathematics and science achievement: Effects of motivation, interest, and academic engagement. *The Journal of Educational Research, 95*(6), 323-332. https://doi.org/10.1080/00220670209596607

Skaalvik, E. M., Federici, R. A., & Klassen, R. M. (2015). Mathematics achievement and self-efficacy: Relations with motivation for mathematics. *International Journal of Educational Research, 72*, 129-136. http://dx.doi.org/10.1016/j.ijer.2015.06.008

Smithsonian. (n.d.). *College entrance examinations.* National Museum of American History: Behring Center. https://americanhistory.si.edu/collections/search/object/nmah_1408575

Smokoska, L. (2020). *An investigation of parental involvement and student academic achievement in middle school.* (Publication No. 4786) [Master's thesis, Eastern Illinois University]. The Keep.

Squires, V. (2019). The well-being of the early career teacher: A review of the literature on the pivotal role of mentoring. *International Journal of Mentoring and Coaching in Education, 8*(4), 255-267. http://doi.org/10.1108/IJMCE-02-2019-0025

Stake, R. E. (1995). *The art of case study research.* Sage Publications, Inc.

Stephenson, D. L. & Baker, D. P. (1987). The family-school relation and then child's school performance. *Child Development, 58*(5), 1348-1357. https://doi.org/10.2307/1130626

Sugimoto, A. T., Turner, E. E., & Stoehr, K. J. (2017). A case study of dilemmas encountered when connecting middle school mathematics instruction to relevant real world examples. *Middle Grades Research Journal, 11*(2), 61-82.

Sullivan, M. M. (2020). *How do middle grade teachers at a rural school utilize IXL in the classroom?* (Publication No. 27830807) [Master's thesis, Eastern Oregon University]. ProQuest Dissertations Publishing.

The Princeton Review. (2021). *What is the ACT?* https://www.princetonreview.com/college/act-information

Topor, D. R., Keane, S. P., Shelton, T. L., & Calkins, S. D. (2010). Parent involvement and student academic performance: A multiple mediational analysis. *Journal of Prevention & Intervention in the Community, 38*(3), 183-197. https://doi.org/10.1080.10852352.2010.486297

U.S. Department of Education. (n.d.). *Every Student Succeeds Act (ESSA).* https://www.ed.gov/essa?src=rn

U.S. Department of Education. (1995). *The Improving America's School Act of 1994.* https://www2.ed.gov/offices/OESE/archives/legislation/ESEA/brochure/iasa-bro.html

U.S. Department of Education. (2004, February 10). *Executive summary.* https://www2.ed.gov/nclb/overview/intro/execsumm.html

Vagle, M. D. (2018). *Crafting phenomenological research.* Routledge.

van Manen, M. (2016). *Phenomenology of practice.* Routledge.

Widmaier, W. W. (2004). Theory as a factor and the theorist as an actor: The "Pragmatist Constructivist" lessons of John Dewey and John Kenneth Galbraith. *International Studies Review, 6*(3), 427-445. https://jstor.org/stable/3699698

Wigfield, A., & Cambria, J. (2010). Students' achievement values, goal orientations, and interest: Definitions, development, and relations to achievement outcomes. *Developmental Review, 30*, 1-35. https://doi.org/10.1016/j.dr.2009.12.001

Xyst, K. (2016). Constructivism, Dewey, and academic advising. *NACADA Journal, 36*(2), 11-19. https://doi.org/10.12930/NACADA-14-027

Yin, R. K. (2018). *Case study research and applications: Design and methods.* Sage Publications, Inc.

Yu, R., & Singh, K. (2018). Teacher support, instructional practices, student motivation, and mathematics achievement in high school. *The Journal of Educational Research, 111*, 81-94. https://doi.org/10.1080/00220671.2016.1204260

Zee, M., Rudasill, K. M., & Bosman, R. J. (2021). A cross-lagged study of students' motivation, academic achievement, and relationships with teachers from kindergarten to 6th grade. *The Journal of Educational Psychology, 113(*6), 1208-1226. https://dx.doi.org/10.1037/edu0000574

Appendix A

Request to Conduct Research

January 19, 2022

[redacted]

Dear Dr. [redacted]

My name is Lindsay Thompson and I am a doctoral student at Valdosta State University.

As I am sure you are aware, Georgia high school mathematics students consistently score poorly on the Algebra I and Geometry Georgia Milestone assessments. Through my study, entitled "A Phenomenological Qualitative Study on Successful Algebra Teachers' Perceptions of the Implementation and Use of IXL," I will explore how successful algebra teachers use the online resource IXL and the key factors they believe affect student learning.

Through a series of interviews with successful algebra teachers, and with the guidance of my dissertation committee researcher, Dr. Bill Truby, I hope to provide school districts effective strategies used with IXL in the classroom to improve student achievement. I hope to also identify key factors affecting student learning, as perceived by successful algebra teachers.

I am writing seeking your permission to speak to two algebra teachers in your school district who use IXL in their classrooms, have had high student achievement for three years as indicated by the student growth model, and whose principal considers them to be successful algebra teachers. Interviews will be conducted at times convenient for the teacher and will not involve any student data. My research proposal has been approved by Valdosta State University and your permission is the final evidence I need to complete the IRB application process. If you are willing to allow me to speak to two teachers who meet these criteria, please write a short Letter of Cooperation/Permission that I may include with my application. Thank you so much for your help!

Sincerely,

Lindsay Thompson, Ed. S.

Questions regarding the purpose or procedures of the research should be directed Lindsay Thompson at lmbeck@valdosta.edu. This study has been approved by the Valdosta State University Institutional Review Board (IRB) for the Protection of Human Research Participants. The IRB, a

university committee established by Federal law, is responsible for protecting the rights and welfare of research participants. If you have concerns or questions about your rights as a research participant, you may contact the IRB Administrator at 229-253-2947 or irb@valdosta.edu.

Appendix B

District Approval to Conduct Research

[redacted]

Office of Sponsored Programs and Research Administration

Valdosta State University

1500 N. Patterson Street

Valdosta, GA 31698

To Whom It May Concern,

After review of her information, I give Lindsay Thompson, graduate student at Valdosta State University, permission to conduct research for her study entitled "A Phenomenological Qualitative Study on Successful Algebra Teachers' Perceptions of the Implementation and Use of IXL" within the [redacted] school system.

Thank you,

[redacted]

Principal

[redacted]

[redacted] BOARD OF EDUCATION

[redacted]

January 28, 2022

Dear Ms. Thompson,

As part of your final IRB step, the [redacted] District is happy to support your research endeavor. [redacted], the district's Executive Director of Secondary Education, is currently stationed at [redacted] School. He will serve as your contact and connection to [redacted] School. Both of these gentlemen will be your best guide to finding the teachers you need with the correct credentials and experience.

We look forward to seeing the results of your investigation if you choose to share them with us!

Sincerely,

[redacted]
Assistant Superintendent of Curriculum & Instruction

[redacted]

February 3, 2022

Office of Sponsored Programs and Research Administration

Valdosta State University

1500 N. Patterson Stre et,

Valdosta, GA 31698

To Whom It May Concern ,

After review of the Information provided, I grant Lindsay Thompson, graduate student at Valdosta State University permission to conduct Interviews with 2 Algebra teachers at [redacted] School. These interviews will be coordinated and approved through [redacted] School's principal and will be conducted at times convenient for the teacher and will not involve any student data.

Please note that this communication only grants permission for Ms. Thompson to gather information within the parameters of this letter. If any additional information is sought or Is requested then Ms. Thompson will be required to complete the full IRB process as outlined for [redacted] Schools.

Sincerely,

[redacted]

Superintendent

[redacted]

Schools Phone [redacted]

[redacted]

Superintendent

Office of Sponsored Programs and Research Administration
Valdosta State University
1500 N. Patterson Street
Valdosta, GA 31698

March 21, 2022

To Whom It May Concern,

After review of her information, I give Lindsay Thompson, a graduate student at Valdosta State University, permission to conduct research for her study entitled "A Phenomenological Qualitative Study on Successful Algebra Teachers' Perceptions of the Implementation and Use of IXL" within the Thomas County School System.

Sincerely,

[redacted]

Superintendent

Appendix C

Letter to Applicants

[redacted]

From: Lindsay Thompson

Date: January 20, 2022

Subject: Request to participate in research study

My name is Lindsay Thompson and I am an Educational Leadership doctoral student from the Department of Leadership, Technology, and Workforce Development at Valdosta State University. I would like to invite you to participate in my research study that will identify the life and career experiences of high school algebra teachers who use IXL in rural South Georgia, strategies used for implementing IXL in the math classroom, and key factors that may affect students and how they learn.

You seem like an ideal candidate for this qualitative study. You were selected as a possible participant because you are a high school algebra teacher in a rural South Georgia school district, have high student achievement, and were recommended by your principal.

If you agree to participate, two interviews that will last approximately an hour each will be scheduled at your convenience. My goal is to space the two interviews roughly a week apart. Interviews will be recorded and any audio recordings will be destroyed upon completion of my dissertation.

There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life.

All data collected will be confidential. A pseudonym will be used for your name as well as the name of your school district. In the data analysis portion of my dissertation, quotes from the interviews will be used to support themes in the study. No one will be able to associate your

responses with your identity. You can expect data from the interviews to further add to the research on student achievement, factors affecting student achievement, and the implementation of IXL.

Participation in this research study is voluntary. You may choose not to participate in the interview, to stop answering questions at any point in the interview, or to skip any questions you do not wish to answer. You must be a high school algebra teacher in a rural South Georgia district to participate in this project. Your completion of the interview series will serve as your voluntary agreement to participate in this research project and your certification that you meet the criteria outlined.

Questions regarding the purpose or procedures of this research study should be directed to Lindsay Thompson at [redacted] or lmbeck@valdosta.edu. This study has been exempted from Institutional Review Board (IRB) review in accordance with Federal regulations. The IRB, a university committee established by Federal law, is responsible for protecting the rights and welfare of research participants. If you have concerns or questions about your rights as a research participant, you may contact IRB administration at 229-259-5045 or by email at irb@valdosta.edu.

I greatly appreciate you taking the time to consider being a part of this research study and I look forward to hearing from you very soon.

Sincerely,

Lindsay Thompson

Doctoral Candidate, Educational Leadership

Cell: [redacted]

lmbeck@valdosta.edu

Appendix D

Interview Guide

Interview Questions

Initial Interview

1. Please tell me about your childhood.
    a. What was your family structure?
    b. What jobs/careers did your parents have?
    c. Where did you grow up? Tell me about your hometown.
    d. What was your relationship like with your parents?
    e. Do you have siblings? What was your relationship like with them?

2. Please tell me about your educational experiences.
    a. Elementary School
        i. What are your first memories of school?
        ii. Tell me about your favorite elementary teacher.
            1. Was he/she the best teacher you ever had?
        iii. Tell me about a positive elementary school memory.
        iv. Tell me about a negative elementary school memory.
    b. Middle School
        i. What are your memories of middle school?
        ii. Tell me about your favorite middle school teacher.
            1. Was he/she the best teacher you even had?
        iii. Tell me about a positive middle school memory.
        iv. Tell me about a negative middle school memory.
    c. High School
        i. What are your memories of high school?
        ii. Tell me about your favorite high school teacher.
            1. Was he/she the best teacher you even had?
        iii. Tell me about a positive high school memory.
        iv. Tell me about a negative high school memory.
    d. Tell me about any school-related activities you were involved in. (sports, band, clubs, etc)
    e. Tell me about any community-related activities you were involved in.
    f. How do you think your peers would have described you in school?
    g. Would you describe your elementary, middle, and high school experiences as positive? Why or why not?

3. Please tell me about your career journey.
    a. What did you want to be when you were growing up?
    b. After high school graduation, what did you do?
    c. Tell me about your college experience.
    d. How did you decide to become a teacher?
        i. How did you decide to teach math?

e. What were your early career experiences like? What specific memories do you have of your first years teaching?
f. Tell me about any mentors you have had as a math teacher. How have they helped you become an effective teacher?
g. Tell me about any of your committee or leadership roles within the school.
h. What are the most positive and negative aspects of being a teacher, specifically for you?
i. What are the best experiences you have had as a math teacher?
j. What are the most difficult experiences you have had as a math teacher?

Follow-up Interview

1. Tell me about your school.

2. How is your department organized?
    a. Do you have a department chair? What does he/she do?
    b. Do you meet collaboratively with other math teachers in your department?

3. How many years have you taught math in this district?

4. Have you taught math in other districts? If yes, for how many years?

5. Please tell me about how you teach algebra.
    a. Tell me about a typical day in your class when you are teaching a new concept.
    b. Tell me about a typical day in your class when students are practicing what you have already taught.

6. For how many years have you used IXL in your classroom?

7. What do you like about IXL?

8. What do you dislike about IXL?

9. Did you have any formal professional learning on how to use IXL in the classroom?
    a. If yes, who led the professional learning?

10. What support do you have when using digital learning tools?

11. Tell me how you incorporate IXL into your lesson plans.
    a. Do students only complete IXL assignments at school?
    b. Do students complete IXL assignments for homework?

c. Do students use IXL to learn or to supplement their learning?
d. How do you hold students accountable for completing IXL assignments?

12. How do you use data from IXL to determine mastery of the algebra content?

13. What do you think is the best, or are the best, strategy/strategies to use with IXL?

14. What internal factors do you believe affect students learning mathematics?

15. What external factors do you believe affect students learning mathematics?

Appendix E

Institutional Review Board Approval

Institutional Review Board (IRB)
For the Protection of Human Research Participants

PROTOCOL EXEMPTION REPORT

Protocol Number: 04259-2022 **Responsible Researcher(s):** Lindsay Thompson

Supervising Faculty: Dr. William Truby

Project Title: *A Phenomenological Qualitative Study on Successful Algebra Teachers' Perceptions of the Implementation and Use of IXL.*

INSTITUTIONAL REVIEW BOARD DETERMINATION:

This research protocol is **exempt** from Institutional Review Board (IRB) oversight under 45 CFR 46.101(b) of the federal regulations **category 2**. If the nature of the research changes such that exemption criteria no longer apply, please consult with the IRB Administrator (irb@valdosta.edu) before continuing your research study.

ADDITIONAL COMMENTS:

- *This protocol has been approved to begin at the following school districts:*
  - [redacted]
- *Exempt guidelines **prohibit** the collection, storage, and/or sharing of recordings. Exempt protocol guidelines permit recording of interviews provided recordings are made to create an accurate transcript. Upon creation of the transcript, the recorded interview session must be immediately deleted from all devices.*
- *As part of the informed consent process, interview recordings must include the researcher reading aloud the consent statement, confirming participant's understanding, and establishing their willingness to take part in the interview. Participants must be offered a copy of the research statement. For documentation purposes, the transcript must include the reading of the consent statement.*
- *To maintain participant confidentiality, pseudonym lists must be kept in a separate file from corresponding name lists, email addresses, etc.*
- *Upon completion of the research study, collected data must be securely maintained (e.g. locked file cabinet, password protected computer, etc.) and accessible only by the researcher for a minimum of 3 years. At the end of the required time, collected data must be permanently destroyed.*

☒ ***If this box is checked, please submit any documents you revise to the IRB Administrator at irb@valdosta.edu to ensure an updated record of your exemption.***

Elizabeth Ann Olphie *01.21.2022*
Elizabeth Ann Olphie, IRB Administrator

Thank you for submitting an IRB application.
Please direct questions to irb@valdosta.edu or 229-253-2947.

Revised: 06.02.16