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THE EFFECTS OF AN INTERACTIVE ONLINE LEARNING PLATFORM ON SECOND-GRADE STUDENTS' MATHEMATICS PERFORMANCE

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ABSTRACT

As the effects of the COVID-19 pandemic continue to surface, educational deficits are the main concern for many educators across the United States. Research has spelled out various effects the global pandemic and remote learning has had on families, especially children and their academic progress. Regardless of the cause, educators are planning their approach on how to fill the educational gaps presented to them to ensure all students achieve academic success. While utilizing a single subject criterion changing quantitative methodology, the purpose of this study was to identify whether IXL Learning was a successful intervention for second-grade students demonstrating a need for remediation of place value skills, as measured by researcher-created, curriculum-based weekly assessments. Data shows a slight increase in weekly researcher-created, curriculum-based assessments centering around place value skills, a large number of exposed place value questions for each student, and a slight increase in place value scores. However, a general pattern of criterion shifting was not found while utilizing IXL Learning as an interventional practice. It is recommended that a blended educational approach with various components be utilized for instructing place value concepts at the second-grade level.

DEDICATION AND ACKNOWLEDGMENTS

The journey through this program would not have been possible without the continuous love and support of my wonderful husband, sons, and family. Following dreams sometimes means making sacrifices. Thank you for giving me grace through this phase of life. I love you!

To my cohort, we have supported each other through one of the most challenging obstacles to endeavor. Participating in an online cohort program may eliminate some of the personal relationships that an in-person program would promote. However, I have made some wonderful friends and engaged in a plethora of professional networking with my cohort.

To my colleagues, thank you for allowing me to steal your students, pick your brain, observe your classrooms, and ask you to revise my extra-long papers. To the administration, thank you for allowing me to utilize the data and daily practices working toward dissertation studies and assisting our students. Your support along the way has been crucial.

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Lastly, this work is dedicated to the mentor who put the thought of “Dr. Swartzfager” into my head all those years ago, Dr. Brian Maguire. Someday, I hope to prepare teachers as he prepared me starting in 4th grade, continuing into my undergraduate, graduate school and then to my first elementary classroom. I sure wish I could have seen him performing his “Dr. Brian and Friends” stories, skits, and songs to my personal children as they enter the same elementary school where he left such an impact.

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CHAPTER 1: INTRODUCTION

The Institute of Education Services indicates many United States (U.S.) students struggle with mathematics, including those with and without disabilities (Chhin et al., 2023). Even though high-quality instruction is provided in the general education setting today, still 15-20% of students are continuing to struggle with academic skills (Vanderbilt University, 2023). Despite targeted interventions in a Tier three or tertiary level of instruction, 30-50% of students will not respond appropriately or successfully to the general interventions provided by educators (Vanderbilt University, 2023). COVID has only exacerbated these disparities (Chhin et al., 2023), requiring a more immediate reaction. The pandemic has shifted the Response to Intervention (RTI) framework to a distribution curve, focusing on providing interventions in the core classroom in addition to the intervention setting (Del Mar, 2023). Previously, RTI was designed to assist in identifying students with learning disabilities and other behaviors, to assist in instructional quality, and to provide students with opportunities within their academic careers (School of Education and Human Services, University of Kansas, 2023). Because more students are requiring interventions in Tier 2 and Tier 3 of the RTI pyramid in each classroom, the bell curve is evolving (Del Mar, 2023) where more students are requiring interventions post-pandemic. *Literacy Today* clearly explained education post-pandemic: educators have been challenged by the "ever-evolving conditions" presented by the pandemic (Zirogiannis, 2021, p. 45). These variables and conditions play a part in the data collected at a rural public education district in the northeastern United States, specifically at the end of first grade and the beginning of the second-grade school year. How do educators prevent educational deficits from continuing or growing? How do educators improve students' mathematical scores? What is research saying?

Given the lack of empirical evidence, the problem within this study is identifying the relationship between a computer-based intervention (IXL Learning) and mathematical (place value) skills of students in the regular education setting of second-grade post- COVID-19 pandemic learning.

Research indicates that the COVID-19 pandemic has created the largest disruption to education in history, affecting 1.6 billion students and more than 94% of the world's student population (Pokhrel & Chhetri, 2021, p. 133). The United States persistently indicates lower math scores compared to other countries (Bvorel, 2021). Barry University shares that educators were most concerned about losing ground in the subject of mathematics during and post pandemic instruction (Bvorel, 2021). This frames the prevalence of mathematics related performance declines pre-pandemic, but more specifically, performance is still declining post-pandemic. Within the small, rural school in western Pennsylvania, educators are being challenged with the many student deficits today. Whether the causation of these deficits was COVID-19 or not, educators are scrambling to support students in closing these educational gaps and improving place value mathematical skills.

As the 2023-2024 school year approached, teachers of first and second grades met on multiple occasions to devise the plan that best supported struggling learners entering second grade in the fall of 2023. During the first-grade school year, 13 students qualified and received special education services from 2022-2023. At the end of the first-grade year, 79% of students in the grade scored proficient on the Savvas EnVision Grade 1 Readiness test. This is a 42% increase from the beginning of the year. Because the Readiness Test assesses the students' readiness for that grade, this means 79% of students had mastered first-grade skills by the end of the first-grade year. The remaining 21% had not mastered first-grade skills but were promoted to second grade based on report card letter grades and overall progress in the grade. This created a

challenge for the second-grade teachers, as reading scores were similar to mathematics, and student needs were high.

Research shares a variety of interventions that are successful for specific learners through a variety of presentation modes. However, research does not specifically look into how IXL Learning may assist a second-grader's skills in the category of place value like this study does. Extending previous research is the goal of the study as the COVID-19 era has already reached its climax, with educational deficits becoming apparent and leaving educators to question what they can do to assist students in the future or to make up for the pandemic deficits. Based on the district's diagnostic assessment data, place value is a large concern for beginning second-grade students. Because research indicates place value as a foundational skill, the district is faced with the problem of determining how to improve second-grade place value skills in an efficient manner and timeframe.

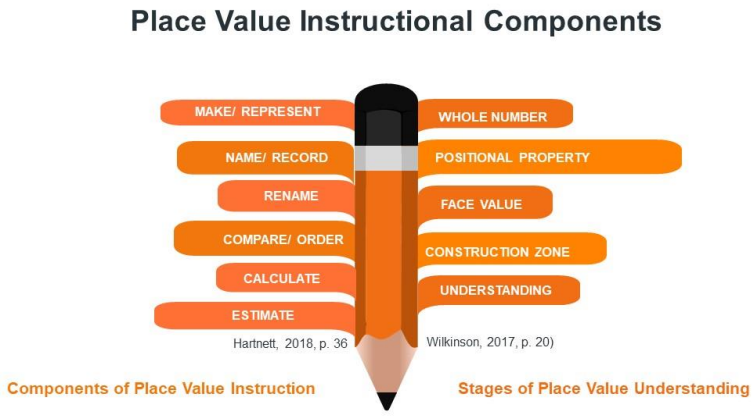
What Is Place Value?

Place value is defined as the position of a number that tells the value, kind, and quantity of an item (White, 2022). Wilkinson (2017, p. 1) explains that a single digit number remains constant, while a multidigit number changes depending on the value of the digit. It is a way of naming or representing numbers, allowing students and educators to write and say numbers for whole numbers, parts of numbers and the possibility of mental computation with those numbers (Major, 2012, p. 1). This concept has been adopted world-wide (Wilkinson, 2017, p. 9). Decomposing numbers is foundational for traditional and alternative algorithms for all operations in basic math (Walkowiak, 2016, p. 453). Conceptual understanding relies on place value knowledge and understanding (Caldwell, 2020, p. 8). According to the Common Core State Standards for Mathematics, in second grade, students will compare two three-digit

numbers, focus on understanding three digits representing hundreds, tens, and ones, (Walkowiak, 2016, p. 454) and continue progressing their skills at each successive grade level. As research indicates, student foundational place value skills will assist them in future content, skills, and application throughout life. Since the onset of COVID-19, the decline in student progress and growth has been pronounced. This is a concern for educators as they move forward. Addressing the learning gaps identified in the last three years will assist student progress as they journey through the rest of their primary and secondary curriculums, eventually preparing them for adulthood.

Figure 1.1

Place Value Instructional Components



Note. This graphic organizer was produced by the researcher, summarizing the place value instructional components and stages found within current research by Hartnell and Wilkinson. (Hartnell, 2018, p. 36 & Wilkinson, 2017, p. 20)

Why Do Students Need Place Value As A Foundational Skill?

Place value is a challenging concept for students within primary grades. Because understanding place value requires students to utilize the same abilities as fractional and algebraic reasoning, place value is considered a foundational skill in mathematics (MacDonald et al., 2018, p. 17). As a foundational skill for measurement, decimal numbers, percentages and higher mathematical learning, place value continues to be crucial content for primary students (Wilkinson, 2017, p. i). Primary teachers identify the need of understanding place value concepts as students begin to learn multi-digit addition problems, multi-digit subtraction problems (Nagel & Swingen, 1998), number words, written symbols, and quantities (Flevares et al., 2022, p. 360). Nagel and Swingen describe place value as an "essential foundation concept" that students require before learning multi-digit addition, subtraction, multiplication, and division and is considered a critical step in the development of comprehension of number concepts (1998). Regrouping, multi-digit multiplication, and the decimal system are based on foundational place value skills (White, 2022). If students lack place value skills, their mathematical learning may become stalled as they lack the higher-level thinking skills needed in the primary curriculum progression (Nagel & Swingen, 1998), or they may experience more complex academic needs like trouble understanding number-based information called dyscalculia (Kong & Chan, 2021, p. 446). According to White (2022), students cannot progress if they have not mastered place value skills first and they will not be able to construct meanings for multi-digit numbers (Gheung & Ansari, 2021, p. 227). Number concept development is most critical from preschool to third grade age ranges (Onal & Altiner, 2021, p. 29), as they build foundational mathematical skills to build upon in future grade levels.

Students who struggle to master place value skills and an abstract understanding of numbers may often give up on learning math (White, 2022). Because seven- and eight-year-olds are learning best from concrete operational methods, abstract concepts may cause misunderstandings and confusion (Onal & Altiner, 2021, p. 30). Providing a solid foundation of place value skills will set students up for mathematical success as they progress through the K-12 curriculums. Nagel and Swingen indicated that by engaging in place value experiences, students may experience learning opportunities in addition, subtraction, and vocabulary within mathematics (1998). As Nagel and Swingen interviewed elementary students, they were able to identify emergent categories representing students' language and understanding of place value in their work samples or responses. These sequential levels of place value understanding include counting, beginning process of subtracting or adding without attention to place value, manipulative understanding represented by trading or exchanging, partial understanding of place value, and demonstrated comprehension of place value (Nagel & Swingen, 1998).

When to Teach Place Value

Place value is the foundation of teaching math to any student from preschool to algebra (White, 2022) and is typically taught in grades K-5 (National Center on Intensive Intervention, 2015, p. 1). Understanding place value may take several years of instruction and practice (Wilkinson, 2017, p. 16). As instruction typically begins in kindergarten, each year allows students to expand, enrich, and apply understandings of place value (Caldwell, 2020, p. 3). A brief study by Kong and Chan (2021, p. 446) indicates students are adept at initializing and comparing place values prior to being introduced to place value concepts. This implies that students may naturally gain place value skills prior to initial instruction in the K-5 setting.

Place value is known as a complex process where research indicates students may understand place value concepts at different components of the same activity (Wilkinson, 2017, p.2). A large variety of strategies have been exercised in current research to supplement place value instruction at the primary level. Wilkinson (2017, p. i) reports the sequence strategy, mixed strategy, separate strategy, and a grouping strategy utilized in current studies while the strategy of use indicates the students' place value understanding. Siegler constructs a theory called "overlapping waves" that explains how students' understanding of place value is related to the activity they are currently engaged in, and the more advanced strategies come as they engage in higher levels of mathematical understanding (Wilkinson, 2017, p. 3). Students may have more than one co-existing strategy. Other strategies found within current research include counting-all, continuation-counting, counting-on, sequence, sequence-separate, separate, and addition (Wilkinson, 2017, p. 22). Wilkinson (2017, p. 12) also explains that conceptual knowledge where students learn concepts with abstract or general principles is flexible and adaptable but requires more time to acquire, while procedural learning is typically obtained quickly by imitation but is prone to error or less generalized. Place value is considered a conceptual skill that requires some abstract thinking from these primary students who are used to learning through concrete concepts and manipulatives at the primary level, specifically second grade.

Conceptual Frameworks

Key concepts examined during the study include instructional and educational technology uses, mathematical interventions, COVID-19 pandemic educational effects, and the timing of when a student can best learn place value skills. Research was examined specifically on the use of IXL Learning. Various evidence was presented by IXL Learning that supports its use as an intervention tool in all subject areas. However, little research is published regarding the use of

IXL Learning as a sole intervention and the relationship between specific second-grade place value skills. The design of the intervention was created while utilizing IXL Learning and previewing other curriculum-based assessments like the Savvas EnVision Diagnostic Assessment. Because curriculum-based assessments (CBA) have been utilized for the last 30 years, it is considered an effective formative assessment for all abilities/disabilities, frequently appearing in educational literature (Hall et al., 2003, p. 2).

The theoretical framework of Universal Design for Learning (UDL) presents a guide for educators to encourage presenting materials in flexible ways that offer a variety of presentations for all types of learners. This allows students to comprehend, demonstrate their skills, and continue to be motivated in their learning (Hall et al., 2003, p. 10) as their assignments are tailored to showcase their strengths and supplement their needs. This study was created with the UDL framework in mind, as the individual needs of each learner was considered and identified. Because IXL Learning is an online platform, presenting the intervention in an electronic version may meet the learning needs of many learners today, including the visual learners.

Because there are three main intervention frameworks, educators must determine which one will meet the needs of their students in the most effective way. The three main intervention frameworks include Response to Intervention, Multi-Tiered System of Support (MTSS), and Positive Behavioral Interventions and Supports (PBIS) (Del Mar, 2023). The framework focused on within this study is the Response to Intervention (RTI) framework where student data is used to assess student needs and educational plans. Ongoing assessment and analysis of progress aligns with the increasing intervention intensities (Del Mar, 2023). The study conducted falls within Tier 2 of RTI- Targeted Interventions. This step allows for differentiated support for those students who have not mastered the place value skills and is supplemental to the regular

curriculum lessons to be taught and reviewed further into the scope of the Savvas EnVision 2nd Grade curriculum.

At the conclusion of the study, students will join the Multi-Tiered System of Support (MTSS) intervention programming, as the district pilots the program for the 2023-2024 school year. This allows students to obtain tiered instruction and support across the board: instructional, academic, and behavioral (Del Mar, 2023). This also allows the faculty and administration of the district to dive deep into the formal data, identifying specific areas of need for each student. Providing Tier 3 intervention could be critical in the primary grades.

What causes "The Bubble"?

As the district identifies the needs of the second graders of the 2023-2024 school year, they often refer to the group as "The Bubble". Currently, 76% of the 2022-2023 first-grade students are reading at basic or below basic levels as measured by the Renaissance STAR Assessments. In addition, 21% of students scored below proficient at the end of the first-grade year utilizing the curriculum-based Savvas EnVision Mathematics Readiness Assessment. Variables such as curriculum sequencing, socioeconomic status, childcare, lack of subscriptions, insufficient materials, COVID-19 procedures, and minimal faculty instruction have played into why this specific grade level is struggling. As Onal and Altiner (2021, p. 28) examine, students' "readiness levels" are not sufficient at age seven for learning place value concepts. Regardless of the cause of this problem, schools need to prepare to support students with various deficits, specifically at age 7 in skills including place value.

Because there have been a variety of concerns following the COVID-19 pandemic onset, a need for a successful, educational, and standards aligned intervention program is high, specifically in mathematics and reading. Teachers from the district have observed some of the

following concerns regarding overall student well-being to promote academics: Faculty have observed an increase in health complaints possibly indicating psychosomatic or mental health concerns including headaches, stomachaches, and nervousness. The school nurse reports an increase of 898 visits from the 2021-2022 school year to the 2022-2023 school year. *The Educator's Room* explains a probable reason for these mental health concerns. Stress induced from COVID-19 present altered student brains, causing early onset maturation including hippocampal and amygdala changes within the brain. Because these areas of the brain regulate emotion, memory, and learning, educators are seeing more mental health symptoms post-pandemic (Odom, 2023). Students may be visiting the nurse because of COVID-19 academic gaps that, in return, produce physical ailments. Students may also be visiting the nurse more because there is not currently a guidance counselor within the elementary building to assist them with their mental health needs, feelings, behaviors, or emotions.

Current second-grade students within the district are categorized as part of "the bubble" grouping, demonstrating a lack of fine motor skills needed for daily school tasks including writing, coloring, cutting, and gluing. Foundational skills including holding a pencil or knowing how to maneuver scissors seems to be an increasing concern for the primary grades. Students typically received instruction from their parents or childcare workers prior to the remote learning conducted during the COVID-19 pandemic. However, students may not have had consistent and productive instruction while at home. Typical students within the district enter second grade with these foundational school skills. It appears many fine motor skills need to be initially taught and remediated as education bounces back from the remote learning of the pandemic.

Executive functioning skills for primary students appear poor within the district. Skills like sitting in their seat for various lengths of time, waiting their turn, raising their hand to talk,

walking in a line through the hallway, or even finding the page number are skills current second-grade students are lacking. This appears as an immaturity or a student deficit to veteran educators compared to pre-COVID times. Observations of current executive functioning at the second-grade level encourages teachers to question if students attended an in-person preschool program or if they were homebound during the COVID shutdowns, causing them to fall behind in school functions, behaviors, and skills.

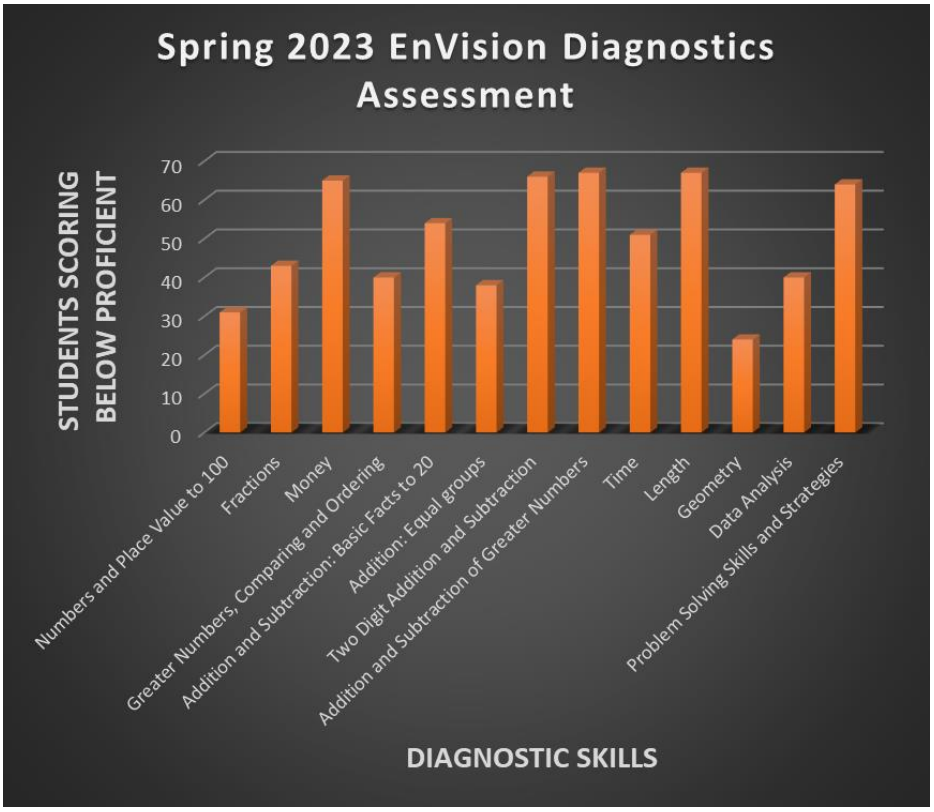
In the spring of 2023, all first-grade students were assessed using the Savvas EnVision Grade 2 Diagnostic Assessment in preparation for second grade. Figure 1.2 demonstrates the strengths and weaknesses of the baseline assessment data. Topics of Time, Money, and Measurement are typically taught at the end of the second-grade school year according to the Savvas EnVision Grade 2 Curriculum sequencing. It was predicted students would indicate deficits in these areas, as they are "end-of-the-year" second-grade skills. Therefore, place value, a foundational and initial second-grade skill, was selected for this particular study, as it also indicated a deficit in scores.

Figure 1.2 demonstrates the Savvas Envision 2nd Grade Diagnostic Assessment Form A given to all first-grade students in May of 2023, prior to starting the second-grade year. The data revealed that almost 30% of students were still scoring, "not proficient" or below the second-grade level on the overall diagnostic score. The five skills indicating 60% or higher are typically taught at the end of the second- grade school year according to the Savvas EnVision Curriculum sequencing, therefore explaining the high percentage of non-proficient scores. However, the Savvas EnVision 2nd Grade curriculum does not have a lesson designated for the instruction of place value until Unit 9 of the curriculum. Prior to Unit 9, students are asked to utilize place

value in addition and subtraction strategies, indicating a flaw in the sequencing of units for second-grade students.

Figure 1.2

Spring 2023 EnVision Diagnostic Assessment Results



Note. The data collected from the Spring 2023 Savvas EnVision 2nd Grade Diagnostic Assessment was utilized when creating this graph by the researcher to identify the place value deficit and intervention importance compared to other second-grade skills.

If place value is presented early, it can be built upon and generalized as new skills are included in the curriculum set by Savvas. Without the place value skills identified, there is less of a foundation for learning the remaining essential skills of second grade, also factoring into the decline of overall mathematics performance in the future. Of the 68 students assessed in the

initial assessment prior to the start of the study, the average score was 30.89 out of 60 possible points, equating to an average score of 51.48%. The district strives for 80% proficiency. Therefore, IXL Learning may be able to provide a successful intervention for students within "the bubble" group in the 2023-2024 school year and increase that proficiency score on the final assessment of the Savvas EnVision Diagnostic Form B Assessment at the conclusion of the study's six-week duration. Because the district already had a subscription to IXL Learning, students were familiar with the platform, as well as the veteran teacher/researcher within the district. However, this study will expand the use of IXL Learning for educators, in hopes of providing supportive data to drive best-practices in the future, with or without IXL Learning.

This list of concerns regarding COVID-19 educational effects is limited to the concerns at the primary level. Secondary and higher education settings may have even more concerns regarding education post-COVID-19. While there is no direct research to say that COVID-19 caused students to exhibit psychosomatic symptoms, to experience mental health concerns, to demonstrate immature skills, or to score lower than previous classes in mathematics and reading, there is research indicating an increase of concern in each of these areas. Current research has addressed the connection between each of these concerns and students' academic success.

Research Problem/Significance of Study

Various intervention programs and strategies have been tried to help these struggling learners, specifically in their mathematical place value skills. Literature findings indicate a wide variety of mathematical interventions arising, including small groups, whole groups, flash cards, online platforms including Reflex Math, FastBridge, ABC Mouse, RocketMath, and many more arising as education evolves post-COVID. Current research does not identify one strategy, program, or technique that works best for students. This may be because all students learn

differently, budgets are arranged differently, and resources or professional development are limited. Educators are concerned and looking for research and evidence-based intervention programs for their students, specifically in the post-COVID time frame. As an intervention, researchers may question if IXL Learning will improve the place value skills of second-grade students when utilized three times a week for thirty-minutes in a controlled setting. The findings of this study can relate to future primary educators and assist in future interventional and instructional practices to best assist all learners.

Delimitations/Assumption

Delimitations within this study include the recruitment of participants. Gender, race, culture, and financial household statistics lay outside the scope of research within the study and were not included. Narrowing the study to specific place value skills allowed for manageable and relevant data collection at the second-grade level standards. Another delimitation of the study was the exclusion of surveys and questionnaires regarding student opinions, parent opinions, and professional opinions of place value skills or interventions programs. The questions surrounding student, parent, and educator opinions are beyond the scope of the study. The analysis and sample size of the study are sufficient in detecting significant increases/decreases in the assessment data collection utilizing researcher-created, curriculum-based assessments, Savvas Realize EnVision 2nd Grade Diagnostic Assessments and IXL Learning programing. Results of the study are generalizable across similar school districts, specifically in small school districts of western Pennsylvania. The results of the study will produce meaningful assumptions regarding the effectiveness of IXL Learning that will promote best teaching practices for current and future second-grade students. Results may assist educators in providing instruction post-COVID-19 educational struggles.

Another delimitation of the study includes the time of the study. Instead of allowing the study to happen over the summer or during regular mathematical instruction, the researcher conducted the study within the first six weeks of the new second-grade school year to prevent data collection interruptions or variability. The location and presentation of the study was not conducted in various rooms or with various instructors to provide consistency in data results and analysis. Students were read all questions on assessments to eliminate reading deficit complications to data and to provide consistency to the elementary student.

Educational/Mathematical Instruction Challenges and Possible Solutions

Educational challenges experienced by educators that prevent high quality instruction include rebounding from lost academics, especially during the COVID-19 pandemic, providing effective and efficient interventions, lack of staffing to implement best mathematical practices, and lack of resources made available to educators to do so. Furthermore, educators may experience lack of reliable internet connection or access to digital devices (Pokhrel & Chhetri, 2021, p. 135). Although many districts strive for a 1:1 technology-to-student ratio, funding and manpower does not always agree. Increased screen time, lack of parental guidance or an unproductive working environment, (Pokhrel & Chhetri, 2021, p. 135) may also affect educational success, specifically in the home setting for students. While in the school setting, negative attitudes of faculty and/or students (Gafoor & Kurukkan, 2015, p. 234) can affect motivation of students and faculty, resulting in loss of educational opportunities.

Additionally, as the Common Core Mathematics Standards were implemented, parents became concerned regarding how their child was to learn math- a different way. A challenge that educators face at the second-grade level is the pushback from families to not use specific Common Core Mathematical strategies included within the curriculum. Parents were taught a

specific way and want their students taught that strategy, too. For example, parents may not have been instructed on how to use a tens-frame to add two single-digit numbers together. Therefore, they are confused as to how to help their child at home. They are most likely prone to use a t-chart or other strategies to add the two numbers together and will encourage their children to do the same, despite the variety of strategies they are being exposed to within the general education curriculum.

Increased parental involvement in student achievement (Gafoor & Kurukkan, 2015, p. 234) would be a great piece to the educational puzzle and a possible solution to educational challenges. Specific examples of this include weekly mathematics newsletters or a math station at the school-wide family night event. A weekly newsletter would communicate with parents the topics of instruction and/or how they could support the instruction in the home. A math table during a school event may promote excitement and allow for exciting activities that might include robots, coding, keyboarding, or other technology to increase mathematical motivation. If all parents are on board with the studies of the child, the child will be given the best education possible by the teacher and district, while feeling supported by all parties involved. For educators, effective teacher mentoring, or induction programs would prepare them as they face the educational challenges listed above, along with professional development webinars, trainings, and conferences. Grant writing could assist with device and resource purchases, along with donation websites. Regulation of screen time, interventions, and progress monitoring would also be a step in the right direction at finding a solution to the challenges facing educators today. Additionally, there is a plethora of assistance to parents on the internet. Videos found on various platforms may allow for parents to see a tutorial of how their student is to complete the math

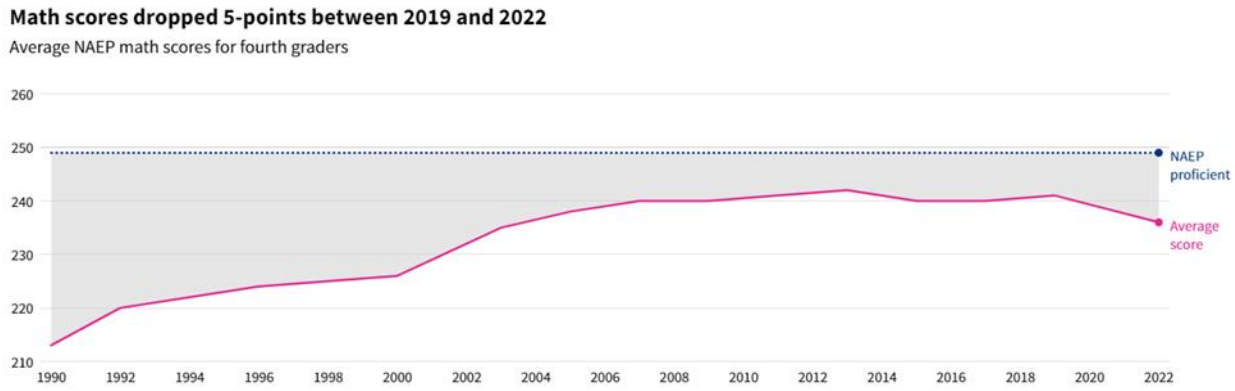
work from the lesson taught in class or give them a preview of other strategies implemented to solve the problem at hand.

When it comes to mathematical instructional challenges, reviewing previous content and generalization of skills (Gafoor & Kurukkan, 2015, p. 241) can be difficult if skills were not mastered in previous lessons. This tends to happen often in mathematics, as content builds upon previous strategies learned or is spiraled throughout different curriculums. If students have not mastered first-grade content, they may struggle with the second-grade level concepts. Furthermore, the Savvas EnVision 2nd Grade curriculum presents the unit on place value, called, "Numbers to 1,000" in the text as the ninth unit of the program. This indicates a challenge for students who struggled with place value skills in areas of "Numbers to 100" and are required to utilize tens and ones place values for addition or subtraction strategies in units one through eight, prior to reviewing the ones, tens, and hundreds place values. Manipulating and supplementing the curriculum may be needed for student success utilizing place value concepts.

Testing results also present a challenge in math instruction, as assessment results indicate the power of the instruction. *The New York Times* published an article identifying the national math scoring decline, dropping to levels from two decades ago (Mervosh, 2022). USA Facts indicate a five-point drop in mathematical scores from 2019 to 2022, as shown in Figure 1.3 (2022). Fourth graders are currently scoring equivalently to 2003 mathematics levels (USAFacts, 2022). If this trend continues, students will be challenged with various new problems to society including finding a job, knowing the skills for adulthood, completing college courses, and functioning independently as an adult.

Figure 1.3

USAFacts NAEP Math Scores 2019 and 2022



Note. The line graph from USA Facts illustrates the decline in mathematical scores for fourth graders since 2019. Even though the study focuses on second-grade assessment scores, similar declines have been identified in current research, supporting such decline in second grade, as well. (USAFacts, 2022).

There are a variety of solutions to mathematical instructional challenges that educators face today. If instructors present the instruction in a familiar manner to students (Gafoor & Kurukkan, 2015, p. 241) and lesson structure is consistent, students may flourish in math lessons by engaging in routines with the tools they need. When starting the lesson, promoting metacognition and self-confidence in their mathematical abilities will also assist students in their progression (Gafoor & Kurukkan, 2015, p. 241). By setting goals with students and educational teams, best practices can be implemented to promote mathematical success (Gafoor & Kurukkan, 2015, p. 241) for all students.

When utilizing instructional technology, some platforms provide additional resource opportunities to coach students as they work through specific assignments (Pokhrel & Chhetri, 2021, p. 137). Videos and other helpful resources for students and teachers can support

implementation of instructional technology and may provide a solution to challenges presented upon utilization. IXL Learning explains incorrect answers to students if an incorrect answer was selected, allowing them to learn from mistakes along the way. This assists in the "lack of time" or "lack of staffing" concerns for individualized instruction or intervention listed above. Even though the COVID-19 pandemic interrupted educational practices for all learners, it has provided educators with the opportunity to "pave the way for introducing digital learning" (Pokhrel & Chhetri, 2021, p. 133) to all learners of all ages and abilities. Because so many online platforms work towards individualized interventions or instruction, students are getting tailored programs without the leg work from the teachers. This allows one teacher to reach a classroom of students simultaneously, without having to teach multiple lessons simultaneously. The software will present the information and skills when the teacher cannot, due to assorted reasons including remote learning, large class size, or differentiated instruction. The teacher's role still consists of monitoring student progress and providing the core instruction, while IXL Learning can be used as a tool to support, reinforce, or remediate the targeted skills identified.

Mathematics is a critical, foundational skill. Therefore, professional development opportunities can be key to implementing successful instruction. Professional developmental challenges experienced by educators include the lack of training in interventions, lack of planning time to implement interventions, lack of funding for conferences or resources, or teacher burnout.

Teachers are actively and continuously collaborating (Pokhrel & Chhetri, 2021, p. 137) at the local and state level to assist in all teaching methods and challenges. This solution can be free of charge, promoting frequent engagement in collaboration across various different settings. Many online platforms or educational organizations offer free help and support to teachers as

they navigate new tools, practices (Pokhrel & Chhetri, 2021, p. 137) or even their website with teacher resources. The Common Core 2nd Grade Mathematical Curriculum presented in the Savvas EnVision curriculum may imitate a Special Education Model- if students do not understand one strategy, the teacher will show the students various other strategies to see if those work better. Many of the addition and subtraction problems explored within the second-grade standards can be interchanged with a variety of strategies. It is the educator's job to show students the various different strategies, while it is the students' job to select which one works best for them and/or which strategy will assist them with specific types of questions. Online blogs, podcasts, and videos are all free and easy ways to expand the teachers' knowledge and understanding of the content they present.

For example, www.donorschoose.org (DonorsChoose, 2023) provides a great opportunity for teachers to create projects to get funded within their community for items or resources that will help their students, classrooms, and instruction. Educators will make a profile, create the project with an estimated amount of funding needed, and then share the link with their desired audience to receive funding online. Once enough donations are complete, educators will receive the desired items by following the DonorsChoose criteria on their site. Also, applying for grants and scholarships are ways educators may be able to afford the training that districts do not fund. In the meantime, a variety of free resources are available at any time and may support the high-quality instruction students need.

Summary

The COVID-19 pandemic has presented an array of challenges for educators, specifically in primary mathematical educational practices. Current research and data indicate a need to improve second-grade place value skills of students referred to as members of "the bubble".

Chapter 1 identifies challenges and possible solutions to these educational difficulties for educators. Because the obstacle in Chapter 1 has been identified and explained, Chapter 2 presents the current research on second-grade mathematical skills, instructional tools, interventional programs, online resources, place-value instruction, and the educational effects of the COVID-19 pandemic. Chapter 3 outlines the structure of this qualitative criterion-changing single case study, while Chapter 4 identifies the data collected within the study of implementing IXL Learning as an intervention for second-grade place value skills. Chapter 5 provides implications represented by the data, along with identifying suggestions for future practices, research, and replications of the study.

Definition of Terms

Educational Intervention- a set of action items that teachers/administrators can take to improve a student's academic progress (Del Mar, 2023)

Curriculum- Based Assessment (CBA)- a set of measurement procedures recording a student's performance in the local curriculum as a basis for gathering information to make instructional decisions (Hall et al, 2003, p. 3)

Instructional Technology (IT)- an area of education centering on instructional design and development, intended for engaging students and producing effective learning experiences, often involving new technologies (Kurt, 2017)

Remediation- the practice of "re-teaching" content that has previously been taught but not mastered, centering on mastering a specific skill or concept (Lake Michigan Academy, 2021)

Response to Intervention (RTI)- a support utilized to provide high quality education to students with disabilities, developed for prediction, remediation, and prevention (School of Education and Human Sciences, University of Kansas, 2023)

CHAPTER 2: REVIEW OF LITERATURE

What happened during the COVID-19 pandemic?

In the spring of 2020, the COVID-19 pandemic spread to the United States. Schools were forced to make educational and safe decisions for all their students, including how they would electronically or remotely provide education to all of their students to prevent the spread of the virus. Lockdowns were considered an effective way to handle a global pandemic and to reduce the spread of the coronavirus (Merlo et al., 2021, p. 2). However, as research surfaces, this strategy may have been more harmful than helpful in the long run regarding various aspects of education for students. Instead of calmly transitioning to a pandemic educational approach, teachers began "emergency remote learning, disaster distance learning, or panic-gogy" (Kamenetz, 2022, p. 20) as they attempted to uphold the revolutionary policy of educating every child during the school shutdowns of the COVID-19 pandemic. Many states attempted to hold off shutting down schools if they could in order to best serve their students, knowing that the outcome of discontinuing education would be problematic in the future if not handled delicately.

Remote learning was the plan for districts during state, county, and district shutdowns. Online platforms including SeeSaw, Google Classroom, and D2L were becoming popular ways to distribute what lessons educators could as the pandemic continued. SeeSaw is a tool utilized by educators to assist in communication, curriculum, interactive lessons, and electronic portfolios to support student learning (SeeSaw Learning, Inc., 2023). Google Classroom of Google Workspace for Education is a platform that promotes personalized, measurable, and manageable learning experiences for students and educators (Google, 2023). D2L prides itself as a tool to empower educators with technology, content, and services to assist in their remote

instruction (D2L Corporation, 2023). Various video conferencing tools including Zoom, Loom, and Screencastify were utilized in the presentation manner of remote educational lessons, along with various interactive online platforms including IXL Learning, Reflex Math, and ABC Mouse. Zoom is a simplified video conferencing software that also includes team chat, phone and other collaboration tools that may be utilized on any device (Zoom Video Communications, Inc., 2023) and is frequently utilized in businesses or schools. Loom and Screencastify are screen recording and video editing tools (Screencastify, LLC, 2023) assisting educators with lesson presentation in a remote manner. Reflex Math is an effective, fluency-promoting program implemented to grow basic addition, subtraction, multiplication, and division facts in a game-like design (Explore Learning, 2023). ABC Mouse is an online platform, leveled curriculum that presents games, puzzles, videos, and books to support student learning in core subject areas (Age of Learning, Inc., 2023). While the world of online educational tools was endless, educators did not have the time, resources, or experiences to utilize these tools to meet the face-to-face expectations of previous lessons.

In December 2019, prior to the COVID-19 shut-down, Zoom video platform hosted ten million people a day (Kamenetz, 2022, p. 20). In March 2020, two hundred million people utilized Zoom per day (Kamenetz, 2022, p. 20). Merlo et al. (2021, p. 2) states that academic and social activities transitioned quickly from in person to remote by utilizing such tools as Zoom. Of households within the U.S, 15% lacked high speed internet needed for remote learning, while District of Columbia specifically indicated 55% of households lacked high speed internet (Kamenetz, 2022, p. 23). Bad internet, old computers, or not enough computers were also reported as concerns regarding remote learning that transpired during the lockdowns of the pandemic (Kamenetz, 2022, p. 147).

The independent research organization, RAND, surveyed teachers in the spring of 2020 only to find that 88% of teachers indicated they had not covered the amount of material they usually would have at that point in the school year (Kamenetz, 2022, p. 21). Because of these struggles, when students finally returned to in-person learning, many students were scoring over a year behind grade level expectations according to standardized testing (Hedrick, 2021). Quarantines increased as students entered the 2021 school year. Extended and frequent quarantines caused students to miss many days of instruction or forced them to have remote instruction. Some students just dropped out for good (Kamenetz, 2022, p. 330).

The Individuals with Disabilities Education Act (IDEA) guarantees a free and appropriate public education for all students. This refers to, where appropriate and possible, attending regular schools, in regular classrooms, with their peers (Kamenetz, 2022, p. 112). This will be a controversial topic for years to come as more research and data is collected or published. All professionals in education questioned whether students were provided a free and appropriate education in this time of crisis. Specific concerns may center around special education students and upholding the legal documents of IEPs for children during such times.

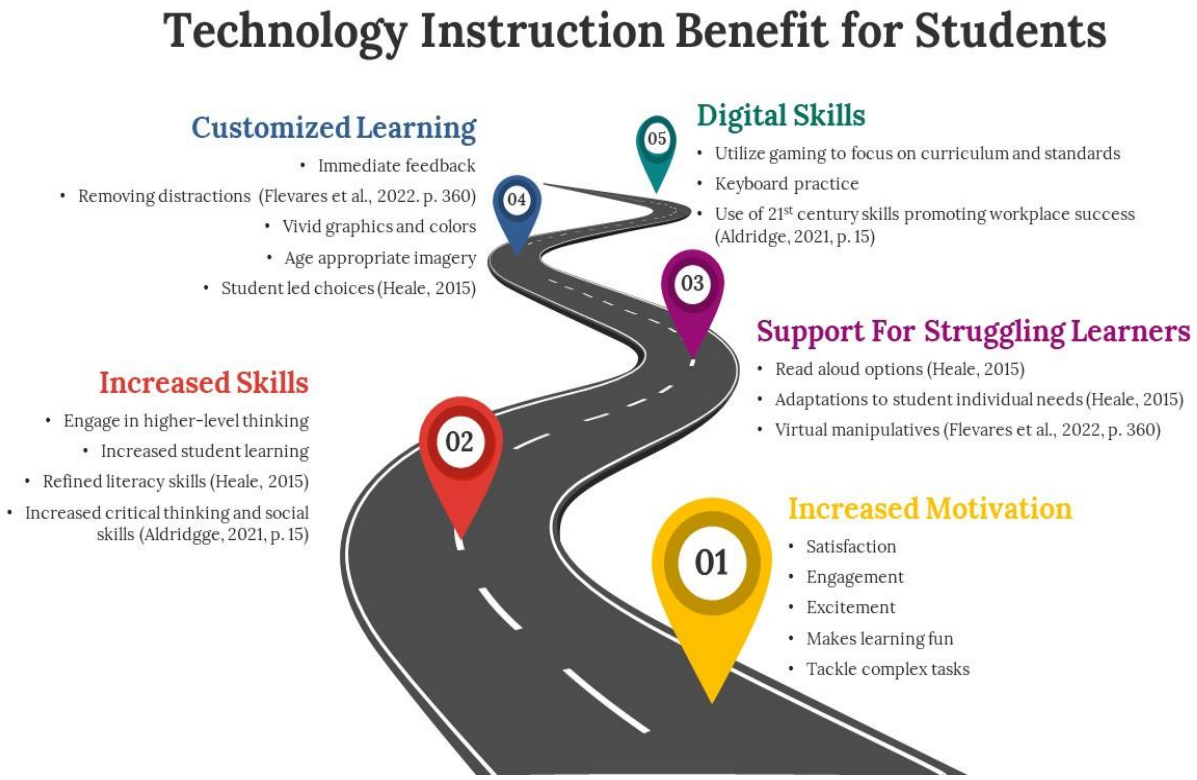
Use of Technology Instruction and Intervention

Educational intervention utilized as a supplement to children's education can look quite different for students and their needs. However, there is one common goal to implement intervention practices: to enhance the students' skills and abilities through various learning modes. The sooner students receive interventions, the sooner they can start to perform at their appropriate grade level and/or with their peers (Del Mar, 2023). When students obtain individualized instruction and intervention, they may progress at a faster pace. Interventions within a school setting may include push-in, pull out, flexible/digital, individualized instruction,

digital assignments, peer tutoring, word study, fluency practice, vocabulary growth, building comprehension, and incorporating visual aids (Del Mar, 2023). This specific study combines individualized instruction with digital components to perform an intervention through IXL Learning.

Figure 2.1

Technology Instruction Benefit for Students



Note. Current research indicates various benefits to using instructional technology in lessons with students, specifically primary grade level students. This researcher-created graphic compiles five different benefit areas, promoting instructional technology within the classroom based on current research.

While various research indicates a variety of positive results from instructional technology like IXL Learning, negative results appear as well. Negative effects of instructional technology found in research can affect students' overall health. Increased anxiety, also known as technostress (Cherney, 2016), within an e-learning program predominantly in females (Aldridge, 2021, p. 51), an increase in depression, and struggles with social interactions (Western Governors University, 2019) are some of the negative effects of instructional technology use. Attention spans, bullying, and lack of privacy are also rising effects on young children and teenagers (Western Governors University, 2019). Even a child's physical health can be factored into the usage of instructional technology, as many students may have an increased obesity rating due to lack of movement and activity (Western Governors University, 2019) while they engage in increased screen time.

The list of positive effects of instructional technology outweighs the list of negative effects. Students may have their own tailored success stories, as instructional technology allows for creativity in instruction. Positive effects found in research regarding usage of instructional technology include using technology as a classroom tool, assisting in the preparation of future technological careers, improving multitasking skills, improving visual-spatial development, and improving problem-solving/decision making (Western Governors University, 2019). Figure 2.1 addresses a variety of instructional technology benefits for students. If research is indicating benefits from the use of educational instructional technology, why not try it as an intervention? IXL Learning has the setup design to be implemented as an intervention.

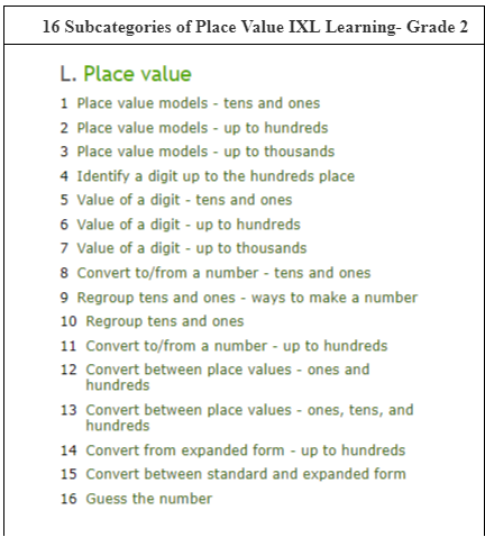
What Is IXL Learning?

IXL Learning is a "membership-based" (Liu & Wu, 2021, p. 246) online platform used in education specifically to target skills in math, language arts, science, social studies, and Spanish.

IXL Learning is currently used in preschool to grade twelve, totaling over eleven million students utilizing the individualized tool. IXL Learning allows students to work at their ability level and desired pacing (Hedrick, 2021). A total of 190 different counties are logging on to IXL Learning (Liu & Wu, 2021, p. 246), while the program specifically presents eighty-four different place value skills across all grade levels. Figure 2.2 outlines the sixteen subcategories of place value skills that are presented at the second-grade level within IXL Learning focused on in this study. As Figure 2.2 presents a screenshot of the place value skill subcategories, the scope and sequence of IXL Learning's progression can be reviewed, as it strategically scaffolds skills to build upon them throughout this specific section of IXL Learning.

Figure 2.2

16 Subcategories of Place Value within IXL Learning- Grade 2



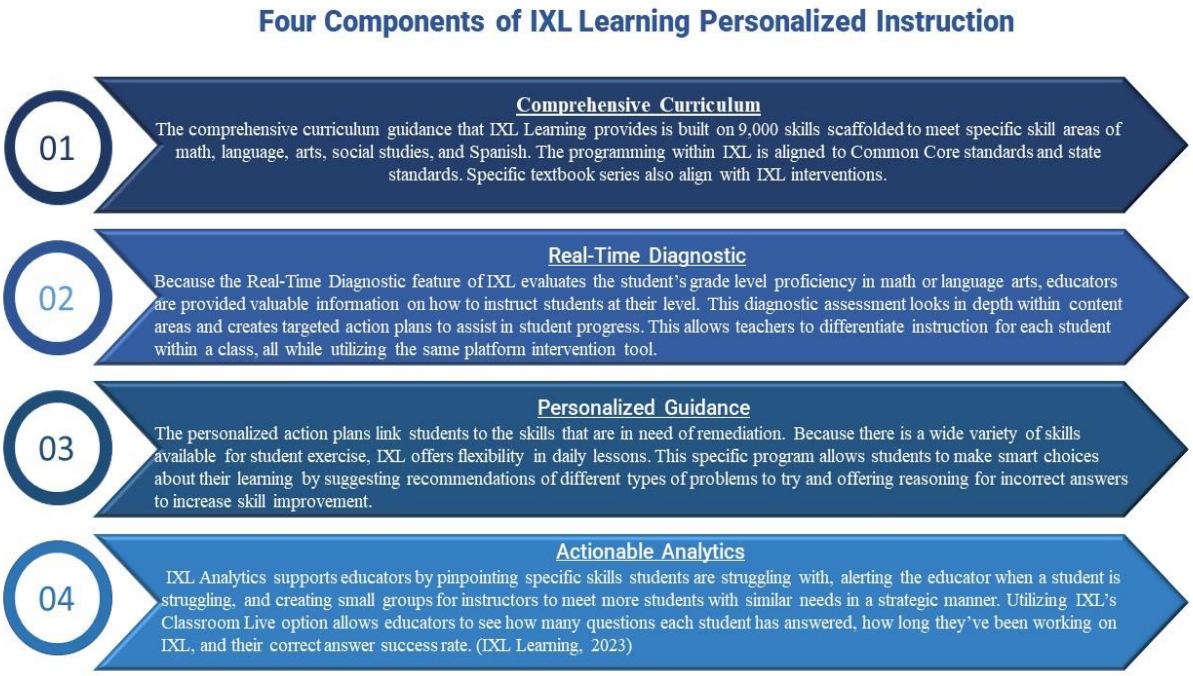
Note. IXL Learning offers 38 different mathematical categories at the second-grade level. Figure 2.2 identifies the Place Value subcategory skills that IXL Learning offers (IXL Learning, 2023).

IXL Learning provides personalized instruction through four components: comprehensive curriculum, personalized guidance, actionable analytics, and real-time diagnostics (IXL

Learning, 2023), illustrated in Figure 2.3. These components support effective components in conducting a successful and efficient, online platform-based intervention program.

Figure 2.3

Four Components of IXL Learning Personalized Instruction (IXL Learning, 2023)



Note. IXL Learning provides four components for personalized instruction that suggests it is an effective and appropriate interventional tool for struggling learners. Comprehensive Curriculum, Real-Time Diagnostics, Personalized Guidance, and Actionable Analytics are the four supporting components of IXL Learning (IXL Learning, 2023).

What Is Research Saying About IXL Learning?

While IXL Learning poses dozens of testimonies from educators and their experiences using IXL Learning on their website, the site lacks independent research regarding IXL Learning used as an intervention in primary grades. Scarce evidence presents IXL Learning as an effective or ineffective intervention practice when utilized alone. However, IXL Learning does present

explanations for incorrect answers, tailored question difficulty and a plethora of skills offered, making it an ideal intervention tool.

Current research trends demonstrate successful learning gains in math and reading with the use of IXL Learning (Cision US Inc, 2020). For example, Triplet identified a student who returned to school from the COVID-19 shutdown reading at a second-grade level as the student entered fourth grade due to gaps in education hindered by the pandemic (Hedrick, 2021). IXL Learning was utilized to remediate and assist the child to grade level work. Not only are the learning gains increasing with the use of IXL Learning, but standardized testing scores and classroom performance within the United States are as well (Hedrick, 2021).

Research studies have compared the use of IXL Learning in various settings, age groups, and instructional practices. A specific study indicated an IXL Learning group outperformed a control group within a small group of fifth grade students, while another study revealed that one practice of instruction was not more beneficial than the other (Liu & Wu, 2021, p. 246). Electronic IXL Learning practice or traditional paper and pencil practice indicate similar performances. Because of the nature of IXL Learning and the ease of data collection, educators have been able to identify and remediate struggling students, especially during the pandemic (Hedrick, 2021) and post-pandemic. The reports utilized within IXL Learning allow educators to compare data with those of the individual student, class, grade, state, local, and class norms to drive their instruction and intervention practices.

What is Research Saying About Mathematical Instructional Practices?

When it comes to successful mathematical instructional practices, a variety of sequences, tips, theories, and standards can be found. As this study focuses on the electronic resources available to educators, Walkowiak recommends electronic resources be used for understanding

the progressions of the Common Core State Standards for Mathematics (Walkowiak, 2016, p. 454) that the district of study follows. Not only is it recommended, but it is becoming a common and customary practice within all types of classrooms for educators to utilize the technology available to them as they teach the standards, mathematical standards, and electronic resources. As far as students with disabilities or at-risk, technology mediated interventions offer a range of mathematical skills and concepts (Bouck & Long, 2023, p. 2) that can be tailored to meet the needs of any learner, appealing to all educators managing their time.

Figure 2.4

2nd Grade Place Value PA Common Core Standards

Note. PA Common Core Standards includes more standards than Figure 2.4 presents. However, the listed standards focus on place value skills, mirroring IXL Learning's intervention program (Pennsylvania Department of Education, 2013).

As Figure 2.4 identifies the Pennsylvania Common Core Mathematical Standards, educators comprehend that reading, writing, skip counting, identifying amounts, comparing numbers, and understanding operational properties to add/subtract are the targeted skills for second grade. As these standards cover a lot of content, educators must be strategic in their presentation and sequencing of skills to build foundational place value skills and prepare students for future mathematical skills.

Another mathematical instructional strategy is Explicit Instruction (EI). Explicit Instruction (EI) is a popular educational approach that focuses on evidenced based practices, specifically for students with disabilities (Bouck et al., 2022, p. 1). EI consists of key components including breaking tasks into smaller chunks, modeling problem solving, using-and-fading-prompts, and providing feedback or opportunity for practice (Bouch et al, 2022, p. 1). Educators have successfully taught strategies to problem solve utilizing EI. As research lacks studies of implementing EI through an online platform, research supports the use of EI in a face-to-face setting for mathematical practices (Bouch et at., 2022, p. 1).

A strategy implemented in a generous portion of primary mathematics curricula is mathematical manipulatives: items students may touch, hold, move, and stack to comprehend abstract mathematical concepts. Manipulative mathematical items offer visual and tactile experiences for students that electronic tools may not permit. While research indicates positive results for utilizing manipulatives within the classroom, providing hands-on activities has shown mixed results by noting that they may hinder learning in specific settings (Vassar, 2017). For

students with specific disabilities like Attention-Deficit/Hyperactive Disorder (ADHD), manipulatives may become distracting while working on mathematical concepts rather than being a useful tool for typical students. The use of manipulatives remains popular and strong while conflicting opinions say manipulatives lose their value after the first year of school (Vassar, 2017).

Current conflicting research identifies other factors that may help or hinder mathematical instructional practices. For example, research focuses on the connection between phonological or reading abilities and mathematical success, along with how long-term memory, working memory, memory capacity and schemas will affect mathematical skills and abilities (Vassar, 2017). Not only will these concepts categorize information but also will determine how specific mathematical information will be used or applied (Vassar, 2017). Figure 2.5 outlines eight mathematical practices supporting educators in their instruction. Some educators might refer to these as the "heart and soul" of the Common Core State Standards for Mathematics, as they inspire to develop all their students' mathematical skills and thinking (Rutherford, 2015). These practices are targeted at assisting students to develop a "deep, flexible, and enduring" understanding of mathematics (Rutherford, 2015).

Figure 2.5

The Standards for Mathematical Practices

Mathematical Practices—Look-Fors as Classroom Indicators

Mathematical Practice	Look-Fors: Classroom Indicators
Mathematical Practice 1: Make sense of problems, and persevere in solving them.	**Students:** Are engaged in solving problems and high-cognitive-demand tasks **Teacher:** Provides adequate time with formative feedback for students to discuss problem pathways and solutions with peers
Mathematical Practice 2: Reason abstractly and quantitatively.	**Students:** Are able to contextualize or decontextualize problems **Teacher:** Provides access to and uses appropriate representations (manipulative materials, drawings, or online renderings) of problems and asks questions focused on determining student reasoning
Mathematical Practice 3: Construct viable arguments, and critique the reasoning of others.	**Students:** Understand and use prior learning in constructing arguments **Teacher:** Provides opportunities for students to listen to or read the conclusions and arguments of others—as students discuss approaches and solutions to problems, the teacher encourages them to provide arguments for why particular strategies work and to listen and respond to the reasoning of others and asks questions to prompt discussions.
Mathematical Practice 4: Model with mathematics.	**Students:** Analyze and model relationships mathematically (such as when using an expression or equation) **Teacher:** Provides contexts for students to apply the mathematics learned
Mathematical Practice 5: Use appropriate tools strategically.	**Students:** Have access to and use instructional tools to deepen understanding (for example, manipulative materials, drawings, and technological tools) **Teacher:** Provides and demonstrates appropriate tools (like manipulatives)
Mathematical Practice 6: Attend to precision.	**Students:** Recognize the need for precision in response to a problem and use appropriate mathematics vocabulary **Teacher:** Emphasizes the importance of precise communication, including appropriate use of mathematical vocabulary, and emphasizes the importance of accuracy and efficiency in solutions to problems, including use of estimation and mental mathematics, when appropriate
Mathematical Practice 7: Look for and make use of structure.	**Students:** Are encouraged to look for patterns and structure (for example, when using properties and composing and decomposing numbers) within mathematics **Teacher:** Provides time for students to discuss patterns and structures that emerge in a problem's solution
Mathematical Practice 8: Look for and express regularity in repeated reasoning.	**Students:** Reason about varied strategies and methods for solving problems and check for the reasonableness of their results **Teacher:** Encourages students to look for and discuss regularity in their reasoning

Note. The Standard Mathematical Practices contains eight components of mathematics suggested to educators to engage students in their mathematical maturity. These practices are implemented through instruction, curriculum design, interventions, and strategic skill instruction. (Solution Tree Press, 2012)

Figure 2.5 illustrates specific mathematical practices for educators to guide and promote engaging, high-level tasks within their lessons. Within these practices, educators are supported with eight practices that could be applied to any or all mathematical skills. These practices allow educators to dive into all components of place value skills in a variety of presentation models or activities and identify the role of the student and teacher within each practice. As the Solution Tree Press' Mathematical Practices (2012) presents tools promoting mathematical success, it

does not identify interventional practices that may assist in closing the educational deficits presented post-COVID-19 pandemic.

Worked examples and workbooks are other strategies present in mathematical instruction and intervention, specifically of place value. This topic has been widely researched and historically implemented. Worked examples may provide students with efficient acquisition time as they take less time to study presented material (Vassar, 2017), where students discuss the step-by-step process needed to appropriately solve a problem. While worked examples provide support and structure, workbooks provide extra practice and the opportunity to demonstrate independence or mastery of the skills taught. Both strategies can be implemented through whole group instruction, small group instruction, and/or individual intervention practices.

Objectives and Purpose

The objective of this study is to determine the effectiveness of the interactive online learning platform of IXL Learning as an intervention for second-grade students who have been identified as performing below grade level in mathematics according to the Savvas EnVision 2nd Grade Diagnostic Assessment Form A. The goal of any educational intervention is to ensure student success and mastery of expected grade level skills, especially for students that have been identified as performing below grade level or who need remediation. Building knowledge of intervention practices and improving decision-making outcomes for educators regarding implementing technology interventions are the intended benefits of this research. Because the educational effects of the COVID-19 pandemic are surfacing, determining research-based practices to improve educational interventions at the primary level is the direct goal of this study, specifically for the district in the area of place value skills.

IXL Learning states that their "engaging, empowering, and effective personalized learning experience" focuses on four components in intervention: comprehensive curriculum, real-time diagnostic assessments, actionable analytics, and personalized guidance (Bashkov et al., 2021), as shown in Figure 2.3. These four components of IXL Learning's intervention could act as an appropriate intervention for possible COVID-19 learning gaps. By conducting this study, insights are sought out as to the effectiveness of this computer-adapted intervention in remediating students' mathematical skills and to promote success for all second-grade students in need of remediation.

The purpose of this study is to analyze data from a representative sample of learners to determine the effectiveness of IXL Learning as an intervention platform and whether or not the district should continue to use this program for mathematics interventions in future practices. IXL Learning has been proven to be an effective tool for providing supplemental mathematics instructions to all levels of learners. This study is unique in that it aims to study the effects of this online interactive program as an intervention tool for a specific population of learners- post COVID-19 pandemic.

Table 2.6

Research Question

Research Question	How does an interactive online learning platform affect the place value abilities of second-grade students at-risk in the area of mathematics as measured by curriculum-based assessments outside of the IXL Learning platform?

Effects of the COVID-19 Pandemic

A wide variety of effects of the COVID-19 pandemic on youth are surfacing as research is conducted and collected. In Kamenetz's text, *The Stolen Year*, it quotes pediatric infectious disease specialists in the New York Times from March 2021 regarding the impact of COVID-19 on children: "Food insecurity. Socialization. Depression. Isolation…Children are suffering academically, emotionally, socially, and physically…The long-term consequences may not be fully realized for years…We are going to have a lost generation- a set of children who will fall behind educationally, with deficits that could affect their entire life course" (2022, p. 8). The New York Times published that students suffered, losing ground in reading, math, and other subjects (Leonhardt, 2023). Educators must prepare and estimate the time frame needed to fix these academic, emotional, social, and physical long-term consequences of the pandemic.

The mental health of many children was impacted by the events of the pandemic. The Journal of Health, Politics and Law states that anxiety and depression affects social, occupational, educational performance, and political participation; therefore, it affects individuals' successful navigation of their personal, professional, and political life (Stances & Campbell, 2021, p. 826). The American Academy of Pediatrics declared children's mental health a national emergency while the COVID shutdown was considered a "moral catastrophe" for children (Leonhardt, 2023). In one survey, Kamenetz identifies that nearly half of mothers of remote learning students indicate a mental health decline in their children (2022, p. 201). COVID-19 has affected the mental health of many children. However, the extent is to be determined as research continues to transpire.

Across the United States, 14% of students are classified as qualifying for special education services (Kamenetz, 2022, p. 111). In May 2020, only 20% of parents reported their

children were receiving special education services they were entitled to during the pandemic, while 39% reported their child was not receiving any services they needed (Kamenetz, 2020, p. 114). Special education services were interrupted, leading to inconsistent intervention, support, services, and growth for many students. During the initial shut-down, the district of study was instructed not to engage in remote learning initially due to determining how they would meet the needs of all special education learners and follow all legal documents (504 plans and IEPs). Considering legal repercussions was a priority before making a remote learning plan for special education students or students receiving educational/behavioral support.

The residential and financial status of families during the pandemic became unstable for many students. One in ten students in New York City experienced housing insecurities while three fourths of students qualified for free and reduced lunches based on family income (Kamenetz, 2022, p. 26) during the duration of the pandemic. A quarter of students within the United States live in a single parent home (Kamenetz, 2022, p. 186) and to assist with the financial needs of the district, “friendship bags" were provided to students in need each Friday of the year, or the last day of the school week before long weekends. These bags were full of pre-packaged donated and purchased canned goods to confirm students had food over the long weekends. The school nurse reported a decrease in stomach complaints on Monday mornings since the implementation of the friendship bags. In March 2023, 52% of students within the district’s elementary school qualified for free or reduced lunches: 216 free lunches and 9 reduced lunches.

While many parents tried their best to assist in remote education, other students struggled due to the decreased opportunity to succeed. Sanz Ponce et al. acknowledges that students during the initial shutdown were forgotten, excluded, or invisible to an educational influence within

their home, leading to a decreased opportunity to learn, a decreased acquisition of learning, decreased acquisition of life skills, and an emotional disengagement to schooling (2022). Because of the pandemic and increased isolation, many students were not prepared mentally and socially to return to in-person courses (Jackaria, 2022, p. 221). The lack of attention and opportunity presents itself as students struggle with foundational and independent skills within the elementary school setting of the district. Poor or inadequate internet, lack of technology in the house, limited parental support/supervision, childcare conflicts, and home environments were just some of the hardships presented during the pandemic that prevented academic success for students. Lack of interest to assist students at home, parental digital illiteracy, decline in educational investment, usage of less stimulating educational materials, decline in family learning experiences outside of school, varying parenting styles, lack of emotional support from teachers, or difficulty of supervision of at-risk students are all reasons identified for struggling students post pandemic (Sanz Ponce et al., 2020).

In the Philippines study of teacher interviews, all teachers indicated an increase of "non-readers' ' upon returning to in-person classes after the pandemic. This resulted in teachers sectioning off their classes as "readers" and "nonreaders" (Jackaria, 2022, p. 221). One teacher admits that "reading is declining" (Jackaria, 2022, p. 221). This is evident in the small district of study, where 76% of students who entered second grade in the fall of 2023 could not read at grade level at the start of the year, as measured by the Renaissance STAR Reading Assessment. During and post-pandemic, librarians worked hard to create a robust e-book catalog available to students so they could continue to build upon their reading skills from any location (Zirogiannis, 2021, p. 46), along with utilizing all online curriculum subscriptions to promote reading for primary students. They also conducted push-in courses, introduced students to applications and

set up accounts for students to access the county library's resources to assist their skillsets (Zirogiannis, 2021, p. 46). Research and the district's data indicate that this might not have been enough for struggling students through the unique remote learning setting, creating fewer readers and increasing educational deficits.

Not only were students' academic success in jeopardy, their mental and physical health were affected, too. *The Educator's Room* explains how extended and prolonged stress can cause parts of the brain to mature at a faster rate. Adversity, life experiences, and prolonged stress play into these changes within the brain, specifically the hippocampus and amygdala (Odom, 2023). The events of COVID-19 put stress on many young students and adults all around the world. Dimitri Christakis, the editor in chief of the *Pediatrics Journal of the American Medical Association,* presented evidence that COVID-19 was not dangerous to children, but the lack of in-person schooling was failing students in three ways: failing to contain the pandemic, closing the schools summarily and abruptly without a distance learning plan or infrastructure, and not immediately planning a reopening procedure (Kamenetz, 2020, p. 232). Current research and assessment data supports Christakis' journal article.

These effects present various reasons why students may not be performing at grade level expectations post-pandemic. Educators must prepare interventions that have the data and rigor to assist in closing the educational gaps students are presenting. IXL Learning can possibly be utilized as a mathematical intervention to improve primary students' mathematical skills, assisting in closing some educational deficits.

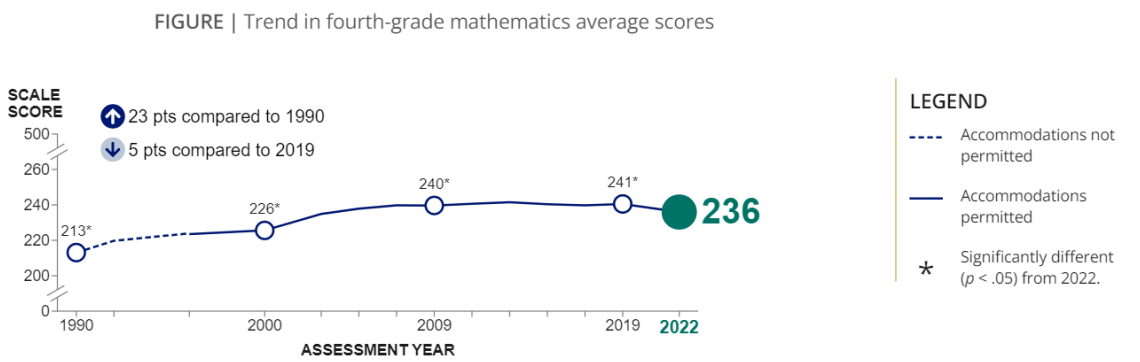
National Performance Levels

National performance levels indicate a slight decrease at the fourth-grade assessment level in 2022 as compared to 2019. Figure 2.7 demonstrates a twenty-three-point increase in

average scores since 1990 with a five-point decrease since 2019 (The Nation's Report Card, 2022). Although this data is focusing on fourth-grade curriculums, research has indicated all grade levels have been impacted.

Figure 2.7

Trend in Fourth-grade Mathematics Average Scores 2022

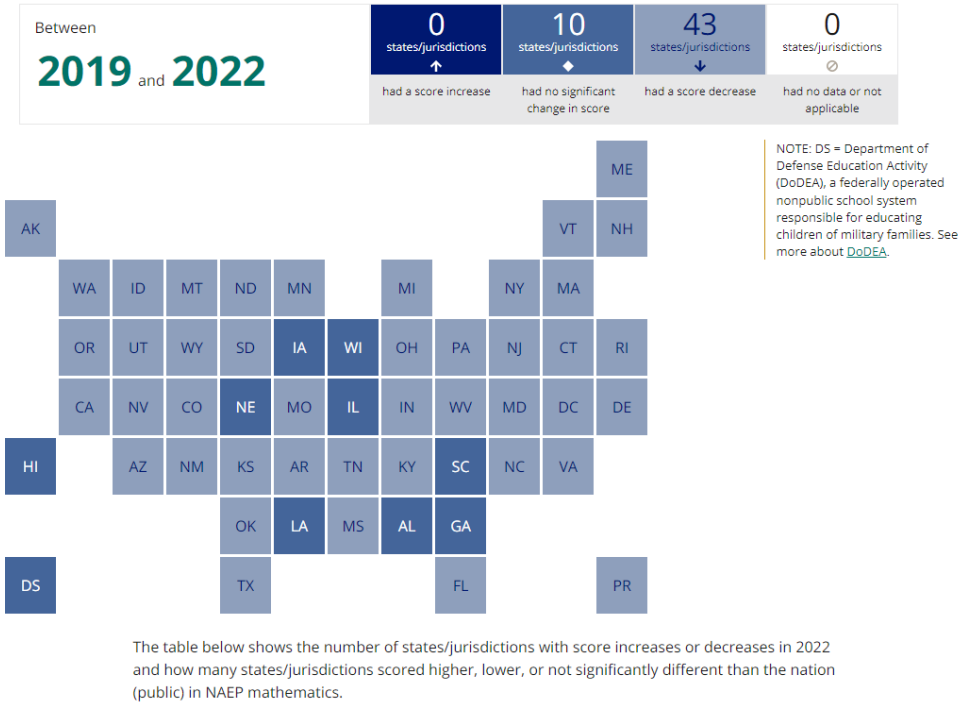


Note. As the graph demonstrates, fourth grade mathematics average scores increased, leveled out, and then began a slight decrease. If generalized across grade levels, this data supports student mathematical score declines within second grade. (The Nation's Report Card, 2022)

While comparing pre-COVID-19 data (2019) to 2022 at the fourth-grade level by state, zero states report an increase in state average mathematics scores, ten report no meaningful change in their mathematics score, while forty-three report a mathematics score decrease, as illustrated in Figure 2.8 (The Nation's Report Card, 2022). This data indicates a national need for better mathematical practices and a drive for improving standardized assessment scores at all grade levels across multiple states.

Figure 2.8

Score Increase or Decrease By State In 2022 NAEP Mathematics



Note. Figure 2.8 identifies the states increasing or decreasing in mathematical scores. Pennsylvania is the light gray color, indicating a decrease in score between 2019 and 2022. (The Nation's Report Card, 2022)

Summary

Despite the causation of such place value skill deficits, educational gaps are being presented in current research. Chapter 2 summarizes the research centering around what is happening world-wide in place value instructional practices, interventional tools, place value concepts, and many educational effects of the COVID-19 pandemic. Chapter 3 will explain in detail the components of this specific study, including the schedule, participant criteria, ethical practices, and parent or administration permission necessary to conduct the research.

CHAPTER 3: METHODOLOGY

Introduction

Not only has research and current observations within the district of study demonstrated a need for educational interventions, but it has identified declines in educational performances across the nation after the global COVID-19 pandemic. This chapter centers around the structure of the study conducted in a small public school in Western Pennsylvania. The research of this study aims at identifying how an interactive online learning platform affects the place value abilities of second-grade students at-risk in the area of mathematics. Using various data collection techniques and curriculum-based assessments outside of the IXL Learning platform will assist educators in identifying effective and efficient interventions at the conclusion of the study.

Research Design

This quantitative, criterion-changing, single subject, correlational study allowed the researcher to use the students' progress to compare IXL Learning data, weekly researcher-created, curriculum-based assessment data, and the Savvas EnVision Diagnostic Assessment data. The researcher examined the correlation between IXL Learning used as an intervention at the second-grade level, specifically with place value skills. The rationale for selecting such study was the abundant research found in utilization of IXL Learning and the availability of materials implemented in such study. The district of study had purchased IXL Learning subscriptions for consecutive years, along with a Savvas EnVision purchase agreement for a total of six consecutive school years. If correlations between data can produce findings regarding

intervention procedures, interactive/online programs, and teaching practices, educators can support student learning accordingly.

Criterion-Changing, Single-Case, Quantitative Design

With changing-criterion design, effects of the intervention are demonstrated by gradual performance changes over the intervention phase (Kazdin, 2011, p. 167). When the performance matches the criterion, the new criterion is shifted, graphically demonstrating a step-like function in performance within the subphases (Kazdin, 2011, p. 168). Because student progress within this study focuses on one mathematical skill for the participants, the criterion gradually increases for each criterion change, making it a single subject criterion-changing design study. As this occurred in a public school, it was important to select a design that did not have a need for suspension or withdrawing the intervention to demonstrate the relationship between the behavior and intervention (Kazdin, 2011, p. 168). Once a student has been identified in need of an intervention, it would be unethical to remove the interventional practices. Because the criterion-changing study design pushes the participant to the next criterion level, the intervention continues, and unethical concerns can be eliminated. The relationship between the behavior and the intervention can be demonstrated without removing or withdrawing the intervention in this case study design.

Action Plan: Intervention

During the first six weeks of the 2023-2024 second-grade school year, participants completed a criterion changing, single case, quantitative study. During the study, participants attempted to work through the sixteen different components of place value subcategories of IXL Learning at the second-grade level. The intervention took place in the researcher's classroom for a thirty-minute enrichment period where all students in the grade implemented skill interventions

and remediation at their instructional level. Even though all students did not have the researcher as their homeroom second-grade teacher, students of similar skill ability attended the researcher's enrichment time frame class, as the rest of the grade participated in remedial practices. Participants completed the intervention utilizing IXL Learning on their school issued Chromebook. Because the district had implemented IXL Learning in the past, students were already familiar with the layout of the interactive online platform and the subscription was already purchased by the district for district-wide practices.

For a student to move on to the next subcategory of the study, their SmartScore (defined later in Chapter 3) must have landed between 80 and 100 for the day, demonstrating proficiency. The phases of the study changed based on performance at each subcategory. Once students met the proficient score, they moved on to the next subcategory. Students who did not complete the sixteen subcategories of place value continued intervention practices post intervention study, demonstrating regular second-grade remediation practices throughout the grade level. Students who met proficiency of the sixteen subcategories and/or scored 100% on the weekly assessment for three consecutive weeks would be exited from the study.

Setting Of Study-Demographics of School District

The participating school district is a small public school located in Pennsylvania, consisting of one high school building and one elementary building. According to Future Ready, 98.6% of the district consists of white students (Commonwealth of Pennsylvania, 2023). Of the students attending the district, 97.1% are considered economically disadvantaged (Commonwealth of Pennsylvania, 2023). In August of 2023, the district high school had 363 high school students. Of those students, 44 were receiving special education services. At the elementary school, of the 418 enrolled students, 60 were receiving special education services.

The National Center for Education Statistics identifies a population of 7,926 with a median household income of $54,545 in the surrounding community (2023). The total number of households in the district is 3,108 with 82.1% maintaining Broadband Internet (National Center for Education Statistics, 2023). Due to the size, interest, and funding of specific programs within the district, this district merges with the neighboring district for specialty clubs, sports, and coursework.

Participants

As a result of the COVID-19 pandemic, reports of student learning have shown dramatic decreases in students' overall performance and, in particular, the learning of young learners who did not have access to early education such as Pre-K and Kindergarten, where many foundational skills are taught. As a result, the first-grade teachers and administrators within the district identified a large group of young learners who were already performing well below grade level after disruptions to their early childhood education or the reduction in access to early childhood education during their first-grade academic year. Based on district-wide benchmarking data, a generous portion of the first-grade students were identified as performing at "basic or below basic" categories in reading at the end of the first-grade year and start of second grade, as measured by Renaissance STAR assessments. In mathematics, Fastbridge (Illuminate Education, 2023) data collected the first week of the second-grade year from the participating district indicated that 30% of the second-grade students scored within the 0-19.99 percentile, 10% scored within the 20-29.99 percentile, 56% scored within the 30-84.99 percentile, and 5% scored above the 85 percentiles. More specifically, of the 66 students assessed, eleven students scored at the "high risk" category in mathematics and twenty-one students at the "some risk" category. Thirty-two students demonstrated a degree of risk in mathematics, calculating to 48% of the

grade level requiring some form of intervention. To help address this need, the district provided special educators with autonomy in selecting remedial intervention programs, English Language Arts Pilot programs, interventions programs like Fundations, Reflex Math, IXL Learning, a "What I Need" (WIN) period, and extra Title intervention scheduling to help address the needs of the most at-risk students. A second-grade level aide was assigned as applicable to assist students with 504 plans and IEPs when possible and/or classroom instruction for struggling learners. This meant support during the general education lesson, individual tutoring, test assistance, small group work, and sight word flash card practice would be provided in addition to daily core content. Participants for this study were selected from the rising second-grade class within the district. Students identified, via the Savvas EnVision Mathematics Diagnostic Assessment Form A, as being "significantly at-risk" began the 2023-2024 academic year in a remedial setting and were provided remedial instruction via the IXL Learning Mathematics platform. All students in this group, regardless of whether they and their parents/guardians chose to participate in the study, still participated in IXL Learning interventions. Utilizing IXL Learning is a standard second-grade practice, as it was projected to assist in closing some COVID-19 learning gaps and to promote enrichment.

All participants within the single case, changing criterion study were first-grade students in the spring of 2023 at a rural, public school in western Pennsylvania, who entered second grade in the fall of 2024. Students who scored less than 80% within the Numbers and Place Value category of the 2nd Grade Savvas EnVision Diagnostic Assessment Form A were considered for the study. Those who were already receiving special education services and/or who were identified as requiring special education services during the study's preparation and duration were excluded from the data. Special education plans incorporate other intervention practices

that would sway data of this specific study. A total of 27 students were invited to participate in the study. Twelve total forms were returned. Eleven students returned parental permission forms, qualifying, and permitting their participation in the study. One parent declined participation. One student refused to participate on the initial start date, while another student refused to complete the weekly assessment on day nine of the study, therefore, excluded from the study. Fifteen qualifying students opted out of the study and/or did not return the permission paperwork. The population of students that the researcher wanted to draw conclusions about were the second-grade students of the 2023-2024 school year. The stratified sampling of the study includes students who meet all requirements, qualified for a need in place value remediation, and obtained parental permission for participation. These specific students were needed for this project because they experienced the educational concerns of COVID-19 and demonstrated the need for remediation. With the results of this study, educators can be more aware of utilizing IXL Learning as an intervention for primary students experiencing learning gaps from COVID-19 or other causations.

To prevent any new learning at the second-grade level that would sway data points, the study took place the first six-weeks of the new school year and ended in the first week of October 2023. This allowed for the study to be completed before a district wide "fall break" and before any place value instruction was conducted within the second-grade curriculum.

Participation Selection Criteria

1. Participants must be enrolled as a second-grade student within the district at the start of the 2023-2024 academic year, and
2. Participants must also need "Urgent Intervention" as identified by the Savvas Realize EnVision 2nd Grade Mathematics Diagnostic Assessment Form A completed as a first-

grade student in May 2023 and therefore obtaining remedial assistance during the 2023-2024 academic year.

Participant Exclusion Criteria

1. Any second-grade student who was not enrolled in the district in the spring of 2023 and therefore, did not receive the Savvas Realize EnVision 2nd Grade Math Diagnostic Assessment Form A as a baseline score were excluded from the study.
2. Any second-grade student scoring above the "Urgent Intervention" level on the spring 2023 Savvas Realize EnVision 2nd Grade Math Diagnostic Assessment Form A by scoring 80% or above within the place value skill category were also excluded from the study.
3. Any second-grade student identified as special education during the initial baseline data collection and/or during the six-week intervention period were excluded, as other special education services will replace the IXL Learning intervention.
4. The study also excludes any second-grade student who moves districts within the six-week intervention period, as other interventions and programs may be implemented.

Participant Consent Steps

After results of the Savvas Realize EnVision 2nd Grade Math Diagnostic Assessment Form A were available from May 2023, the researcher, a second-grade teacher within the district, contacted via phone (Appendix F) the parents/guardians of the students identified in need of urgent intervention. The researcher explained the purpose of the study and answered any questions or concerns they had before parental verbal consent. It was explained that while their student does not have to participate in the study, they will still receive interventions through IXL Learning throughout the year. The researcher explained to parents that the reason they are being

asked if they want their student to participate in the study is so their child's results can be included in the study and shared, confidentially, through publications and presentations.

If the parents/guardians agreed to have their student participate, a consent form (Appendix G) was sent home in a school-addressed envelope to be signed and returned prior to the start of the 2023-2024 school year.

At the beginning of the 2023-2024 academic year, the researcher met with the second-grade students participating in the study and explained the purpose. Students were informed that if they did not wish to have their scores used within the study, they would still use IXL Learning for mathematics remediation in second grade, no matter which class they are in. Due to the age of the students, a verbal 'yes' or 'no' and checking a box indicating 'yes' or 'no' was used for assent purposes (Appendix G).

Procedures

Recruitment occurred after the results of the initial Savvas Realize EnVision 2nd Grade Math Diagnostic Assessment Form A, given to all first-grade students in May 2023, were available. The researcher, a second-grade teacher in western Pennsylvania, contacted via phone (Appendix F) the parents/guardians of the students identified as in need of urgent intervention. The researcher explained the purpose of the study to parents and answered any questions they had. It was explained that while their student did not have to participate in the study, they still would receive mathematics interventions using Reflex Math, Fastbridge, and IXL Learning, as determined by the building administrators (principal, behavior specialist, and superintendent). All second-grade students would still be receiving interventions through the IXL Learning program throughout the year. The researcher explained to parents the reason their child was being asked to participate in the study. That reasoning was so their child's results could be

included in the study and shared, confidentially, through publications and presentations for future educational practices. If the parents or guardians agreed to have their student participate, a consent form (Appendix G) was sent home with the student in a school-addressed envelope to be signed and returned. Parents/guardians were given the researcher's contact information in case any questions arose over summer break and/or participation status changed. A total of nine students completed the six-week study after obtaining appropriate permissions.

At the beginning of the 2023-2024 academic year, the researcher met with the second-grade students and explained the purpose of the "study" (see student assent script in lieu of the assent form in appendices- Appendix G). Students were informed that they did not have to allow the researcher to use their scores in the study and that, if they did not wish to have their scores used, they would still participate in IXL Learning or other interventional practices. Due to the age of the students, a verbal 'yes' or 'no' and checking a box indicating 'yes' or 'no' was used for assent purposes by the researcher.

Shifting Through Criterions

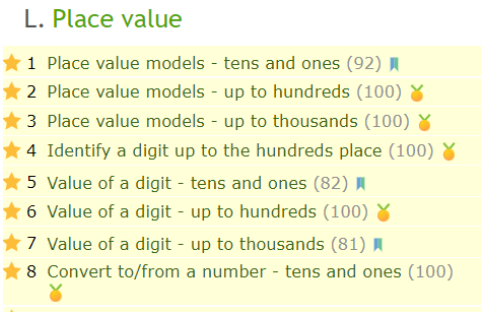
The criterion change within this specific study is dependent on the students' ability to reach a SmartScore of 80-100 in each subcategory of place value skills within IXL Learning at the second-grade level. The SmartScore is an electronic score given to students based on their progress in the program of IXL Learning. When students answer a question incorrectly in IXL Learning, their SmartScore will decrease while they get instant feedback on the question, allowing them to see the correct answer (Liu & Wu, 2021, p. 246). As the students get the answers correct, their SmartScore increases. The targeted SmartScore is 80 to 100. Once students reach a SmartScore of 80, they have mastered that subskill within IXL Learning or are considered proficient in that skill area.

Within IXL Learning, the SmartScore indicates how well students understand the skill. This proprietary algorithm allows students to see their progress in the skill. Students start at a SmartScore of zero and their score increases as they answer questions correctly or decreases as they answer incorrectly. It is calculated by the number of questions completed, the difficulty of the question, consistency, and accuracy of the students' achievement.

If students reached a SmartScore of 80-100, they then moved on to the next skill subphase/subcategory. If the intervention was responsible for the change in performance, the shift in criterion from subphase to subphase would demonstrate the change (Kazdin, 2011, p. 169). The researcher allowed students to reach their Smartscore of 100 if they so desired. Reaching that Smartscore resulted in more electronic ribbon icons within the program illustrated in Image 3.1. The blue ribbon indicated a SmartScore of 80 or above, while the medal indicated a SmartScore of 100.

Image 3.1

IXL Learning Electronic Reward System Icons Example



Note. Image 3.1 illustrates the blue ribbon icon, along with the gold medal icon within IXL Learning. These rewards indicate a SmartScore of 80 and 100, indicated by the number in parentheses to the left of the icon. These icons allow for self-reflection within independent work of IXL Learning. (IXL Learning, 2023)

At the point where students reach the 80-100 SmartScore range in this study, they would move on to the next subcategory or criterion within the targeted skill area. This continued until they reached mastery of all place value skills in the place value category of IXL Learning (IXL Learning, 2023) and/or the completion of the six-week study. When utilized within regular practices and outside of targeted research, educators can instruct students on the skill area to work in IXL Learning to build their SmartScore. For example, English Language Arts teachers might assign their second-grade students to work on Vowel Teams, indicated by F1 on IXL Learning, “Choose the picture that matches the vowel team word” (IXL Learning, 2023). In Image 3.1, the golden star to the left of the subcategory skills listed indicates the teacher as “recommended” or assigned that skill to the student.

Researcher-Created, Curriculum-Based Weekly Assessment

Once per week, each student completed a researcher-created, curriculum-based assessment. The assessment aligned to the district's mathematics curriculum while assessing the transferability of the skills developed in IXL Learning to the general education classroom. By repeating the intervention with gradual criterion changes, the goal of the program was approached gradually, in small increments (Kazdin, 2011, p.189). However, if a subcategory is easier for the student, the duration of time spent on that subcategory would be significantly shorter than a difficult subcategory. Some students could change criteria multiple times in one thirty-minute session. A clear effect of the study is evident if student performance follows the changing criterion of the intervention (Kazdin, 2011, p. 190). All cautions were taken in order to produce close "point-by-point correspondence" between the criterion levels and student skill performances, demonstrating whether the intervention is responsible for the changes (Kazdin, 2011, p. 191). Daily data collection occurred, including if students completed the thirty-minutes

of intervention, which subskill they worked on during that day, if they completed that subskill and what their SmartScore was at the end of the session. The data collection page, previewed in Figure 3.2, also allowed for researcher notes indicating restroom visits, student comments, technology, or schedule restraints.

Figure 3.2

Researcher-Created Data Collection Template

Student Name						
Date of Trial	30 Minutes Complete Y/N	IXL Subskill Worked On	Subskill Completed Y/N	SmartScore at Completion of 30 Minutes		Notes:
8/28						
8/29						
8/30						
8/31	Assessment Score:					
9/5						
9/6						
9/7						
9/8	Assessment Score:					
9/11						
9/12						
9/13						
9/14	Assessment Score:					
	Notes:					

Note. The graphic organizer was created by the researcher specifically for the study's data collection procedures. However, it could be tailored to meet the needs of a variety of interventional practices requiring daily data collection.

Timeline and Scheduling

The Intervention Study Activity table schedule (Figure 3.3) demonstrates the weekly schedule utilized during the six-week intervention. Because the district was in session for five

full weeks of school (5 school days each week) and one week with four days as Labor Day was observed, the students remained consistent with their participation each day and week. Because IXL Learning requires a lot of screen time, the fifth day was designed to provide students with a break from the screen and allow them to focus on other skills that needed remediation at the second-grade level. This was often a game, puzzle, or class activity that did not require technology or screens and did not focus on place value skills. Games and activities used in the study can be found in Appendix I. The intervention was initiated the last week in August and concluded the first week of October 2023.

Students were engaged in IXL Learning on days 1, 2, and 3 of the schedule for thirty-minutes each day during the enrichment period scheduled. Students returned to the researcher's classroom each day for intervention practices within the study. The researcher circulated the classroom to ensure engagement in IXL Learning practices. If a student was off task, redirection was given, along with praise for working hard. Restroom breaks were granted, along with eating breakfast if they picked one up on their way to the classroom. On rare occasions, students would have technical difficulties including getting logged in, uncharged Chromebooks, or needing to be redirected to the correct subskill, as they clicked the wrong button. These concerns were corrected in a timely manner and were predicted while working with second-grade students. Day 4 of the study week was a researcher-created, curriculum based assessment. Day 5 of the study included an additional second-grade mathematical activity that focused on other areas of deficit for the participants but would not sway data collection of the study. This also provided participants with a break from screen-time that the IXL Learning study required or screen time that they may engage in throughout each school day or outside of the school building.

Figure 3.3

IXL Learning Researcher-Created Intervention Study Schedule

Day #	Intervention Study Activity
1	IXL Learning Implementation at Targeted Subcategory
2	IXL Learning Implementation at Targeted Subcategory
3	IXL Learning Implementation at Targeted Subcategory
4	Curriculum-Based Researcher-Made Assessment
5	Paper-Based Unrelated Skill Remediation

Note. The weekly schedule for this specific study includes three days of electronic work within IXL Learning, one day of assessment, and the last day of unrelated math skill practice. The fifth day is utilized as a break to prevent student exhaustion in the study and to discourage overuse of screen time for the primary learners participating in the study.

Data Collection and Analysis

Data collection methods included:

1. Savvas EnVision 2nd Grade Diagnostic Assessment- The end of the first-grade school year, Savvas EnVision 2nd Grade Diagnostic Test assessments were utilized as baseline data and post-intervention data to track growth of the intervention. The initial baseline assessment took approximately thirty-minutes per student and was read aloud to all participants, along with the four multiple choice answer options. The initial assessment took place over two days during the month of May 2023 to eliminate disruptions to their daily routines and instructional times.
2. Savvas EnVision 2nd Grade Diagnostic Assessment Individual Record Form (Appendix C)- This document was designed to record students' correct and incorrect answers

according to each of the categories throughout the curriculum designed in the Savvas program. The form indicates a quantitative score that demonstrates proficiency in each category. The category examined during the study is the Place Value and Number Sense, including five questions on the assessment. This documentation allowed for second-grade educators to compare overall scores across the grade level, and to examine scores that would be used for promoting ability grouping corresponding to individualized ability grouping for interventions time periods.

3. IXL Learning SmartScore- Students demonstrated progress within each subcategory by their SmartScore. A SmartScore of 80 or higher demonstrated proficiency in each subcategory of the place value skill. The targeted criterion was a SmartScore of 80 to 100 in each subcategory skill. This data was monitored daily within the six-week study. Students were permitted to continue working until their Smartscore reached 100 if they desired. The minimum score of 20 was needed to move on to the next subcategory, while 100 is the maximum score possible for each subcategory. The SmartScore was utilized in hopes of measuring student comprehension of the skill subcategory in an effective and efficient manner.
4. IXL Learning Data- Specific skill reports, SmartScores, and data specifying number of correct/incorrect answers were also utilized during the study. IXL Learning is the online platform that generates these resources for educators to assist in data analysis. Scoring accuracy is also provided while using the online platform. IXL Learning does the scoring for the educator. IXL Learning was the main intervention component of the study. Because IXL Learning provides remediation as needed for specific skills and was tailored to each student's progress, the intervention was utilized and examined. IXL Learning

states that their diagnostic is an accurate reading of student achievement and a strong predictor of performance on standardized assessments including NWEA MAP, Star, FSA, PSSA, SOL, MCAS, ILEARN, and SC READY (2023). Because IXL Learning is grounded in research and standards aligned, it has received the Based Design Product Certification from Digital Performance (IXL Learning, 2023). The website indicates that schools who participate in IXL Learning may score as much as fifteen percentile points higher in math and seventeen percentile points higher in language arts on state assessments, indicating it is a valid and reliable instrument for this specific study (IXL Learning, 2023). The automatic electronic data analysis was a draw to the researcher as it provided quick, accurate, and valid data on student progress, therefore, eliminating human error.

5. Weekly Researcher-Created, Curriculum-Based Assessments- The researcher-created, curriculum-based assessments (Appendix H) became a valid tool utilized within the study as it aligned with the second-grade Pennsylvania State Standards and focused on place value categories that aligned with the Savvas EnVision 2nd Grade Curriculum. Participant scores were reliable, as they were double checked by the researcher for accuracy. The researcher created assessments intended to track student progress as they continued through the six-week study with IXL Learning interventions being implemented. This tool has high validity, as it corresponds to real student scores and place value abilities. This specific tool is a reliable tool, as it was consistent with level of performance over multiple measurements and was created to mimic the questioning of the Savvas EnVision 2nd Grade Diagnostic Assessment questioning formats. The researcher was also able to observe student strategies utilized during the assessment, as they provided feedback in

the form of counting, drawing, and orally communicating which strategy they utilized when questioned by the researcher. As the assessment was read aloud to students, the researcher would indicate the strategy of use as the students shared or demonstrated their thought process.

Data Analysis

Data analysis was conducted in three stages: an analysis of the Savvas EnVision 2nd Grade Diagnostic Assessment Form A benchmark assessment data, which was recorded on the Individual Record Form (Appendix C), analysis of criterion-changing sixteen subcategories achieved on IXL Learning (Figure 2.2), analysis of the weekly curriculum-based researcher-constructed assessments (Figure 4.5), and the Savvas EnVision 2nd Grade Diagnostic Assessment Forms A and B (Appendix A and B) utilized as the final benchmark assessment.

Data was analyzed initially to determine participant qualification and selection. Students in first grade were grouped by ability and skill deficits for intervention periods for the 2023-2024 school year to supplement instruction with additional interventions as they entered second grade. Once all assessments were scored, students who demonstrated a place value deficit by scoring less than 80% in the place value category of the Savvas EnVision Diagnostic Assessment were selected for the study. During the study, students participated in the IXL Learning intervention sessions three days each week for thirty-minutes each day for the duration of the study. Because repeated researcher-created, curriculum-based assessments were utilized, student absences were recorded while no “make-up” session was planned. Students picked up right where they left off when they returned.

Savvas EnVision Assessment Comparison - Qualitative data was collected from the initial assessment in May 2023, Savvas EnVision 2nd Grade Diagnostic Assessment Form A. Of

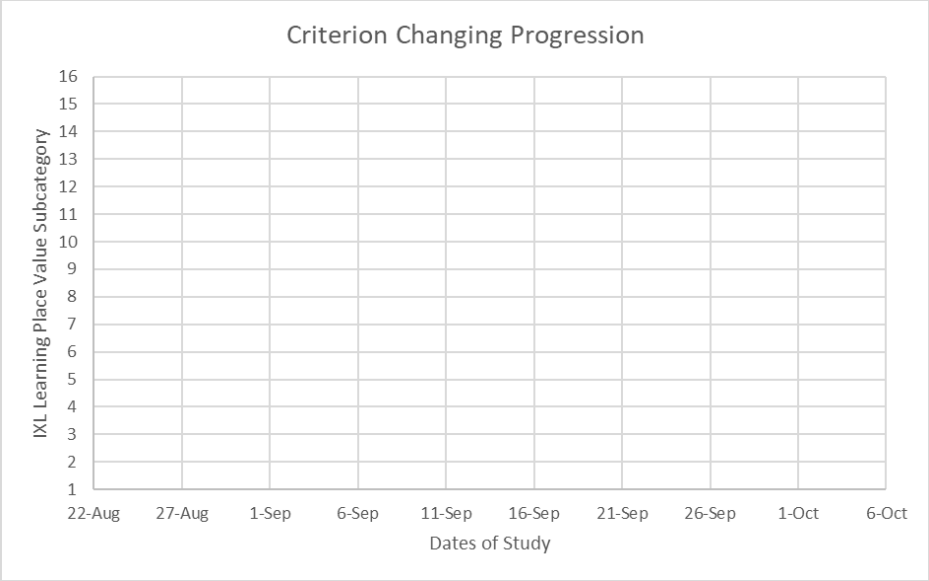
the 68 students assessed in the initial assessment prior to the start of the study, the average score was 30.89 out of 60 possible points, equating to an average score of 51.48%. This scoring equates to “not proficient” or below second-grade levels. At the conclusion of the study, students were given the 2nd Grade EnVision Diagnostic Assessment Form B (Appendix B) to compare to the quantitative data results of the Form A assessment from the spring of 2023. The Individual Record Form papers located in Appendix C, outline the number of correctly answered questions needed to demonstrate proficiency in each category of the assessment, including place value. The overall score of the formal assessments were compared. Is there an increase or a decrease from the initial baseline assessment? The category scores were also compared. Is there an increase in the place value score? Did the student score 80% or higher in the "Numbers and Place Value to 100" category?

IXL Learning Changing Criterion Comparison- Data was compared and reviewed to determine how many subcategories within the sixteen IXL Learning place values skills (Figure 2.2) were mastered within the six-week time frame of the study. How quickly could students work through each subcategory? How many of the sixteen subcategories could reach a SmartScore of 80-100 within the six-week time frame? IXL Learning generated reports indicating the students' SmartScores in each subcategory, so identification of which subcategory needed to be completed was simple. If their SmartScore was below 80, they continued to work on it until they reached 80-100 to demonstrate proficiency. By following the range-bound changing criterion design, each subcategory of IXL Learning Mathematics under the place value skill was utilized as subphases of the criterion. Therefore, the graph (Figure 3.4) holds the baseline and sixteen subphases of IXL Learning place value skills, representing the quantitative

data of the length of time for each subphase. The graph demonstrates how many days it took for each student in the subphase to reach a SmartScore of 80-100.

Figure 3.4

Criterion Changing Progression Graph for Student Data Collection



Note. The Criterion Changing Progression graph was created by the researcher to track daily participation data within IXL Learning for each specific data.

Weekly Assessment Comparison- The six researcher-created, curriculum-based assessments were centered around the EnVision Curriculum and focused on the place value skill. Seven multiple choice questions focused on numbers and place values at the second-grade level were presented to participants each week of the six-week intervention period. Scores from each assessment demonstrated progress/lack of progress in the intervention program and progress monitored on a line graph for publication purposes or visual inspection. The reliability or consistency of the intervention's effects may be graphed visually when examining data and can quickly communicate changes in means, levels, or trends within the data (Kazdin, 2011, p. 286,

p. 288). Again, scoring 80% demonstrated proficiency on the weekly assessments and allowed for quantitative data collection to occur. Proficiency of 80% was selected as it is frequently utilized during formative and summative assessments (Williams, 2018). If students scored 100% for three consecutive weekly assessments, they were to be exited from the study, as they demonstrated mastery of place value. According to the research question, students who had an increased score on the researcher-created, curriculum-based assessments demonstrated a successful intervention utilizing IXL Learning as an online educational tool. Students who decreased their score on the researcher-created, curriculum-based assessment demonstrated that IXL Learning was not a successful tool for improving place value skills with those specific students at the time of the study.

Presentation of Results

A system of coding was developed to indicate the students' progress throughout the study without stating any personal or identifying information for their security. Students were numbered randomly to publicly share results with stakeholders. Results were prepared to be shared with current and future educators at the local, state, and national level as applicable.

Within this specific school district, findings of the study were prepared to be shared with the first, second, and third-grade teachers, along with intervention specialists, administration, and special education teachers, as needed to make educational decisions for future and best practices within the district.

Permissions and Protection

In order to protect the students of the study, initial parental AND student consent was obtained. The researcher was in communication with parents and guardians throughout the study to confirm students still wished to participate or did not have questions or concerns. No physical

harm was presented to students during the study. All students within the district had an IXL Learning account at the time of the study, as most educators in the building implement IXL Learning into their Direct Instruction, remediation, or free time play options for students. All students had access to the interventional tool of IXL Learning. All students participated in the enrichment time frame within the daily schedule, allowing them to gain instruction and remediation in their specific areas of deficit. Students of all genders, ethnicities, financial demographics, age, and ability groups were assessed for study participation criteria.

Study Approval

Not only did the administration and superintendent approve of the study (Appendix E), but the researcher submitted an Institutional Review Board application to Slippery Rock University's Review Board prior to the start of the study (Appendix G). This process ensures ethical soundness of the study, university research requirements, and protection of participants, including informed consent. Within the requirements of Slippery Rock University's Ed.D. of Special Education program, the researcher completed various courses centering on the research process prior to starting the study. The researcher also completed the CITI (Collaborative Institutional Training Initiative) Human Subjects Research training, obtaining certification in the Students Conducting No More than Minimal Risk Research category, located in Appendix D.

Informed Consent

Prior to the formal invitation to participate, possible participants' parents were contacted by the researcher to discuss the purpose of the study and reasoning for the invitation via phone calls in May 2023. The parental contact script utilized in May 2023 prior to mailing official permission paperwork home with students is located in Appendix F.

Possible participants were then sent the participation paperwork (Appendix G), including the participation permission form. Participants were given the opportunity to withdraw from the study at any time with no consequences. All participants of the study were fully informed about the procedures and risks involved in the research project before agreeing to participate. This includes parental consent AND student consent for this specific study. All participant engagement was voluntary. This paperwork explains the research, the purpose, duration, procedures, risks/discomforts, benefits, alternative procedures, confidentiality of records, and contact information of the university, staff, and researcher.

On the first day of the study, one student indicated he did not want to participate in the mathematics intervention, therefore, was excluded from the study. During week two, another student declined to take the assessment and was also excluded from the study.

Bias Mitigation, Risks, and Discomforts

To mitigate researcher confirmation bias, the researcher consistently reevaluated impressions of the participants and future readers while challenging pre-existing assumptions and hypotheses. In the same light, social desirability bias was eliminated when the researcher explained to participants and their parents that there will not be any consequences or rewards of participating in the study. Utilizing IXL Learning is consistent with the interventions used in second grade on a regular basis. The only advantage of permission was the ability to share their progress and results with future educators. Unconditional positive regard was implemented by explaining that there were no consequences for declining study participation in order to be socially accepted. Cultural and gender bias were mitigated simply by including all students who met the study participation criteria, without knowing their gender, race, economic status, or culture.

Question-order bias was eliminated by implementing tools that were computer generated or curriculum-based. While participants completed the Savvas EnVision Diagnostic Assessments and the researcher-created, curriculum-based assessments, students were read the questions aloud by the researcher, but were unaided in their responses to prevent incorrect data. Because these assessments were either computer multiple choice or paper and pencil multiple choice, leading question and wording bias was mitigated.

Risks and Discomforts

Coercion risk may have been present for parents and guardians as they may have felt pressured to have their student participate in the study because a second-grade teacher was asking them to participate. The researcher let parents/guardians know that student participation, or refusal to participate, would not determine the educational services, instruction, and/or interventions used within the second-grade setting. All students participated in the IXL Learning interventions at their respective levels and ability groupings. The study only asked to use student scores for publication purposes at the conclusion of the study.

No physical risks were presented to participants. Grades or academic standing were not affected based on participation in the study. Parents and guardians were informed that students would not suffer any consequences should they not wish to participate or if they chose to participate and then change their minds. Participation involved voluntarily sharing of student data in which the students cannot be identified. No penalty or loss of benefit occurred for declining participation of the study.

Security questions and strong passwords for all parties involved assisted in securing confidential student records and results. Students utilized a district owned Chromebook with their Google account username and password. Security was also protected by IXL Learning's

username and password login procedures. Student data was protected on the researcher's personal laptop using a password and/or fingerprint identification to unlock. Student names were replaced with numbers within the study to eliminate student identification for security and privacy concerns.

Reliability, Validity and Limitations

Data collected from the Savvas EnVision Diagnostic Assessments were reliable due to the research-based curriculum distributed by Savvas. The diagnostic assessments have been recognized by Tech & Learning, received Awards of Excellence: Best of 2021 (Savvas Learning Company, 2023). Savvas reports their program was created with WestEd to ensure reliability and validity (Savvas Learning Company, 2023). WestEd is a non-profit organization that is rooted in data informed by research and equality, working at local, state, and national levels to produce unbiased and equitable assessments (Savvas Learning Company, 2023). Because their program is vertically aligned from Kindergarten through Algebra 2, mathematical standards can effectively and reliably be addressed (Savvas Learning Company, 2023).

As the Savvas EnVision Diagnostic assessments make instructional recommendations for every learner, it becomes a valid assessment, offering flexibility for progress monitoring and data reporting (Savvas Learning Company, 2023). Student performance can be compared to grade level expectations and national norms. The Individual Record Form from the Savvas EnVision Curriculum indicates what the norm score should be to demonstrate proficiency in each category (Appendix C). Because there are two forms of the diagnostic assessment, validity of the scores is acceptable. The assessment is not intended to be given multiple times throughout the school year to prevent familiarity of questions. Valid results were obtained on the diagnostic assessment by allowing students to take a break or break up the 60-question assessment. Some students

demonstrated fatigue or loss of focus after a portion of the assessment was given due to the extrinsic length of the measure. One student asked for a break and verbalized an overwhelmed feeling during the assessment.

Other factors ensuring validity of research include an appropriate time scale for the study to be conducted during the first six-weeks of a new school year, along with the most suitable method of data collection for second-grade students the first few weeks of school. All students had a thirty-minute time frame where they utilized interventional practices that focused on their respective educational deficits. During this time frame, redirection, encouragement, and prompting was needed to ensure reliability and validity of the program.

The repeated measures of the researcher-created, curriculum-based assessment allowed students to still participate in the study if they were absent from school a day. The repeated measures also provided a valid picture of student knowledge and skills within the place value category. The structured atmosphere set during the first week of school supported student engagement in the program, along with flexible seating utilizing Kore Wobble chairs (Kaplan Early Learning Company, 2023). Students had their own device with which they were familiar with. The researcher used proximity control to prevent students from clicking random answers or becoming "click happy" (Heale, 2015).

Limitations

Limitations found within the study included low statistical power in a small sample size of one school district, a lack of post-COVID research or literature in educational practices, and disadvantages associated with educational technology practices, as suggested by The ViewSonic Corporation (2020). Because the rural school district was studied, external validity may be compromised when generalizing the findings from the relatively small sample to a larger

population in an urban setting. The ability to generalize results of this specific study is limited to smaller populations. Research indicating similar studies in a larger school district or setting is limited.

To eliminate the participants' new learning opportunities, the study needed to be conducted during the first six weeks of the second-grade year, a time constraint limitation. Some educators may view the study as unethical by eliminating special education students. However, to ensure students were not getting any other specific math interventions, they were excluded from participation in this specific study. Other electronic diagnostic assessments were researched and considered for this study, yet were unobtainable for various reasons (funding, communication, subscription stipulations and student access). Also, because the Savvas EnVision Diagnostic Assessments were hand-scored by the researcher, human error is possible but was prevented with revising assessment scoring more than once.

Lastly, there were conflicting opinions on whether place value is a foundational skill or not, causing limitations in the study. Elizabeth Bridgett (2022) recommends spending time on arithmetic structures or number structures rather than place value in secondary schools. Looking at the commutative and distributive laws rather than column addition would benefit students more by exploring algebraic manipulation. Is place value a "distraction from mathematical structures" like Bridgett suggests (2022)? According to Happy Numbers, before starting place value instruction, students should be fluent in numeracy, addition, and subtraction up to ten (Happy Numbers, 2023). They also state that place value skills will appear throughout grade levels, contradicting the thought that place value is a foundational skill. This presents a limitation to the study, as the study focused on place value.

One last limitation within this specific study is the knowledge of the participants' birth dates within the second-grade class. According to the district's "cut off" age, are the participants considered young for their grade? Were they held back in kindergarten or first grade? Does their age affect their progression within interventional programming? These are all factors that were not explored upon participant criterion selection but could sway data in a specific manner.

Summary

Chapter 3 outlines the details of this specific study, as it examines the practices associated with implementing IXL Learning as an interventional tool. This chapter also identifies the schedule of the study, participant selection criteria, parental communication, and the structure of data collection and analysis. The reliability and validity of the collected data is supported through the practices and protection of data conducted by the researcher. Data collection and presentation in Chapter 4 will demonstrate the progression of each participant's progress within the study.

CHAPTER 4: RESULTS OF QUANTITATIVE DATA

Savvas EnVision 2nd Grade Diagnostic Assessment Baseline Data

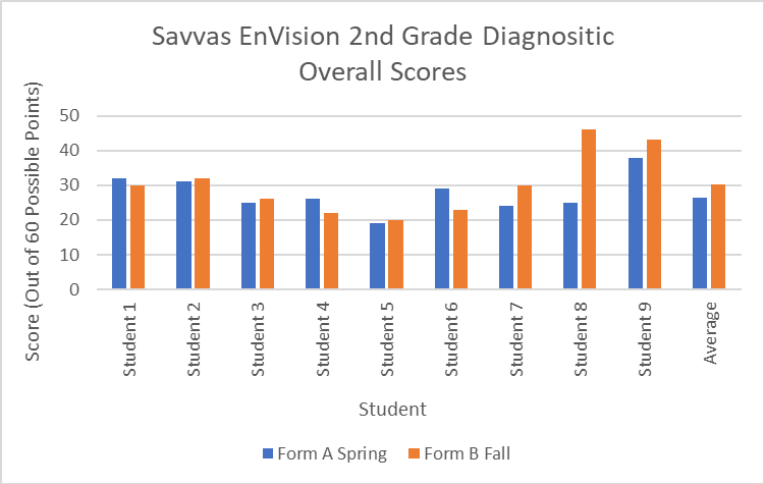
Baseline data was collected in May 2023 at the end of the first-grade year for all students in the grade level on the Savvas EnVision 2nd Grade Diagnostic Assessment Form A. On the initial assessment, from the 68 students in the grade, an average score of 30.89 out of 60 possible points was presented, equating to an average score of 51.48%. This scoring calculates to "not proficient" or below second-grade levels according to the Savvas EnVision Norms set by the research-based curriculum. This data was utilized to solidify criteria for the participation in the study, solidify which area of mathematics needed intervention, and assisted in narrowing the selection of students who would be invited to participate in the study following the criteria. This data was also used to group students by ability, to monitor progress, and to record data for future district collaboration meetings.

Figure 4.1 illustrates the comparison between the May 2023 assessment of the Savvas EnVision 2nd Grade Diagnostic Assessment Form A and the October 2023 Savvas EnVision 2nd Grade Diagnostic Assessment Form B assessment results. Three of the nine participants scored lower in the Fall testing session compared to their Spring baseline results. Six of the nine participants, 66.6%, increased their score from the baseline collection. The highest increase in score was 21 points by Student #8. Students #2, #3, and #5 had the lowest increase of one point on the assessments. Three students decreased their scores, equating to 33.3% of participants declining in scores after the interventional time frame. Because the time frame of the study is conducted during the first six weeks of the second-grade school year, validity of the interventional practices is supportive of the study. New learning of the Savvas EnVision Math

Curriculum does not focus on instruction of place value skills within the first four units of the curriculum, preventing alteration of study data collected. The curriculum introduces place value in the ninth unit, skipping over explicit instruction of the tens, ones, and hundreds place values to focus on adding the thousands place value in the instruction in the ninth unit. The curriculum assumes students have already obtained the place value skills of the tens, ones, and hundreds place values in units one through nine.

Figure 4.1

Savvas EnVision 2nd Grade Diagnostic Overall Scores 2023



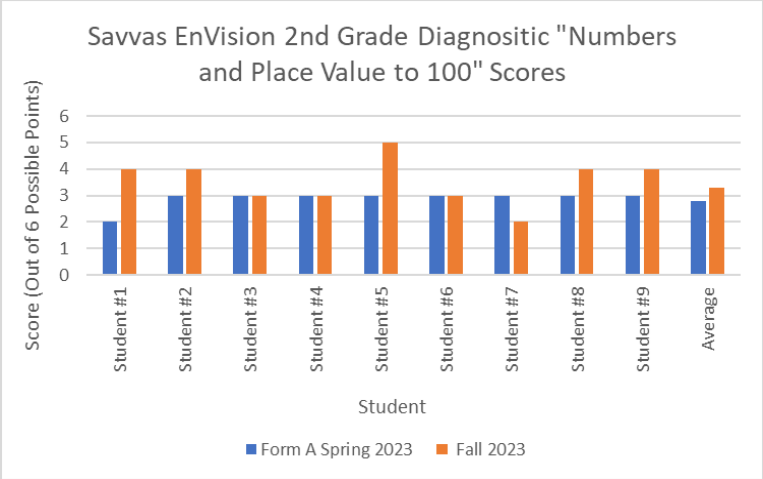
Note. Figure 4.1 illustrates the comparison in Savvas EnVision Diagnostic scores for each specific participant of the study, along with the average score for all students. This visual was researcher-created, specifically for the study.

When examining the Numbers and Place Value to 100 sections of the Savvas EnVision 2nd Grade Diagnostic Assessment, educators can analyze the study's progress and the intervention's effectiveness. Eight out of nine participants either maintained or increased their score from May 2023 to October 2023 on the Numbers and Place Value to 100 sections of the assessment. A decreased score was presented by one student after the six-week study time frame.

The overall participant average in the Numbers and Place Value to 100 sections increased from 2.8 to 3.3 after the six-week trial.

Figure 4.2

Savvas EnVision 2nd Grade Diagnostic "Numbers and Place Value to 100" Scores 2023



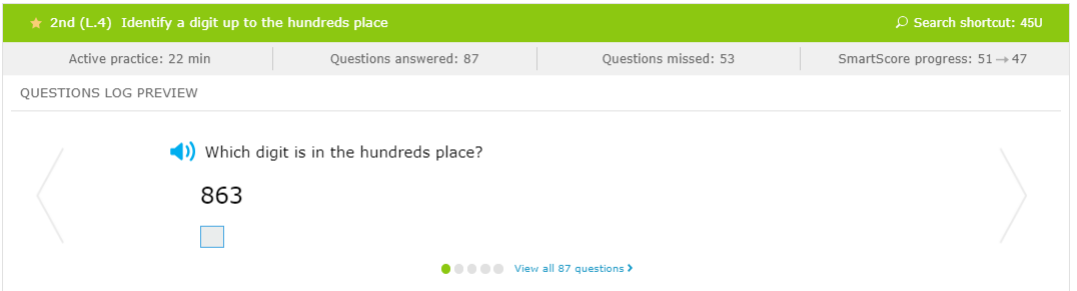
Note. Figure 4.2 illustrates the "Numbers and Place Value to 100" scores of each participant, along with the overall average score within the Savvas EnVision Diagnostic Assessment. This visual was researcher-created for this specific study.

IXL Learning Data

As students participate in IXL Learning, the online program tracks correct answers, incorrect answers, difficulty of questions, the number of questions answered in each work session, and the amount of time students are engaged in the skill. Figure 4.3 illustrates the educator's progress monitoring screen through IXL Learning that shows this data. This data may be used for various reasons for educators. Figure 4.3 shows that Student #1 was active in IXL Learning at level 4 (L4) for twenty-two minutes. This student answered 53 out of 87 questions incorrectly, causing the SmartScore to decrease from 51 to 47.

Figure 4.3

IXL Learning's Educator Progress Monitoring Screen Example



Note. Figure 4.3 demonstrates what the instructor's screen looks like while monitoring student progress within IXL Learning. A plethora of data collection components can be gathered from this electronic tool. (IXL Learning, 2023)

Figure 4.4 identifies the average number of questions each student answered in the thirty-minute time frame within the study. The mean number of questions answered each day of the study was 30.6 questions per participant. The highest average number of questions answered by a participant each day was 49 questions, while the least number of questions answered was 13.

Also illustrated in Figure 4.4, the total number of questions answered by all participants throughout the duration of the study was 4,816 questions. The highest number of questions answered by one student was by Student #5 with 882 questions, while Student #4 answered the least number of questions with 245 answered. Students who scored over thirty questions per session were working at a pace faster than one question per minute. Three students within the study were working at a pace faster than one question per minute.

Figure 4.4

Total Number of Questions Encountered Per Student

Total Number of Questions Encountered		
Student	**Number of Questions Answered Total**	**Average Number of Questions Per Day**
Student #1	620	38.7
Student #2	366	21.5
Student #3	536	28.2
Student #4	245	13
Student #5	882	49
Student #6	394	20.7
Student #7	828	48.7
Student #8	524	29
Student #9	421	28
Total Overall	**4,816**	**30.6**

Note. Figure 4.4 was created by the researcher to illustrate the total number of questions completed by each participant in the study, along with the overall total number of questions completed by all participants over the six-week study.

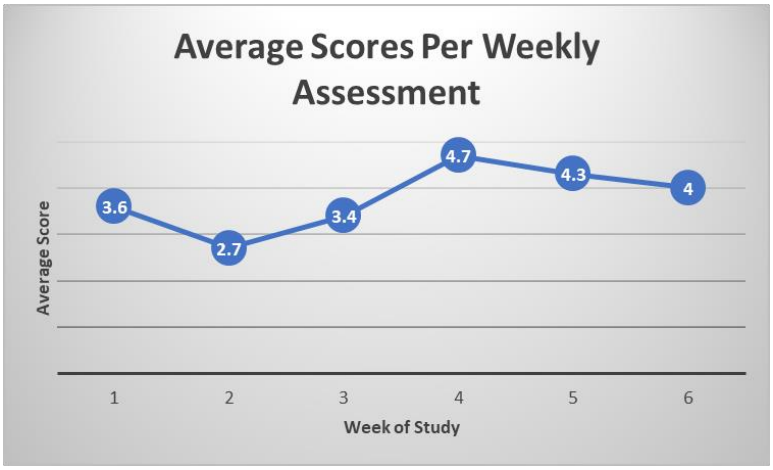
Researcher-Created, Curriculum-Based Weekly Assessment Data

Participants were provided a researcher-created, curriculum-based assessment of seven questions weekly throughout the duration of the study (Appendix H). Figure 4.5 demonstrates the average score for each week on the seven-question assessment, aligned to the Savvas EnVision curriculum. A slight increase is evident after week two of the study. If data is compared from initiation of the study (an average score of 3.6) and the conclusion of the study (an average score of 4.0), it would appear the study has slightly improved students' place value

skills within the study according to weekly researcher-based, curriculum-based assessments at the second-grade level. Note, the research question of this study centers around the weekly assessment data collection. Individual student weekly assessment data is published under each student later in Chapter 4.

Figure 4.5

Average Scores Per Weekly Assessment



Note. The Average Scores Per Weekly Assessment graph, created by the researcher, is utilized to demonstrate the weekly progress in researcher-created, curriculum-based assessments to assess student mastery of place value skills.

Individual Student IXL Learning Place Value Subcategory Progression

Student #1

Student #1 participated in sixteen of the eighteen study days of IXL Learning data collection. Data concludes that Student #1 progressed through thirteen of the criterion levels and subcategories of IXL Learning Place Value skills. On three occasions, Student #1 mastered three criterion levels in one thirty-minute session of the study. Data illustrates that subcategory 7 and

10 challenged the student, requiring three days of implementation at that criterion level. Figure 4.6.1 demonstrates the progression of Student #1's participation in the study.

Figure 4.6.1

Student #1 IXL Learning Criterion Changing Progression

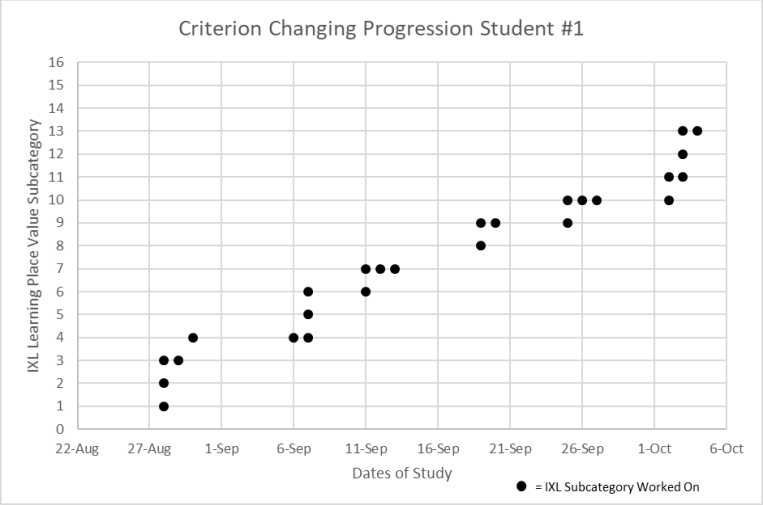


Figure 4.6.2

Student #1 Researcher-Created, Curriculum-Based Weekly Assessment Scores

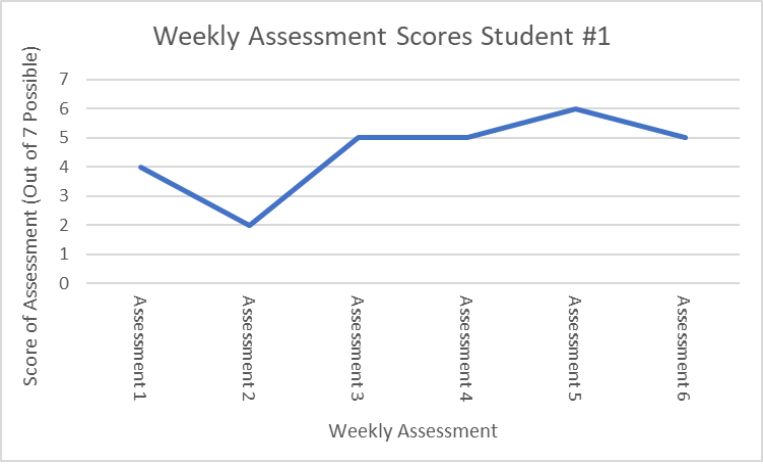


Figure 4.6.2 demonstrates Student #1's slight growth in weekly assessment scores. Student #1 first scored 4 out of 7 total points on the researcher-created, curriculum-based place value assessment. During the intervention, Student #1 scored the lowest on assessment #2 with a

score of 2 correct answers and the highest on assessment #5 with 6 correct answers. The concluding assessment scores Student #1 with 5 correct answers out of seven possible. Student #1's average score on the weekly assessments was 4.5 or 64% accuracy. Slight growth is measured by the increased scores of the weekly assessment for Student #1.

Student #2

Student #2 participated in sixteen of the eighteen study days of IXL Learning data collection. Data concludes that Student #2 progressed through nine of the criterion levels and subcategories of IXL Learning Place Value skills. On two occasions, Student #2 mastered three criterion levels in one thirty-minute session of the study. Data illustrates that subcategory 2 challenged the student the most, requiring nine days of implementation at that criterion level. Also illustrated is the participant remaining at criterion level 9 for four consecutive study dates. Figure 4.7.1 demonstrates the progression of Student #2's participation in the study. On five days within the study, Student #2 worked through more than one criterion level. Two of the days that Student #2 was engaged in more than one criterion level, the student mastered three subcategories in one thirty-minute session.

Figure 4.7.1

Student #2 IXL Learning Criterion Changing Progression

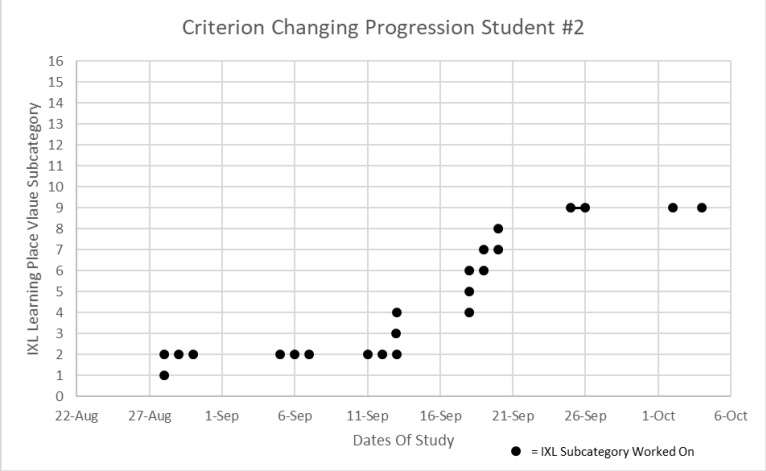


Figure 4.7.2

Student #2 Researcher-Created, Curriculum-Based Weekly Assessment Scores

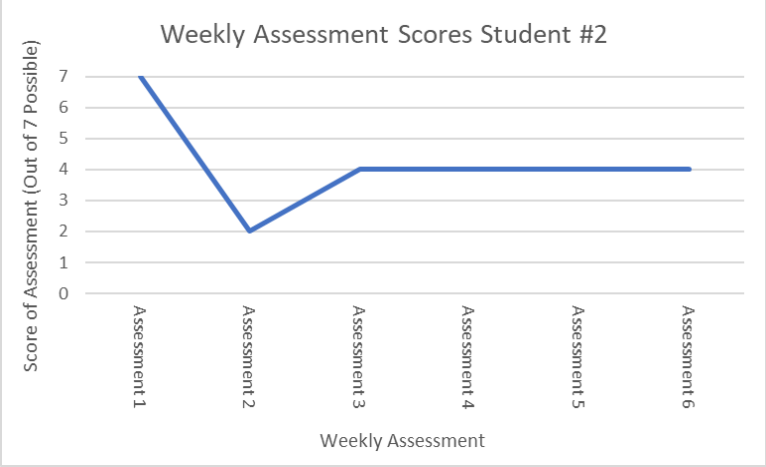


Figure 4.7.2 demonstrates Student #2's stagnant growth in weekly assessment scores. Student #2 first scored 7 out of 7 total points on the researcher-created, curriculum-based place value assessment. At this point, the researcher decided that a student would be discharged from the study if the participant scored 100% accuracy across three consecutive weekly assessments despite his or her progress in IXL Learning or the Savvas EnVision 2nd Grade Diagnostic Assessment scores. During the intervention, Student #2 scored the lowest on assessment #2 with a score of 2 correct answers and the highest on assessment #1 with 7 correct answers. The

concluding assessment scores Student #2 with 4 correct answers out of seven possible. Student #2's average score on the weekly assessments was 4.16 or 59% accuracy.

Student #3

Student #3 participated in all eighteen study days of IXL Learning data collection. Data concludes that Student #3 progressed through four of the criterion levels and subcategories of IXL Learning Place Value skills. On one occasion, Student #3 mastered three criterion levels in one thirty-minute session of the study. Data illustrates that subcategory 4 challenged the student, requiring fifteen days of implementation at that criterion level. Figure 4.8.1 demonstrates the progression of Student #3's participation in the study.

Figure 4.8.1

Student #3 IXL Learning Criterion Changing Progression

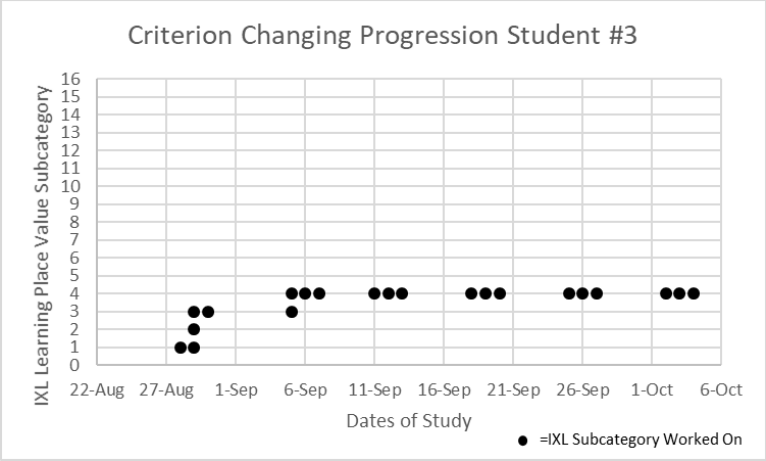


Figure 4.8.2

Student #3 Researcher-Created, Curriculum-Based Weekly Assessment Scores

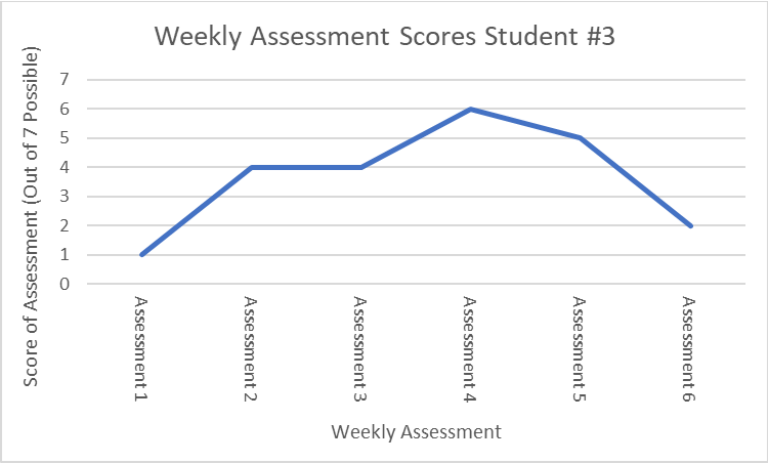


Figure 4.8.2 demonstrates Student #3's inconsistent growth in weekly assessment scores. Student #3 first scored 1 out of 7 total points on the researcher-created, curriculum-based place value assessment. During the intervention, Student #3 scored the lowest on assessment #1 with a score of 1 correct answer and the highest on assessment #4 with 6 correct answers. The concluding assessment scores Student #3 with 2 correct answers out of seven possible. Student #3's average score on the weekly assessments was 3.6 or 52% accuracy. Student #3 indicates an increase in scores for the initial four weeks of the study, followed by a decline in scores during the last two weeks of the study.

Student #4

Student #4 participated in all eighteen study days of IXL Learning data collection. Data concludes that Student #4 progressed through four of the criterion levels and subcategories of IXL Learning Place Value skills. On three occasions, Student #4 mastered two criterion levels in one thirty-minute session of the study. Data illustrates that subcategory 4 challenged the student, requiring nine days of implementation at that criterion level. Data also indicates criterion level 3 presenting a concern for Student #4, requiring 7 days of practice at the criterion level. Figure 4.9.1 demonstrates the progression of Student #4's participation in the study.

Figure 4.9.1

Student #4 IXL Learning Criterion Changing Progression

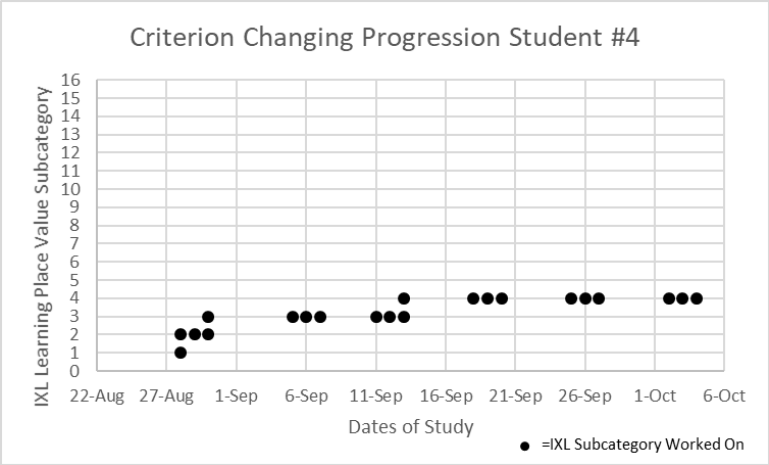


Figure 4.9.2

Student #4 Researcher-Created, Curriculum-Based Weekly Assessment Scores

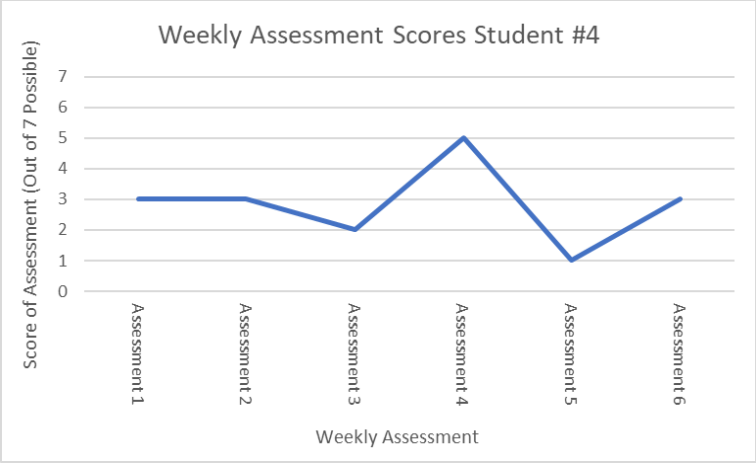


Figure 4.9.2 demonstrates Student #4's inconsistent performance in weekly assessment scores. Student #4 first scored 3 out of 7 total points on the researcher-created, curriculum-based place value assessment. During the intervention, Student #4 scored the lowest on assessment #5 with a score of 1 correct answer and the highest on assessment #4 with 5 correct answers. The

concluding assessment scores Student #4 with 3 correct answers out of seven possible. Student #4's average score on the weekly assessments was 2.8 or 40% accuracy.

Student #5

Student #5 participated in all eighteen study days of IXL Learning data collection. Data concludes that Student #5 progressed through two of the criterion levels and subcategories of IXL Learning Place Value skills. On one occasion, Student #5 mastered two criterion levels in one thirty-minute session of the study. Data illustrates that subcategory 2 challenged the student, requiring seventeen days of implementation at that criterion level. Figure 4.10.1 demonstrates the progression of Student #5's participation in the study. Student #5's stagnant data is analyzed further in Chapter 5.

Figure 4.10.1

Student #5 IXL Learning Criterion Changing Progression

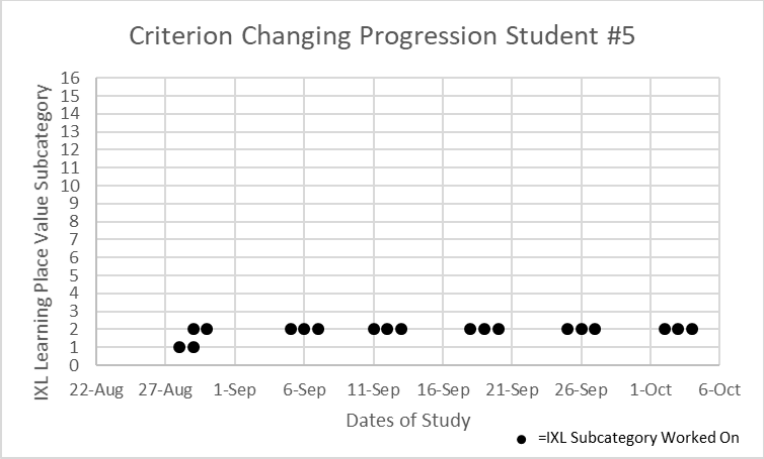


Figure 4.10.2

Student #5 Researcher-Created, Curriculum-Based Weekly Assessment Scores

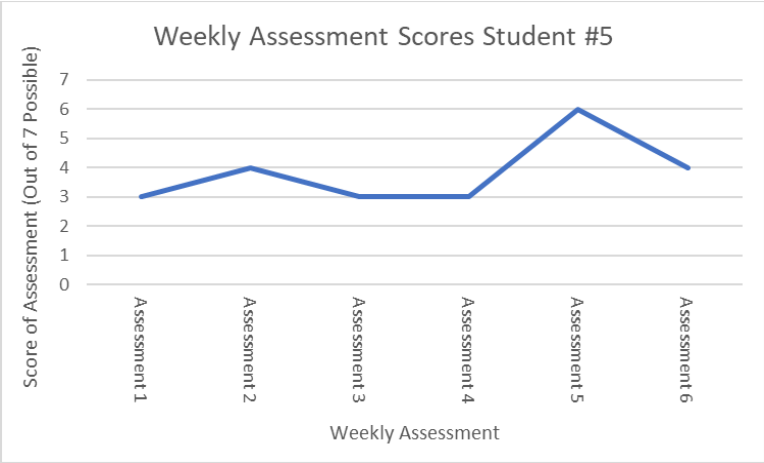


Figure 4.10.2 demonstrates Student #5's slight growth in weekly assessment scores. Student #5 first scored 3 out of 7 total points on the researcher-created, curriculum-based place value assessment. During the intervention, Student #5 scored the lowest on assessments #1, #3, and #4 with a score of 3 correct answers and the highest on assessment #5 with 6 correct answers. The concluding assessment scores Student #5 with 4 correct answers out of seven possible. Student #5's average score on the weekly assessments was 3.8 or 54% accuracy. Figure 4.10.2 illustrates a slight growth in Student #5's weekly assessment scores.

Student #6

Student #6 participated in all eighteen study days of IXL Learning data collection. Data concludes that Student #6 progressed through four of the criterion levels and subcategories of IXL Learning Place Value skills over the six-week study. On three occasions, Student #6 mastered two criterion levels in one thirty-minute session of the study. When data is presented in table form like Figure 4.11.1, Student #6 started the first three weeks by mastering the first criterion level presented. Data illustrates that subcategory 4 challenged the student, requiring twelve days of implementation at that criterion level. Criterion levels 2 and 3 also required multiple days of engagement from Student #6 before meeting the SmartScore of 80 or above and

allowing the student to move to the next criterion level. Figure 4.11.1 demonstrates the progression of Student #6's participation in the study.

Figure 4.11.1

Student #6 IXL Learning Criterion Changing Progression

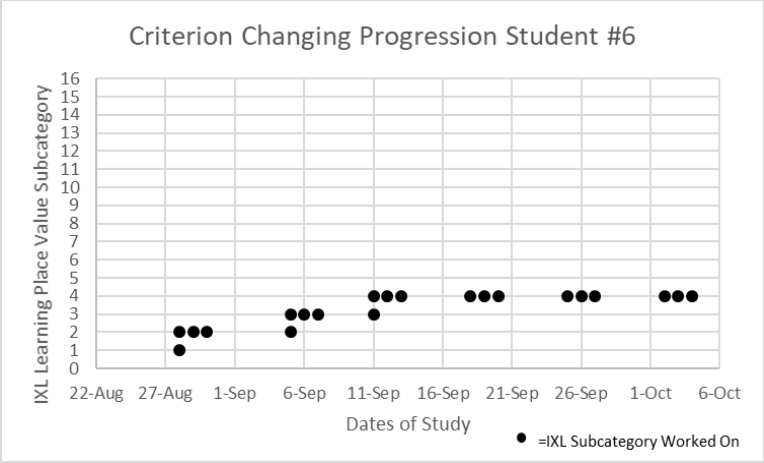


Figure 4.11.2

Student #6 Researcher-Created, Curriculum-Based Weekly Assessment Scores

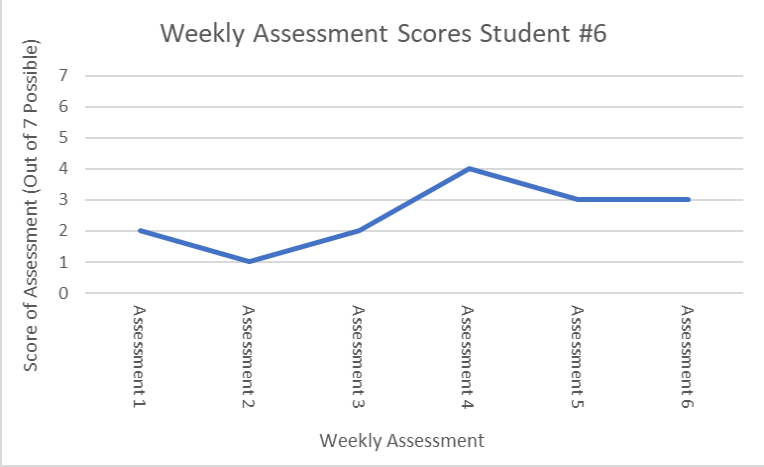


Figure 4.11.2 demonstrates Student #6's slight growth in weekly researcher-created, curriculum-based assessment scores. Student #6 first scored 2 out of 7 total points on the

researcher-created, curriculum-based place value assessment. During the intervention, Student #6 scored the lowest on assessment #2 with a score of 1 correct answer and the highest on assessment #4 with 4 correct answers. The concluding assessment scores Student #6 with 3 correct answers out of seven possible. Student #6's average score on the weekly assessments was 2.5 or 35.7% accuracy. Student #6 produced the lowest accuracy percentage within the weekly researcher-created, curriculum-based assessments of the study.

Student #7

Student #7 participated in all eighteen study days of IXL Learning data collection. Data concludes that Student #7 progressed through six of the criterion levels and subcategories of IXL Learning Place Value skills. On five occasions, Student #7 mastered two criterion levels in one thirty-minute session of the study. Data illustrates that subcategory 4 challenged the student, requiring twelve days of implementation at that criterion level. Data also indicates three days engaged in criterion level 6 at the conclusion of the study. Figure 4.12.1 demonstrates the progression of Student #7's participation in the study.

Figure 4.12.1

Student #7 IXL Learning Criterion Changing Progression

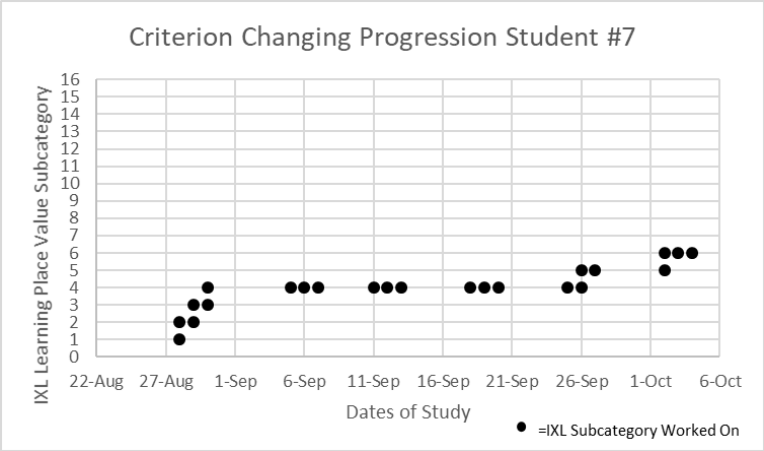


Figure 4.12.2

Student #7 Researcher-Created, Curriculum-Based Weekly Assessment Scores

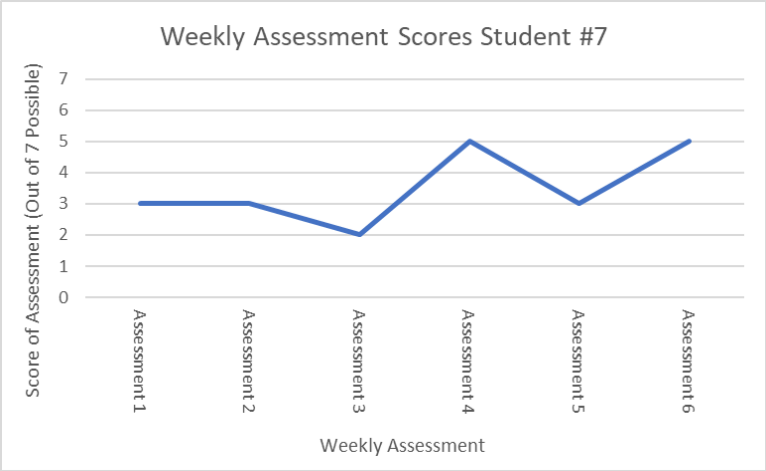


Figure 4.12.2 demonstrates Student #7's growth in weekly researcher-created, curriculum-based assessment scores. Student #7 first scored 3 out of 7 total points on the researcher-created, curriculum-based place value assessment. During the intervention, Student #7 scored the lowest on assessment #3 with a score of 2 correct answers and the highest on assessment #4 with 5 correct answers. The concluding assessment scores Student #7 with 5 correct answers out of seven possible. Student #7's average score on the weekly assessments was 3.5 or 50% accuracy. The graphed data indicates a slight growth in weekly assessment scores by student #7 on the weekly researcher-created, curriculum-based assessments.

Student #8

Student #8 participated in seventeen of the eighteen study days of IXL Learning data collection. Data concludes that Student #8 progressed through eleven of the criterion levels and subcategories of IXL Learning Place Value skills. On two occasions, Student #8 mastered three criterion levels in one thirty-minute session of the study. On four occasions, Student 38 mastered two criterion levels in one thirty-minute session. Data illustrates that subcategory 10 challenged

the student, requiring eleven days of implementation at that criterion level. Figure 4.13.1 demonstrates the progression of Student #8's participation in the study.

Figure 4.13.1

Student #8 IXL Learning Criterion Changing Progression

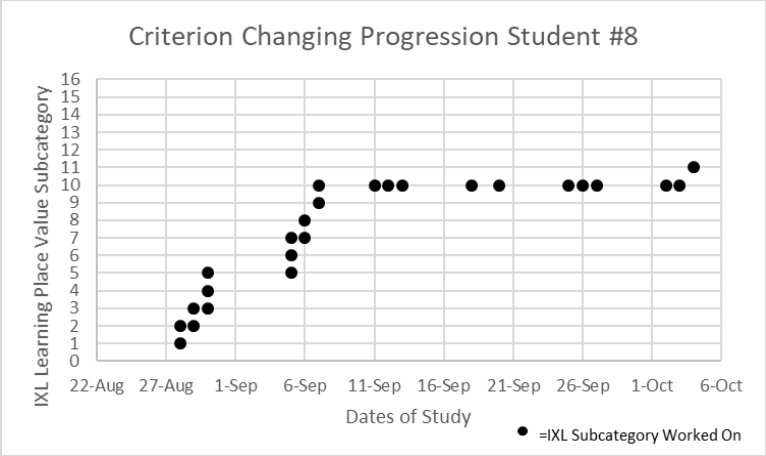


Figure 4.13.2

Student #8 Researcher-Created, Curriculum-Based Weekly Assessment Scores

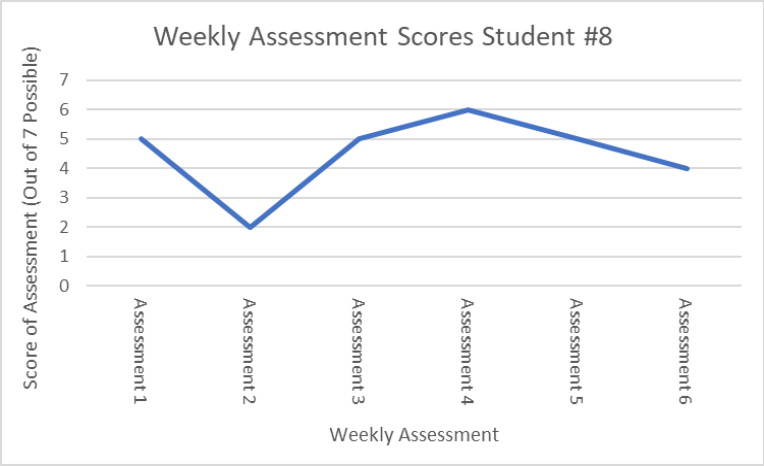


Figure 4.13.2 demonstrates Student #8's progression through the weekly assessment scores. Student #8 first scored 5 out of 7 total points on the researcher-created, curriculum-based

place value assessment. During the intervention, Student #8 scored the lowest on assessment #2 with a score of 2 correct answers and the highest on assessment #4 with 6 correct answers. The concluding assessment scores Student #8 with 4 correct answers out of seven possible. Student #8's average score on the weekly assessments was 4.5 or 64% accuracy.

Student #9

Student #9 participated in fifteen of the eighteen study days of IXL Learning data collection. Data concludes that Student #9 progressed through all sixteen of the criterion levels and subcategories of IXL Learning Place Value skills. On one occasion, Student #9 mastered four criterion levels in one thirty-minute session of the study. One two occasions, Student #9 mastered three criterion levels in one thirty-minute session. Data illustrates that subcategory 16 challenged the student the most, requiring five days of implementation at that criterion level. Figure 4.14.1 demonstrates the progression of Student #9's participation in the study.

Figure 4.14.1

Student #9 IXL Learning Criterion Changing Progression

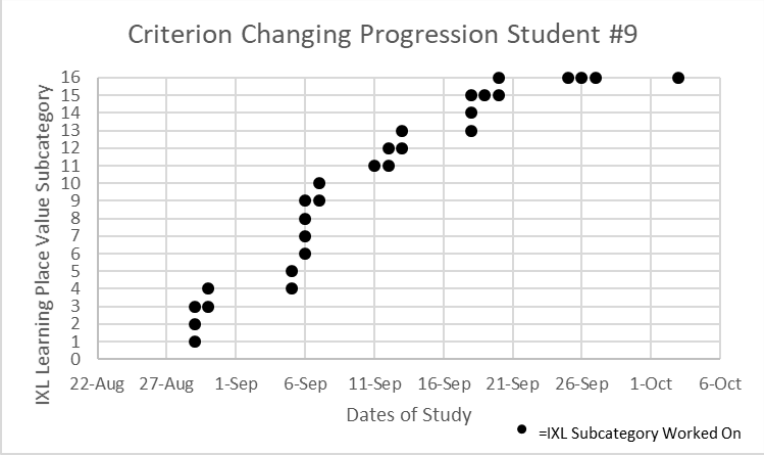


Figure 4.14.2

Student #9 Researcher-Created, Curriculum-Based Weekly Assessment Scores

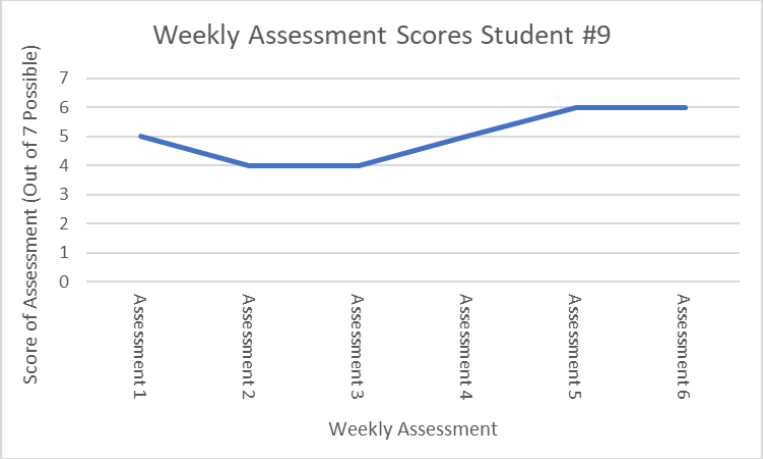


Figure 4.14.2 demonstrates Student #9's slight growth in weekly assessment scores. Student #9 first scored 5 out of 7 total points on the researcher-created, curriculum-based place value assessment. During the intervention, Student #9 scored the lowest on assessment #2 and #3 with a score of 4 correct answers and the highest on assessment #5 and #6 with 6 correct answers. The concluding assessment scores Student #9 with 6 correct answers out of seven possible. Student #9's average score on the weekly assessments was 5 or 71% accuracy. Student #9 produced the highest accuracy percentage within the study on the weekly researcher-created, curriculum-based assessments.

Missing Data

Missing data within the study includes school days that students were absent, causing them to miss the thirty-minute IXL Learning session. They were excused from the study on those days and continued within the program when they returned to school. No penalty or disruption of the study occurred due to absenteeism. Their total number of questions were calculated based on days present in the study. Their average number of questions per day was calculated based on days present within the study. Absences were not calculated into the data analysis, including

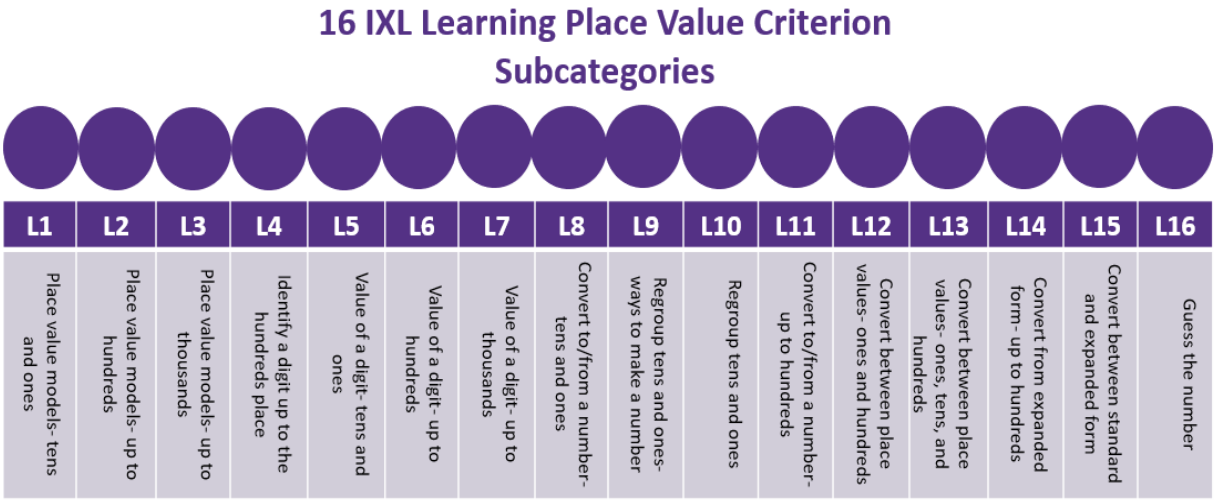
restroom visits during the thirty-minute time frames or time spent eating breakfast during the first half-hour of the school day.

Patterns

The flow of the consecutive criterion subcategories is pictured in Figure 4.15. Students started at level 1 (L1) and continued through as many subcategories as they could, reaching the 80 or higher Smartscore before moving on. One pattern found within the study includes a large number of students who quickly completed criterion 1 (L1) of IXL Learning Place Value skills on the first day of the study. Seven students completed at least subcategory 1 (L1) on the first day of the study. The two remaining students needed two sessions to complete subcategory 1 of IXL Learning Place Value skills. A pattern also noticed in the progression of subcategories is the quick movement through multiple criterion levels in one thirty-minute session. Students maneuvered through two or even three subcategories in one session multiple times throughout the study.

Figure 4.15

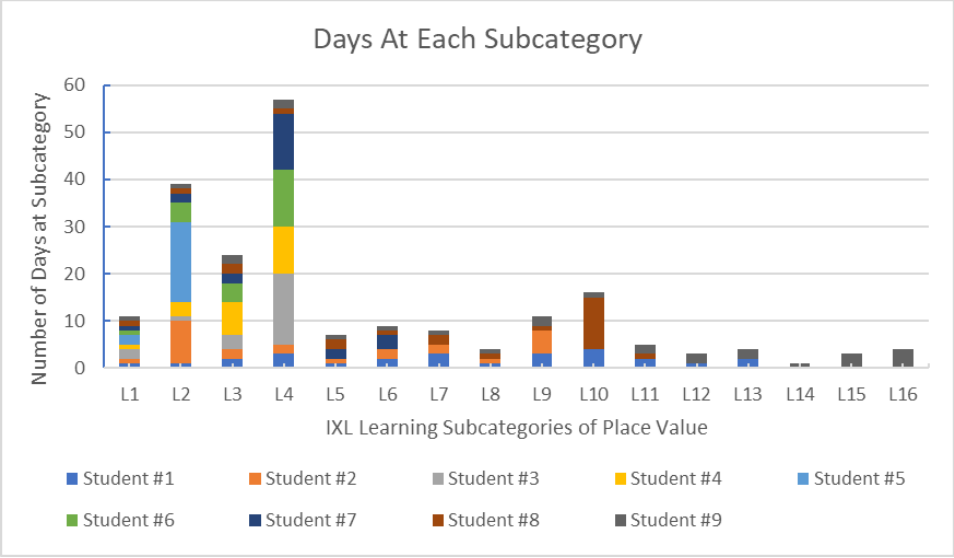
16 IXL Learning Place Value Criterion Subcategories



Note. Figure 4.15 illustrates the sixteen subcategories of IXL Learning, naming each category by specific skill within place value. (IXL Learning, 2023)

Figure 4.16

Total Number of Days Spent Within Each Subcategory



Note. Figure 4.16 illustrates which subcategory criterion levels provided challenges to the participants. Level 2 (L2) and level 4 (L4) appear to have had the most total number of days spent at that level by all participants.

The second pattern identified in the study is the number of students who spent multiple days on subcategory 4 (L4). Figure 4.16 demonstrates the number of days each student spent at each criterion subcategory. Students spent the most time at L4; Identify a digit up to the hundreds place. Something to note is the connection between L2 and L4. Both subcategories took students longer to complete, while both categories work with identifying numbers with hundreds digits- not reviewed until unit nine of the Savvas EnVision 2nd Grade curriculum.

Inconsistencies

Inconsistencies found within the study include the number of days each student spent in each criterion subcategory of IXL Learning. Some students moved quickly, while others worked at a slower pace. Specific subcategories appeared to present a challenge to students, specifically L2 and L4. However, no data was collected on the percentages of students who read the remedial lessons after each incorrect answer that IXL Learning provides. This data would be valuable to the inconsistencies in the number of days students spent at each criterion level. If students were obtaining the remedial lesson provided, would they be able to move more quickly through the study? Students appeared to click to the next question instead of reading the explanation for their incorrect response.

Weekly assessment scores were also inconsistent each week for the nine participants. Figure 4.5 demonstrates the slight growth in overall weekly assessment averages, while each student demonstrated inconsistent growth in place value skills on the assessment from week to week. Inconsistencies found within the assessment process included the strategies students used.

For example, the assessment questions frequently stated for students to skip count by ten on a specific question, while students counted by one to find the answer. Application of place value strategies by the participants was inconsistent and was not generalized.

Inconsistencies found within the Savvas EnVision Diagnostic Assessment comparisons also present a limitation to the data analysis. As results indicate, student data was mixed; some students improved scores, while others decreased scores. This inconsistency would prevent the researcher from identifying IXL Learning as an effective tool when measured by the Savvas EnVision Diagnostic Assessments.

Summary

Chapter 4 delves into each participant of the study's IXL Learning subcategory progression, number of questions exposed to within the six-week time frame, the researcher-created, curriculum-based weekly assessment results, and the Savvas EnVision 2nd Grade Diagnostic assessment data. Missing data, patterns, and inconsistencies were explained within this chapter. As data was collected, interpretation of results began communicating findings with fellow educators and researchers, as found in Chapter 5. Participants within the study provided great data points for future research and educational practices for educators following the COVID-19 global pandemic.

CHAPTER 5: INTERPRETING RESULTS

Introduction

Chapter 5 presents a summary of the study and conclusions drawn from the data and research presented in previous chapters. It provides a discussion of the implications of an online learning mathematics intervention program intended for the education profession. Data analysis indicates many benefits to IXL Learning, while also identifying some negative findings within the participant progression throughout the subcategories of the second-grade place value skills. Identifying productive and counterproductive practices within mathematical instruction is the goal of this study and is outlined in Chapter 5. The chapter concludes with recommendations for further research regarding student interventions and the implementation of online, interactive platform interventions to improve student skill levels. The researcher also recommends specifics necessary for successful replication of this study.

Summary of Study

As research and current local data indicates, students are lacking the place value skills needed to prepare them for the third-grade curriculum and future learning. Research has also indicated a decline in mathematical assessment scores. Finding an effective and efficient intervention system is still being researched, as COVID-19 has disrupted the educational practices found in schools. Nine students from a rural western Pennsylvania school participated in an online interactive program of IXL Learning for three, thirty-minute sessions per week for the first six weeks of the 2023-2024 school year. Students within this criterion-changing, quantitative study provided valuable information for other mathematical educators and future practices centering around second-grade place value skills instruction and intervention, specifically IXL Learning.

Findings Related to The Literature

Findings relating to the literature reviewed within the study include the data supporting a decline in mathematical scores for primary students, more specifically post-COVID-19 pandemic educational deficits. The Institute of Education Services indicated that students with and without disabilities struggled with mathematics (Chhin et al., 2023). This specific study supports the educational struggle of all students, disregarding any label or diagnosis provided. Regular education students demonstrated a struggle with place value skills within this study as indicated by the baseline data collected from the Savvas EnVision 2nd Grade Diagnostic Assessment from May 2023. Students scored 51.48% accuracy on the initial assessment as a grade level, across a variety of mathematical skills. This supports various research sources sharing the decline of mathematical skills, specifically after the COVID-19 pandemic. Because the district did not utilize the same assessment prior to the pandemic, this specific data could not be compared to previous years prior to the COVID-19 pandemic.

Research indicates that specific strategies like counting-all, continuation-counting, counting-on, sequence, sequence-separate, separate, and addition assisted in conceptual knowledge of place value skills (Wilkinson, 2017, p. 22) can be utilized in place value instruction or problem solving. IXL Learning included strategies like counting-all, continuation-counting, counting-on and sequencing. Within the remedial section of IXL Learning place value questions, these specific strategies were presented to students to support their progress in the program. The researcher-created, curriculum-based assessments also included the same strategies, along with the comparison of numbers, as it was created to mimic the Savvas EnVision Diagnostic assessment questions centering around place value skills. This demonstrates that IXL Learning is supporting research-based instructional strategies regarding

place value skills by encouraging specific strategies within their questioning and practices. Students are practicing the same skills on IXL Learning as they are learning within the Savvas EnVision mathematical programming. Whether the students can generalize the skill(s) is another story.

Gafoor & Kurukkan (2015, p. 241) indicate generalizing skills can be a challenge, along with building upon skills that have not been mastered yet. IXL Learning set up the sixteen subcategory skills in an appropriate sequence to promote scaffolded learning. However, students who participated in the study had not mastered basic place value skills in subcategory L1 or L2 to progress through the other subcategories. One student mastered each of the subcategories of IXL Learning place value skills but did not improve the weekly assessment scores, centering on similar question wording and problem-solving. This specific student was able to demonstrate mastery by scoring a SmartScore of 80 or above on the questions IXL Learning presented, while the student could not demonstrate mastery of similar problems on the researcher-created, curriculum-based assessments. This component of the study supports the research by Gafoor & Kurukkan that generalization is a struggle for students regarding place value skills and assessment/intervention presentation modes. This also allows the researcher to question the use of paper and pencil diagnostic/monitoring assessments utilized with an online interactive interventional program. Is there a disconnect between presentation modes for specific learners? Would there have been a better outcome if the presentation and assessment modes were consistent?

Within the research, Kong and Chan (2021) state that some students may acquire place value skills inadvertently, prior to formal instruction on place value skills and strategies. Student data collected within this specific study does not support this research, as students who may or

may not have been instructed on place value skills did not score proficiently within IXL Learning's criterion changing progression. Even with some instruction or remedial prompts, students did not gain the place value skills needed to meet the SmartScore goal of 80 and above. This is evidence that primary students need concrete instruction prior to using place value skills.

Furthermore, Wilkinson (2017) shares that students may comprehend different components of place value skills within select problem-solving questions. Student data from this study may support this, as their data produced inconsistent results and trends on the weekly assessments, concluding that they do comprehend random components of place value skills. This could also be a great explanation for the inconsistent data collection on all tools utilized within the study, as no other patterns or causations were identified.

It is also suggested in research from Wilkinson (2017) that students learn concepts with abstract or general principles with flexibility, but adapting those skills requires more time to acquire the skills. This indicates that maybe the six-week time frame of the study was not long enough for students to obtain and master those specific flexible and adaptable skills. A longer duration of study may be required for comparison and to allow students to utilize skills acquired through interventional programming.

Subjective Analysis and Summary of Each Learner

Student #1

Student #1 progressed consistently throughout the IXL Learning subcategory criterion levels without completing all sixteen levels. If given another week of interventional practices, it is predicted that Student #1 would have completed all levels within the place value skill category at the second-grade level. This participant was consistently engaged in the program and excited to get logged on to the Chromebook upon entering the intervention classroom. Student #1 had

asked for restroom breaks and a two-minute break during one of the sessions due to a stomachache. Other than those two incidents, Student #1 worked hard within the program and was excited to share with the researcher the progress made, often bringing the Chromebook to the researcher, looking for positive verbal feedback. Student #1 was very familiar with using a Chromebook. The participant rarely needed help logging into the device or IXL Learning after the initial start date. This indicates self-regulation, responsibility, and maturation compared to students of the same age.

As Student #1 scored lower on the second researcher-created, curriculum-based weekly assessment compared to the first week, the researcher questioned what caused the dip in scores. Was the first assessment score lucky? As the study continued after assessment two, Student #1's weekly assessments increased, supporting a prediction IXL Learning producing increased scores.

In summary, Student #1 gained content knowledge in the place value skills categories while participating in the IXL Learning criterion-changing study. Assessment data and weekly researcher-created, curriculum-based assessment scores are similar, demonstrating an incline in Figures 4.6.1 and 4.6.2 of data collected. It is apparent that this study was productive for Student #1 and would continue to do so after the duration of this specific study.

Student #2

While analyzing Student #2's graphed progression through the IXL Learning place value skills criterion levels, Student #2 demonstrates progressive growth. Upon further examination, it is evident that Student #2 was halted at criterion level two (L2) for three weeks of the six-week study duration, and then again at criterion level nine (L9) for the last two weeks of the study. However, within those last two weeks, the student was absent one day per week of the IXL Learning intervention days. Did absenteeism affect the progression from criterion level nine (L9)

to criterion level ten (L10)? If the study continued for another two weeks, could Student #2 have made it through all sixteen levels of the study?

While examining Student #2's weekly researcher-created, curriculum-based assessments, the initial score started at 100% accuracy. At this point, the researcher was alerted to the proficient score, questioning how the student would perform throughout the next few weeks of the study. Unfortunately, the student dipped down to a score of 2 correct answers and then remained stagnant at 4 correct answers for the remainder of the study.

In summary, Student #2 gained some place value skills as measured by their IXL Learning data. However, the weekly researcher-created, curriculum-based assessment results indicated an inconsistent conclusion. When reading the weekly assessment scores, the researcher cannot confidently state that Student #2 gained skills by participating in the six-week study. It is important to note that Student #2 would often sit quietly, waiting for the researcher to prompt to initiate the thirty-minute session. This made the researcher question how much of the session the student was on task or engaged in the actual work of IXL Learning. Only closer monitoring and data collection would be able to assist with this information in a replication of this study.

Student #3

While analyzing Student #3's progression in the IXL Learning place value skills, the student demonstrated slight growth with a stall at criterion level 4 (L4). The researcher found it interesting that this student worked through three criterion levels on day 2 of the study but did not progress much further throughout the next sixteen IXL Learning trial dates. This causes the researcher to question what caused the stagnant progression for Student #3 and how it could be prevented in replication of this study.

As Student #3's weekly researcher-created, curriculum-based assessment results, inconclusive data is presented. The student scores low at the beginning of the study, increases up until week four of the study, where they start a decline for the remainder of the study. The researcher questioned what caused the decline after week four, almost leveling out with the initial week score of 1 correct answer.

In summary, Student #3 gained minimal place value skills as measured by their IXL Learning data. However, the weekly researcher-created, curriculum-based assessment results indicated an inconsistent conclusion. When reading the weekly assessment scores, the researcher cannot confidently state that Student #3 gained skills by participating in the six-week study, as measured by the weekly assessments.

Student #4

Student #4's IXL Learning data points appear very similar to Student #2 and #3's progression trend. Student #4 also got stalled at criterion level 4 (L4), causing the researcher to question why so many participants got stuck at that level, as examined in the Unexpected Findings section of Chapter 5.

When looking at the weekly researcher-created, curriculum-based assessment data for Student #4, a concluding pattern is not able to be drawn. The participant starts off with two weeks of a stagnant score of 3, yet continues to increase, decrease, and then increase their score again at the conclusion of the study.

While working with Student #4, there were many days where the student appeared to be in an upset or angry mood. This prompts the researcher to question the student's motivation, mental health, cooperation with the IXL Learning study, and the progress/lack of progress within the study. In summary, Student #4 started with 3 correct answers on the first weekly assessment,

and also ended with 3 correct answers on the concluding assessment. Without the data from assessment 2-5 and focusing on the initial and final researcher-created, curriculum-based assessments, it would appear this specific study was not beneficial for Student #4's place value skills and the student demonstrated no growth by participating in the study. In fact, Student #4 presented a decline in the Savvas EnVision Diagnostic assessment, scoring 26 total points in the spring and only 22 points in the fall. This does not support an effective intervention program of IXL Learning.

Student #5

Student #5 appears to have scored at the lowest criterion level of IXL Learning for the longest duration within the study. Student #5 was halted at criterion level 2 (L2) for seventeen IXL Learning days. Outside of this specific study, an intervention specialist would have acted sooner to assist Student #5 in their progression by changing up the intervention to promote success. By providing a "mini-lesson", video, or instructional lesson, Student #5 may have been able to progress past criterion level 2 in the study. However, for the sake of the research and design of the study, Student #5 was encouraged to try their best and continued to participate, despite knowing they weren't progressing like some peers within the study. This factor did not seem to affect the student's outlook on the study or attitude within the classroom. A positive and exciting attitude remained throughout the study.

On the other hand, Student #5's weekly researcher-created, curriculum-based assessment data indicates a significant increase in place value scores. After balancing between 3 or 4 points for the first four weeks, Student #5 soared to 6 correct answers in week five and 4 correct in the final week. Student #5 increased their weekly researcher-created, curriculum-based assessment scores and their overall Savvas EnVision Diagnostic assessment by one point. Diving deeper,

Student #5 score 3 correct answers out of 5 total in the Numbers and Place Value to 100 section of the Savvas EnVision Diagnostic assessment in the spring. In the fall, Student #5 increased that score to five out of five correct on the same assessment. When comparing these assessments to the halted IXL Learning data, the researcher questions the validity of using all three tools within the study. How can the student progress on paper assessments but make no progress in IXL Learning over seventeen days? Is just the exposure to the problems through IXL Learning enough to support their learning and progression through the IXL Learning criterion levels?

Student #5 appeared to have a positive and excited outlook while participating in the study. The student would question the researcher on the schedule of the study, in excitement to repeat the weekly events. However, Student #5 would often get distracted by neighbors who were not participating in the study but were still instructed to utilize IXL Learning, engaging in conversations that required prompting from the researcher to continue to focus on the study. These prompts were most needed on IXL Learning days, as assessment and puzzle/game days were mainly one-to-one student-to-researcher ratios that could eliminate distractions of other students within the enrichment class period. In summary, Student #5's data is conflicting. IXL Learning does not show an improvement to the student's skills, while the weekly assessments and Savvas EnVision Diagnostic assessments indicated IXL Learning as a successful intervention that assisted in improving the weekly researcher-created, curriculum-based assessment scores. This conclusion is vital when sharing with educators. Some students may increase specific data, while others may not when presented with the same opportunities. Assessment data pieces or trends may not match intervention data pieces or trends for the same student. This also supports an individualized approach to intervention, as each student has their own needs, styles of learning, and engagement in specific activities.

Student #6

For three consecutive weeks, Student #6 started the week in IXL Learning advancing to the next criterion level within the program. However, this progression stopped in week three, where Student #6 remained at criterion level 4 (L4) for the remainder of the study, very similarly to other participants in the study.

Like Student #5, Student #6's weekly researcher-created, curriculum-based assessments demonstrate growth in scores. Even though Student #6's IXL Learning progression is halted, their progress in the weekly assessments increased after the six-week study. Student #6's Savvas EnVision Diagnostic assessment declined by six points from spring to fall and remained the same within the Numbers and Place Value to 100 section of the assessment.

In summary, Student #6's data is not supportive in confirming IXL Learning as an effective and efficient interventional program for place value skills. Inconsistent assessment results and IXL Learning data confirms that no implications can be made on Student #6's data. Because Student #6 was quiet and reserved, the researcher questions if the student was seeking or needing assistance working in IXL Learning but was hesitant or scared to ask the researcher for help. There were many instances where the researcher would have to verbally prompt the student and/or give the student a countdown of how many minutes were left until the group was complete with the enrichment time frame and permitted to transition to their next class. If the researcher was positioned next to Student #6 in a smaller ratio, would that have promoted continued engagement and promotion through the sixteen levels of place value IXL Learning?

Student #7

Student #7 started off trending like many other participants where they were halted at level 4 (L4) within the sixteen subcategories of place value skills in IXL. However, Student #7

was able to progress to criterion 5 and 6 (L5 and L6) in the last two weeks of the study. The researcher questions if there was more time in the study, would Student #7 have continued to progress. Did the student just need more time? What caused Student #7 to break through to criterion level 5 and 6 at the tail end of the study?

The weekly researcher-created, curriculum-based assessment data for Student #7 increased overall. Student #7 started with 3 correct answers and ended the study with 5 correct answers at the conclusion of the study. The inconsistent trend line throughout the body of the study does not support the hypothesis that IXL Learning would promote second-grade place value skills. However, if the initial and final assessment results are compared, this data does support the hypothesis that IXL Learning will improve weekly assessment scores over a six-week time frame.

In summary, even though the graphing for Student #7 shows fluctuation, the trend of data collected increases, indicating IXL Learning as a successful tool used to increase weekly place value skills. It is important to note that this specific student has an Oppositional Defiant Disorder (ODD) diagnosis, requiring medication to be administered daily. Did medication/lack of medication sway data collection? The student appeared to be compliant with the study with a positive attitude. However, the researcher questions if there was a silent opposition to fully participating that may have hindered progression within the study that was not obviously presented at the time.

Student #8

Within the first week of the study, Student #8 progressed rather quickly, jumping from criterion level 1 (L1) to 5 (L5) within the first three days of IXL Learning intervention. This growth caused the researcher to predict the student would move quickly throughout the total

sixteen criterion subcategories and could then be identified as the first student to exit the study. However, week three of the study halted the student. Student #8 remained at Level 10 (L10) for a total of eleven days before progressing to the final criterion level 12 (L12) on the last day of IXL Learning. What caused Student #8 to be stuck at level 10 (L10) for so long? And, what caused the student to finally progress on the last day of the study? Student #8 completed more subcategories in IXL Learning skills compared to most participants in the study.

In summary, while analyzing Student #8's weekly researcher-created, curriculum-based assessment results, the common dip in scores of assessment week 2 is present. When looking at the initial score of 5 out of 7 and comparing it to the final score of 4 out of 7, it appears that IXL Learning was not a productive intervention for Student #8 despite the growth through the IXL Learning criterion subcategories, landing on criterion level 10 (L10) at the conclusion of the study. However, the high score of 6 out of 7 for Student #8 assists in the computation of the average score of weekly assessments of all participants, resulting in naming IXL Learning a successful intervention. It is important to note that Student #8 was very particular about their performance in IXL Learning. This participant insisted on completing each level of IXL Learning to the SmartScore of 100 for each subcategory. This demonstrates self-regulation, goal setting, and a great work ethic. However, this could have caused the student to remain at each level longer than necessarily needed for the study. It was evident that Student #8 had participated in IXL Learning for other skills in previous courses, as the goal was internally set to a SmartScore of 100 by that student. This information allows the researcher to recommend setting a common SmartScore goal for all students instead of allowing the SmartScore of 80 to 100 demonstrating proficiency. If all students reach the exact same SmartScore, no time within the study will be misspent.

Student #9

Student #9 remained the fastest growing student when comparing the criterion changing progression charts. This student reached the last criterion within week four of the study and was exited in week six. The demeanor of this student matches the progress in the graph (Figure 4.14.1). This participant was excited, upbeat, and willing to work hard with minimal prompting or rewards. At times, student #9 would ask to continue working on the criterion level to reach the 100 SmartScore. This demonstrates the work ethic and pride Student #9 presented in their work.

The weekly researcher-created, curriculum-based assessment scores for Student #9 also demonstrates consistent progress within the program. Like many of the other participants, the dip in score is present at week 2. This dip remains for the third week, but is eliminated by the fourth week, as Student #9 continued to climb to 6 out of 7 answers correct at the conclusion of the study. This growth may appear minimal, starting with a score of 5 and ending with a score of 6. However, the trend line of Student #9 is the most supportive of the hypothesis, indicating that IXL Learning is an appropriate and effective intervention for second-grade place value skills. If data for all students demonstrated such growth, the researcher could confidently state that IXL Learning is the best interventional program to utilize with place value skill deficits for second-grade students.

In summary, the progress that Student #9 presented in IXL Learning and the researcher-created, curriculum-based assessments would be ideal for all students who have demonstrated a place value deficit. It is understood that not all students would be as successful with such a program but allows current educators to see successful interventional practice post-COVID-19 with a second-grade student dedicated to improvement. Student #9's data also supports an individualized approach to student intervention needs and practices presented by educators.

Unexpected Findings

Within this specific study, various unexpected findings occurred regarding student engagement, curriculum scope and sequencing, and conflicting data comparison across two measurement tools of the study. The first unexpected finding within the study was the lack of student initiative to read the remedial lessons provided after incorrect answers. IXL Learning provides remediation to students when they answer a question incorrectly. However, it was evident that many of the students who engaged in the study did not scroll down on their screen after an incorrect answer to review the remediation tips to assist them in promoting their learning and increasing their Smartscore. By ignoring the remedial prompts, they were not obtaining feedback provided to them by IXL Learning. This was an unexpected limitation and could be the causation of four students remaining stagnant in the study for several session dates at subcategory L2 and L4. Students would frequently click to the next question without trying to understand their mistake. Also presented as a limitation, is the lack of initial emphasis from the researcher on encouraging participants to scroll down to read the remedial text. Future replication of the study should include an emphasis on student engagement with the remedial prompts to assist in determining IXL Learning a successful interventional program.

It is important to note that some students desired to reach a SmartScore of 100 in their IXL Learning subskills before moving on to the next criterion level. Other students stopped working on that subcategory once they reached the score of 80 SmartScore points, as set as the goal by the researcher. Upon data analysis, the researcher questions if students who insisted on obtaining a score of 100 misspent time within the study. Could that student have moved to the next criterion level quicker, producing a more successful study? It is recommended that one

common SmartScore goal is selected prior to replication of this study. This will eliminate wasted time and promote consistency between all participants.

Unexpected variables throughout the study also included student restroom use within the half-hour time frame, technological and internet difficulties, lack of experience with Chromebooks in second-grade students, limited Chromebook availability, and the lack of excitement in student participation as the study went on. These findings should be considered for future replications of IXL Learning intervention research. These limitations are to be expected when working with primary education students and technology in the public education setting.

Another unexpected finding is that the Savvas EnVision 2nd Grade Curriculum requires students to utilize place value skills of the tens, ones, and hundreds digits for addition and subtraction strategies without reviewing the skills at the second-grade level. Not until the ninth unit of the series does the review of those place value skills arise, with the addition of the thousands place value instruction. This presents confusion for students and supplemental instructional work for the educator to meet the needs of the students if the curriculum is presented in sequence as Savvas EnVision recommends. In future presentations of this curriculum, units may require alternate sequencing to assist students in foundational and sequential learning throughout the second-grade mathematical curriculum, along with various supplemental tools, activities, and worksheets to review the ones, tens, and hundreds place value concepts throughout the first nine units of the curriculum. Also, to be debated in future research, Savvas EnVision 2nd Grade Diagnostic Assessment includes only five "Numbers and Place Value to 100" questions on the assessment. Is this enough to portray the student's understanding of place value where IXL Learning divides it into sixteen subcategories? Should Savvas include

more questioning to assess all areas of place value skills? Is the assessment piece biased, valid, or reliable at the second-grade level?

When looking at the researcher's prediction of data collected in this specific study, an increase in the weekly assessment scores should indicate IXL Learning as an effective interventional tool. The study data indicates this, as Figure 4.5 explains the average score of all participants each week of the study increasing from 3.6 to 4.0. However, what was unexpected within the data was the comparison between the successful weekly assessment data and the stagnant data collected from IXL Learning for the majority of students of the study. Students demonstrated inconsistent progression through the IXL Learning subcategories. Some students did not make it through subcategory L4, while only one made it through all sixteen. It was interesting that data from one tool supported IXL Learning while data from another tool (IXL Learning) did not indicate IXL Learning as a successful independent intervention tool. There is consequential data presenting an increase of student weekly assessment scores after implementation of IXL Learning three times a week on second-grade place value skills. Inconsistencies between data collection modes were evident as some students remained flat or stagnant within their IXL Learning criterion-changes, yet their weekly assessment scores fluctuated. These inconsistencies were explained in Chapter 4, examining each participant of the study.

Furthermore, a dip in scores on the weekly assessment is presented by a larger number of the participants during week 2 of the study. The researcher questioned why this decrease occurred and reviewed the weekly events of that specific calendar week. No major changes to the district, teacher, or students' calendars were indicated. The only disruption to the schedule found was that students were given a day off school for a local festival held at the conclusion of week 6

of the study, indicating no disruption to week 2's intervention schedule. The causation of the dip in scores for week 2 is inconclusive.

As educators would have anticipated, student participation in the repetitive weekly assessment should have created increasing scores. This is not the case for most of the participants within the study. The weekly researcher-created, curriculum-based assessments were mirrored from the questions presented on the Savvas EnVision Diagnostic Assessment from the "Place Values and Numbers to 100" section to prevent biased data collection and increase repetition. Names and numbers within the questions were altered from week to week. However, the instructions of the question, the formatting, the order, and the physical appearance of the questions remained the same. Educators would anticipate a repeated assessment would increase scores and produce increasing trend lines within the data. Unpredictable data trends were collected regarding the weekly assessment averages, allowing the researcher to question why students were unsuccessful at producing predominant outcomes in support of the hypothesis.

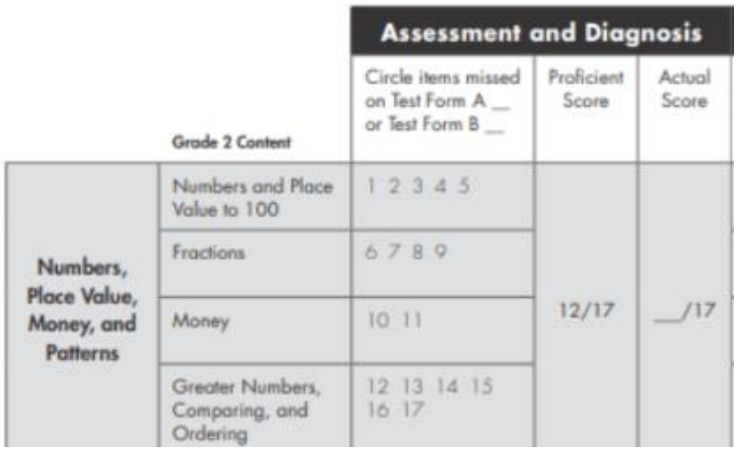
As mentioned before, subcategories 2 (L2) and 4 (L4) appear to have the greatest number of days spent on that level across all participants in the study. This caused the researcher to question why those two specific levels were challenging for students. As examined closer, level 2 (L2) focuses on "Place Value Models- Up to Hundreds", while level 4 (L4) focuses on "Identify A Digit Up to The Hundreds Place". The only connection between these levels is the addition of hundreds of place values within the content. What is unexpected within the data is that some students were able to master the "Place Value Models- Up to Hundreds", move on to "Place Value Models-Up to Thousands" (L3), but then get stuck on level 4 (L4), "Identify A Digit Up to The Hundreds Place". Educators might assume if students can use place value models to identify a hundreds digit number, then they should have no hesitation identifying a

digit up to the hundreds place value. Data collected within this study suggests the opposite of that. This could be a coincidental connection between levels, yet more research could assist in identifying connections between the two subcategories of place value skills within IXL Learning.

While seeing a possible connection between the challenging subcategories of the IXL Learning model, the researcher then started to question other components of the study that may have presented bias to the data. These include the connection between the data and genders, the connection to socioeconomic status of each student compared to their performance, the connection between their pre-schooling experiences during the COVID-19 pandemic, the data connections to students administered ADHD/ODD medication on a daily basis compared to participants who are not administered any medication, and the connection between their age in the grade level compared to the data collected within this study. However, the foundations of this specific study did not plan to examine the data in depth to identify the listed connections. More research is needed to appropriately make those implications to eliminate such biased results in a similar place-value skills research study.

Figure 5.1

Savvas EnVision Diagnostic Individual Record Form



		Assessment and Diagnosis		
	Grade 2 Content	Circle items missed on Test Form A __ or Test Form B __	Proficient Score	Actual Score
Numbers, Place Value, Money, and Patterns	Numbers and Place Value to 100	1 2 3 4 5	12/17	__/17
	Fractions	6 7 8 9		
	Money	10 11		
	Greater Numbers, Comparing, and Ordering	12 13 14 15 16 17		

Note. Figure 5.1 illustrates the Numbers, Place Value, Money, and Patterns section of the Individual Record Form of the Savvas EnVision Diagnostic Assessment. This same form is utilized with Form A and Form B of the diagnostic assessment. (Savvas Learning Company, 2023)

When analyzing the initial benchmark assessment of the Savvas EnVision 2nd Grade Diagnostic Assessment Form A, the researcher used the 80% threshold discussed in Chapter 1 to determine place value proficiency. Therefore, students who scored four correct answers out of five possible answers scored 80% proficiency and were excluded from the participant invitation at the onset of the study. Upon further examination of the Savvas EnVision Individual Record Form (Appendix C) it is determined that the place value skill is conjoined with four other categories, combining to make the Numbers, Place Value, Money, and Patterns section of the assessment. The Numbers, Place Value, Money, and Patterns section of the Individual Record Form is illustrated in Figure 5.1. A set of norms was not outlined specifically for the Numbers and Place Value to 100 components of the assessment. When looking at a completed Individual Record Form, it could appear that a student would score proficient in the Numbers, Place Value, Money, and Patterns section. However, the scenario of a student scoring all possible points in the Fractions, Money, and Greater Numbers, Comparing, and Numbering sections could produce a sum meeting the norms set by Savvas EnVision of a proficient score of 12 correct answers out of 17 possible. In this sample scenario, the student could have missed all Numbers and Place Value to 100 questions and still scored proficient in that overall Numbers, Place Value, Money, and Patterns section of the assessment. With this information, the researcher questions the reliability of the results produced from the Savvas EnVision Individual Record Form. If the assessment record form provided norms for each individual section of the assessment, educators could have

a better idea of student strengths and weaknesses, rather than knowing the student is struggling in such a broad range of mathematical skills like Numbers, Place Value, Money, and Patterns. It is recommended that the Savvas Learning Company identify the proficient criteria according to national norms identified through their standards-based curriculum and evidence-based research for each specific category of the curriculum and assessment.

What Is Working and What Is Not Working

Referring to Figure 4.4, the number of questions students were exposed to by using IXL Learning is extremely high for a thirty-minute period of mathematical intervention in the general education setting. Without technology, one teacher would not be able to present thirty questions independently to a student in a thirty-minute time frame on the appropriate skill and ability level. Therefore, what is working for students by engaging in IXL Learning is that they are engaged in frequent and abundant mathematical practice with or without the correct answer. This is something educators may not be able to replicate in the classroom utilizing other resources including human/instructor performance. This data exceeded any expectations for student participation within the study and supports the use of a tailored interventional program when working with primary students.

What also was working in the study was the consistent work on place value skills. Students working on the skill three times a week for six weeks allowed them to focus on those skills alone. A lot of times, interventionists or interventional programs jump around, using different resources, and assessments with students. This study provides consistency of interventional practices with the students and the programing of the resources implemented in the study. Students were even able to identify which subcategory they needed to work on next

due to their familiarity with the program after the six-week program. The researcher supports this self-regulation and educational independence inadvertently supported within the study.

For this specific study, there were two components that were not working or were considered unsuccessful. First and most importantly to the study, students did not take the time to read the remedial assistance that IXL Learning provided to them after an incorrect answer. This prevented students from obtaining feedback regarding how they answered the question incorrectly. Students then clicked on the next question, appearing to move quicker through the questions with or without the correct answers and remediation needed. If students read the remedial instruction, could they have effectively and efficiently moved through the sixteen subcategories at a quicker pace? Would this have changed the weekly researcher-created, curriculum-based assessment results?

The second component of the study that was unsuccessful was creating and prolonging student motivation or engagement. Throughout the study, students engaged in behaviors indicating a lack of desire to complete place value questions or indicating boredom with the repetition of the IXL Learning portion. Verbal praise and encouragement from the researcher was not enough to motivate students to want to complete the thirty-minute IXL Learning sessions with excitement, accuracy, and focus. At one point, a student asked if a piece of candy would be awarded upon completion of the thirty-minute session. This type of reward/feedback may be considered for replication or similar studies in the future outside of such a research study. Researchers cannot forget the primary components of working with seven- and eight-year-old students. Feedback, praise, rewards, and motivational behavior plans assist their engagement and excitement in a variety of ways. When utilizing this interventional schedule outside of a

dissertation research study, tangible rewards may alter and improve data points for these primary students who are struggling and lacking motivation.

Overall, in education, what is not working is the instructional practices of place value skills. Students are demonstrating a decline in place value skills, as evident in the research and current Savvas EnVision 2nd Grade Curriculum sequencing. As universities are preparing future educators, attention should be focused on instructional strategies or such foundational skills like place value and number sense. Research provides a lack of interventional series or programs to assist with place value remediation; therefore, focus should be placed on instructional practices and professional development for future/current instructors. When selecting new mathematical series for instruction, administration and educators should note the sequence and depth of place value skills before selecting the series to promote the foundational skill in the most efficient and effective way.

What Is the Answer?

Data collection of the researcher-created, curriculum-based assessments support the study's prediction that IXL Learning increases students' weekly assessment scores. This data shows IXL Learning as an effective tool to be utilized in place value instruction. On the other hand, data from IXL Learning that tracked student progress through the sixteen subcategories of place value does not support IXL Learning as an effective intervention. Many students remained stagnant within the sixteen subcategories of the program, indicating they were not getting the remediation they needed to continue to the next criterion subcategory. If IXL Learning is not considered a successful intervention when utilized alone and lacking student motivation, then what is the solution to declining mathematical practices and student scores?

After reviewing the research and data found within this study, it is recommended that a blended approach to mathematical instruction be implemented in second-grade classrooms to best support place-value learning. Utilizing whole group instruction, small group instruction, IXL Learning, teacher professional development opportunities on place value, and other interventional practices would support all components of mathematical instruction, more specifically place value skills. Including manipulatives and visual representation of place value by using base ten blocks could reach diverse types of learners. Math manipulatives encourage students to make the "hand-to-mind" connection for such abstract mathematical topics or strategies (Continental, 2022) and may be beneficial in such a topic like place value. It is recommended that educators continue to utilize IXL Learning as a supplemental tool for specific skill sets in any subject area. The ease of implementation and tailored presentation of questions of IXL Learning is valuable for educators striving for differentiated instruction, simultaneously. However, educators must not rely on IXL Learning for full instructional responsibilities, alone. A blended approach, including a variety of instructional modes for any skill would meet the specific needs of all learners.

Also, moving around the sequencing of units within the Savvas EnVision 2nd Grade Curriculum would be beneficial for sequential and scaffolded learning of place value skills. At the second-grade level within this rural, low-income district of study, the second-grade team plans to alter the sequencing of units to best provide instructional and foundational skills necessary for place value skill acquisition. The researcher will advocate and promote similar curricular changes or alterations for future instruction across grade levels as the district's curriculum maps are being created and aligned.

If the study were to be replicated as an interventional program, a quick remedial lesson could be presented at the conclusion of each week of the study, assuring participants obtain the instruction needed in the place value subcategory. Allowing students to discuss or ask questions would assist in their comprehension of the place value topics of this study. Providing a remedial lesson could prevent students from getting stuck at a specific subcategory. This would also increase students' SmartScores at a quicker pace if students were able to get a blended, remedial approach to the content of each category.

While looking at IXL Learning as an online-interactive educational tool, a suggestion to their programing would be to present the remedial information in a short video, rather than text after an incorrect answer. This would promote or ensure that students obtain feedback in the remedial lessons of IXL Learning in an alternate format that could be comprehended without reading. Students in this specific study also struggled with reading skills, therefore, struggled to obtain the text provided. If a video or voiceover option was presented that a student was required to view before moving on to the next question, comprehension of the skill and proficiency may improve at a faster pace. By requiring the students to view the remedial lesson, educators could be confident students had been presented the information after each incorrect answer. Another suggestion to IXL Learning would be to include an introductory lesson/video to students before they begin answering questions. At times, students would ask the researcher what the question was asking because it was new to them, and they needed clarification. By providing an example of the expectations for that specific skill and question type, students may increase their productivity throughout the program, resulting in successful skills.

Within the small district of study, there is a large need for an Intervention Specialist position. Creating this position would provide the classroom educators with additional

interventional tools, data collection and analysis, special education reporting assistance, and support in the overall child study progress. Currently, the district has many goals identified in the initial stages of the MTSS programing. However, obtaining and implementing an Intervention Specialist within the district would assist in reaching those goals, including academic and behavioral goals within the MTSS process. As educators within the district administer assessments and share results of the assessments, an Intervention Specialist would encourage all faculty to dive deeper into student deficits, creating plans for progress in all areas. By including an Intervention Specialist, areas that may also be promoted include extra mathematical intervention groups, ability grouping for core subject areas based on skill deficits, supported and overseen progress monitoring of interventional processing, and assisting in communicating data throughout the district and with all stakeholders. Utilizing one leader within the district would simplify and stimulate successful instructional practices, interventional practices, and communication throughout the district.

Furthermore, a curricular change may be necessary in the developing mathematical success within the small district. Maybe the Savvas EnVision Curriculum and Diagnostic assessments are biased? Maybe they are ineffective in promoting mathematical success to students who have endured interruptions to their education and other events associated with the COVID-19 pandemic. A curricular change would require all stakeholder's participation and support within such a small district. Curriculum maps were created in the spring of 2023 for all teachers within the district, in hopes of aligning grade levels and subjects in future inservice sessions. This initial step will allow the faculty of the district to identify needs and strengths within their curricular practices across all grade levels, along with identifying MTSS goals for core subject areas and behaviors.

Conclusions and Implications

In reference to the literature reviewed, IXL Learning provided tailored instructional interventions that technology can provide, eliminating some professional duties of the teacher. Students worked at their own ability level and paced themselves throughout the study as IXL Learning intends (Hedrick, 2021). Participants' weekly researcher-created, curriculum-based assessment scores slightly increased after the six-week study. However, when considering the literature available and this study's findings, it is recommended that a blended intervention approach be utilized when providing place value intervention to second-grade students. It is recommended that educators not rely on software or online programs alone to support place value skills and learning to second-grade students, rather than utilize such programming as an educational tool supporting core skills.

As inconsistent data was collected on both the weekly researcher-created, curriculum-based assessments and the IXL Learning criterion progression charts, the Savvas EnVision curriculum and diagnostic program is questioned. Was Savvas EnVision the best assessment to measure the IXL Learning program? Is the assessment program producing biased results, specifically found within this study? The researcher questioned if other assessment and diagnostic programs are available for replication of this specific study of IXL Learning in place value skills. It is propounded that the validity and reliability of the Savvas EnVision program be researched by administrators and educators prior to purchasing or implementing the program to assure alignment with their instructional and assessment goals. Future research may also explore the specific strategies and wording of questions between the Savvas Envision curriculum and the IXL Learning place value questions. Do they align perfectly? Are all skills taught or reviewed in a similar manner?

As the effects of the COVID-19 pandemic continue to surface, educators are being tested in their abilities to improve student progress and their own instructional practices. Because all students learn differently, intervention strategies vary, including the online interactive platform like IXL Learning. The findings within this specific study allow educators to see the implementation of IXL Learning as an intervention, in hopes of improving student place value skills. The results of this study allow educators to reassess the sequencing of their curriculum maps in order to present content fluidly to students, keeping place value skills in mind as the foundation. Educators are also able to relate to the happenings within this specific district post-pandemic. Implications presented at the conclusion of the study support the continuation of IXL Learning as an interventional tool, supported with other blended instructional strategies and resources to best support place value skills for second-grade students in the public education setting.

Future Research Recommendations

Various recommendations for future research were identified as a result of this study. A major component of the study was the use of educational technology as an intervention. Exploring professional development opportunities and tools for educators on implementation and utilization of educational technology would be beneficial to educators today. Also, comparing the educational technology of IXL Learning and other online educational intervention platforms would be beneficial to educators targeting specific mathematics skills or programs that successfully support student needs.

Because this specific study was performed with a small sample size in a shortened time frame, performing the same study with a larger sample of students is worth researching. With the study only including nine students, generalization of the data was difficult. Student permission

forms were sent home with students at the end of May 2023. The school year ended the first week of June 2023. It is assumed that many families forgot about the permission paperwork over summer break, therefore, producing a small sample of students with parental permission. To produce a larger sample size, the researcher should have reached out to all parents again upon returning to school in the fall, identifying the participation status of their child. A larger sample size would be beneficial in determining if IXL Learning is a successful intervention for place value skills to generalize the data across districts, socioeconomic differences, and district locations.

It is recommended to conduct the same research in a longer, longitudinal study. Eighteen days of online IXL Learning appears to be a short period of time when setting the goal of sixteen IXL Learning place value criterion levels. This may have been an unattainable goal for the struggling learners due to a short time frame of the study and their level of educational deficits at the initiation of the study. The researcher intended on making the study short to prevent core content being instructed in regular mathematics classes that could control the data in an unintended manner.

Alterations to the study could also include different age groups with similar mathematical skill needs. Students' perspective of place value skills and strategies in qualitative data collection would also produce some valuable information for current educators. How do students feel about their skills, needs, and instruction? Can parents provide some further information to assist in data analysis, skill deficits, or the use of the tools utilized within this study?

By adding a motivational reward other than those administered through IXL Learning, students may engage with increased effort. When tangible rewards are presented or offered on a daily or weekly basis, students would have a goal to look forward to and work towards. A small

reward like a piece of candy might be a motivating factor after each IXL Learning thirty-minute session and would promote student success in the program, along with a larger reward at the end of each week and/or the completion of the study. While investigating the results of this study, future similar studies may include two specific groups; one that performs as this study did, while the second group has a short lesson on day five of the weekly schedule with the teacher. Comparing the progress of the two groups would provide more information, as educators would want to generalize data collected from such a study.

Promoting engagement and motivation prior to the start of the study can be connected to the emphasis on reading the remedial prompts provided by IXL Learning after each incorrect answer. Future replications of this study should include this detail within their initial discussion with students. Within this specific study, it was not emphasized to participants to confirm they were reading or reviewing the remedial prompts before continuing to the next question.

Future exploration of the connection between the theory of memory and place value skills is desired. How do educators accurately assess a student's place value understanding? Is it rote-learned procedures or understanding (Wilkinson, 2017, p. 51)? How do students acquire the knowledge of place-value when they have not yet received any formal instruction on it (Kong& Chan, 2021, p. 454)? Children's understanding of place value within specific tasks or strategies is yet to be researched in depth, along with how memory affects their comprehension, application of skill, or generalization.

Another recommendation for future replication of this study would be the utilization of an alternative curriculum-based, standards-based assessment program to identify student strengths and deficits. Because the Individual Record Form does not specifically identify the norm referenced criteria for proficiency in the place value section, an alternative assessment may

be able to provide different data regarding student needs, in a more specific manner. In future studies, researching the different diagnostic assessments could be beneficial to educators and administrators.

Lastly, exploration of IXL Learning interventional practices on a different subject area and/or skill could provide alternative data, presenting meaningful analysis for educators at the second-grade level. It is possible that the place value skill was too narrow or too broad of a skillset, causing inconsistent data across the analysis tools of this study. At the second-grade level, an IXL Learning language arts skill of "verb tense" consists of 18 subcategories, while the "silent e" skill only has 4 subcategories. Comparing the data similar to that of this study could allow researchers to compare the number of subcategories with the student progression in the study. Furthermore, the language arts skills data collection and analysis could be compared to the data collection of this specific place value skills study. Because there is a lack of research regarding IXL Learning as an intervention, the researcher should continue to use IXL Learning as a supplemental tool in all skill areas, as needed for specific instructional goals or student needs.

Summary and Conclusion/Concluding Remarks

After reflecting on the collected data of Chapter 4 and the reflection within Chapter 5, the researcher can conclude that IXL Learning as an independent intervention when utilized for thirty-minutes per day does increase students' weekly assessment scores. IXL Learning produced inconsistent results regarding student's criterion level progression in the place value subcategories. It is recommended that a balanced and blended instructional approach be utilized in addition to IXL Learning as an appropriate place value intervention. Although students were not successful in completing all sixteen subcategories of the place value skills of IXL Learning

in the six-week study time frame, they were exposed to over 4,000 place value questions and demonstrated a slight increase in scores of their weekly assessments. As COVID-19 educational effects surface and are analyzed, interventional practices will be improved and solidified for primary students affected by the pandemic in all academic areas, including place value skills. The data collected within this study can only assist educators close those educational gaps and deficits, while supporting future research on instructional technology, interventional programming, place value skills at the primary level, and the implementation of IXL Learning.

REFERENCES

Age of Learning, Inc. . (2023). ABCmouse: Educational games, books, Puzzles & Songs for Kids & Toddlers. ABCmouse.com. https://www.abcmouse.com/abc/?8a08850bc2=T680450816.1699654549.696

Aldridge, K. (2021). *The Relationship Between I-Ready Intervention and Grade 8 Mathematical Achievement* (dissertation). Kenyatta Shanta Aldridge, Columbus, GA.

Bashkov, B., Mattison, K., & Hochstein, L. (2021, March). *IXL Design Principles*. IXL Designing Principles. https://www.ixl.com/research/IXL_Design_Principles.pdf

Bashkov, B. (2021, August). *Assessing the Impact of IXL Math over Three Years: A Quasi-Experimental Study*. IXL Learning. https://www.ixl.com/materials/us/research/IXL_Math_3-Year_QED_ESSA_Tier_2.pdf

Bouck, E. C., & Long, H. (2023). Online delivery of a manipulative-based intervention package for finding equivalent fractions. *Journal of Behavioral Education*, *32*(2), 313–333. https://doi-org.proxy-sru.klnpa.org/10.1007/s10864-021-09449-y

Bouck, E. C., Long, H., & Jakubow, L. (2022). Teaching struggling students mathematics online via explicit instruction. *Preventing School Failure*, *66*(2), 126–135. https://doi-org.proxy-sru.klnpa.org/10.1080/1045988X.2021.1980852

Bridgett, E. (2022). A place for everything and everything in its place: Is place value a help or a hindrance? *Mathematics Teaching*, *280*, 32–33.

Bvorel. (2021, May 12). 5 critical issues in Mathematics Education. Barry University. https://online.barry.edu/degrees/education/masters-science/curriculum-instruction-,ath/criticial-issues/

Caldwell, J. (2020). *Developing conceptual understanding: The case of place value*. Savvas. https://assets.savvas.com/asset_mgr/current/201922/DevConceptUnderstanding-JC_WP.pdf

Cherney, K. (2016, June 29). *Anxiety and technology in the classroom: Identification and solutions for multimodal inclusivity*. Digital Rhetoric Collaborative. https://www.digitalrhetoriccollaborative.org/2016/06/29/anxiety-and-technology-in-the-classroom-identification-and-solutions-for-multimodal-inclusivity/

Cheung, P., & Ansari, D. (2021). Cracking the code of place value: The relationship between place and value takes years to master. *Developmental psychology*, *57*(2), 227–240. https://doi.org/10.1037/dev0001145

Chhin, C., Brasiel, S., & Bresina, B. (2023, April 17). *Investing in Math Learning and Achievement for All Learners*. IES Blog. https://nces.ed.gov/blogs/2023/04/17/default

Cision US Inc. (2020, January 14). IXL Efficacy Research Meets Every Student Succeeds Act (ESSA) Tier 2 Requirements. https://www.prnewswire.com/news-releases/ixl-efficacy-research-meets-every-student-succeeds-act-essa-tier-2-requirements-300986503.html

Continental. (2022, January 17). The power of elementary math manipulatives. Continental Press. https://www.continentalpress.com/blog/elementary-math-manipulatives/#:~:text=Math%20is%20full%20of%20abstract,hands%20have%20a%20special%20connection.

Del Mar, Z. (2023, April 5). What is Intervention in Education? Insights for K-12 Educators. https://www.hmhco.com/blog/what-is-intervention-in-education.

DonorsChoose. (2023). Support a classroom: Build a future. DonorsChoose. https://www.donorschoose.org/

D2L Corporation. (2023, October 3). Online learning platform: Creators of the Brightspace LMS Software. D2L. https://www.d2l.com/

Explore Learning. (2023, August 9). Home: Reflex. Meet Reflex. https://www.reflexmath.com/

Flevares, L. M., Perry, M., Beilstein, S. O., & Bajwa, N. P. (2021). Examining first-graders' developing understanding of place value via base-ten virtual manipulatives. *Early Childhood Education Journal*, *50*(3), 359–370. https://doi.org/10.1007/s10643-021-01162-9

Gafoor, K., & Kurukkan, A. (2015, December). Learner and teacher perception on difficulties in learning and Teaching Mathematics: Some Implications. National Conference on Mathematics Teaching- Approaches and Challenges. https://files.eric.ed.gov/fulltext/ED568368.pdf

Google. (2023). Classroom Management Tools & Resources. Google for Education. https://edu.google.com/intl/ALL_us/workspace-for-education/classroom/

Hall, T., Vue, G., & Mengel, M. (2003). *Curriculum-Based Assessments and Implications for UDL Implementation.* Wakefield, MA: National Center on Accessing the General Curriculum. http://aem.cast.org/about/publications/2003/ncac-curriculum-based-assessments-udl.html

Happy Numbers. (2023). *Place Value: Building A Strong Foundation*. Happy Numbers. https://happynumbers.com/blog/place-value-building-strong-foundation/

Hartnett, J. (2018). *Teaching place-value: Concept development, big ideas and activities*. Primary Standards. APMC, 23(3). https://files.eric.ed.gov/fulltext/EJ1231242.pdf

Heale, A. (2015). *Technology Enhancing Kindergarten Students' Literacy Skills in Math* (dissertation). SUNY.

Hedrick, N. (2021, March 5). *Turning things around: Online learning platform helps tackle Covid slide*. Journal Review. https://www.journalreview.com/stories/turning-things-around,147910

Illuminate Education Inc. (2023). *Fastbridge Learning: Research to results*. FastBridge Learning Research to Results. https://auth.fastbridge.org/login.do

IXL Learning. (2023). *How it works*. IXL Learning. https://www.ixl.com/membership/teachers/how-it-works

Jackaria, P. M. (2022). Elementary teachers' experiences and instructional challenges during the return to school after the COVID-19 closure in the Philippines. I*nternational Research Journal of Science, Technology, Education, & Management* (IRJSTEM), 2(2), 216–225. https://doi-org.proxy-sru.klnpa.org/10.5281/zenodo.6955920

Kaplan Early Learning Company. (2023). *Kore Wobble Chair*. Kaplan Early Learning Company. https://www.kaplanco.com/product/142279GP/kore-wobble-chair?c=1%7CFC1080&utm_term=&utm_campaign=%28ROI%29%2BNB%2BDSA%2B-%2BMain&utm_source=google&utm_medium=cpc&hsa_acc=4352476128&hsa_cam=17614154575&hsa_grp=141871854361&hsa_ad=607285928627&hsa_src=g&hsa_tgt=dsa-19959388920&hsa_kw=&hsa_mt=&hsa_net=adwords&hsa_ver=3&gad=1&gclid=CjwKCAjwzJmlBhBBEiwAEJyLuy50UbYI0eGm303_PEm7IfGo64a39sKpqZZe6bXQg9WHnfqZDYjcvhoC8dMQAvD_BwE

Kamenetz, A. (2022). *The stolen year: How covid changed children's lives, and where we go now.* PublicAffairs.

Kazdin, A. E. (2011). *Single-case research designs: Methods for clinical and applied settings* (2nd ed.). Oxford University Press.

Kong, M. N. K., & Chan, W. W. L. (2021). Automatic processing of place-value in kindergarteners. *European Journal of Developmental Psychology*, *18*(3), 446–458. https://doi.org/10.1080/17405629.2020.1854216

Kurt, S. (2017, February 8). *Definitions of Instructional Technology*. Educational Technology. https://educationaltechnology.net/definitions-of-instructional-technology/

Lake Michigan Academy. (2021, August 9). *Intervention vs. Remediation: What's the Difference?* Lake Michigan Academy. https://www.lakemichiganacademy.org/intervention-vs-remediation-whats-the-difference/

Leonhardt, D. (2023, April 28). *The long shadow of Covid school closures*. The New York Times. https://www.nytimes.com/2023/04/28/briefing/pandemic-school-closures-randi-weingarten.html

Liu, K., & Wu, J. (2021). The effect of online homework (IXL) on students' Mathematics achievement. *Asian Journal of Education and Training*, *7*(4), 244–249. https://doi.org/10.20448/journal.522.2021.74.244.249

MacDonald, B., Westenskow, A., Moyer-Pakenham, P., & Child, B. (2018, January 8). Components of place value understanding: Targeting mathematical difficulties when providing interventions. *School Science and Mathematics, 118 (1-2), p. 17-29.* https://onlinelibrary.wiley.com/doi/full/10.1111/ssm.12258

Major, K. (2012, July). *The development of an assessment tool: Student knowledge of the concept of place value*. https://files.eric.ed.gov/fulltext/ED573292.pdf

Merlo, A., Hendriksen, P. A., Garssen, J., Bijlsma, E. Y., Engels, F., Bruce, G., & Verster, J. C. (2021). Transition to online education during the COVID-19 pandemic: Impact of changes in alcohol consumption and experiencing hangovers on academic functioning. *Journal of Clinical Medicine, 10*(22), 5332. https://doi-org.proxy-sru.klnpa.org/10.3390/jcm10225332

Mervosh, S. (2022, September 1). The pandemic erased two decades of progress in math and reading. The New York Times. https://www.nytimes.com/2022/09/01/us/national-test-scores-math-reading-pandemic.html

Nagel, N. G., & Swingen, C. C. (1998). Students' explanations of place value in addition and subtraction. *Teaching Children Mathematics*, *5*(3), 164.

National Center for Education Statistics. (2023). *Education Demographic and Geographic Estimates.* ACS School District Profile 2017-21. https://nces.ed.gov/Programs/Edge/ACSDashboard/4206090

National Center on Intensive Intervention. (2015). *Place-value concepts - intensive intervention*. Washington, DC: U.S. Department of Education, Office of Special Education Programs, National Center on Intensive Intervention. https://intensiveintervention.org/sites/default/files/Place-Value_Concepts_508.pdf

Odom, J. (2023, January 3). *How covid-19 affected students' brains*. The Educator's Room. https://theeducatorsroom.com/covid-19-impact-student-brains-neuroscience-trauma-educators/

Önal, H., &; Altiner, E. Ç. (2021). The level of 7- and 8-years old children understanding of the place value concept. *European Journal of Educational Sciences*, 8(4), 28–52. https://doi.org/10.19044/ejes.v8no4a28

Pennsylvania Department of Education. (2013, January). Academic standards for mathematics - state board of education. Pennsylvania Department of Education. https://www.stateboard.education.pa.gov/Documents/Regulations%20and%20Statements/State%20Academic%20Standards/PA%20Core%20Math%20Standards.pdf

Pincus, R., Hannor-Walker, T., Wright, L., & Justice, J. (2020). COVID-19's effect on students: How school counselors rise to the rescue. *NASSP Bulletin*, *104*(4), 241–256. https://doi-org.proxy-sru.klnpa.org/10.1177/0192636520975866

Pokhrel, S., & Chhetri, R. (2021). A literature review on impact of COVID-19 pandemic on teaching and learning. *Higher Education for the Future*, 8(1), 133–141. https://doi.org/10.1177/2347631120983481

Rutherford, K. (2015, April 15). *What do the standards for mathematical practice mean to you?*. What Do the Standards for Mathematical Practice Mean to You? - National Council of Teachers of Mathematics. https://www.nctm.org/Publications/TCM-blog/Blog/What-Do-the-Standards-for-Mathematical-Practice-Mean-to-You_/#:~:text=These%20eight%20practices%20describe%20the,and%20enduring%20understanding%20of%20mathematics.

Sances, M. W., & Campbell, A. L. (2021). State policy and mental health outcomes under COVID-19. *Journal of Health Politics, Policy & Law*, *46*(5), 811–830. https://doi-org.proxy-sru.klnpa.org/10.1215/03616878-9155991

Sanz Ponce, R., López-Luján, E., & Giménez-Beut, J. A. (2022). Pandemic, poverty and education: A challenge for the sustainable development goals. Policy Futures in Education, 0(0). https://doi.org/10.1177/14782103221112542

Savvas Learning Company. (2023). *Savvas realize*. Savvas Realize - Savvas Learning Company.

https://www.savvasrealize.com/

Savvas Learning Company. (2023). *EnVision math - diagnostic assessment – savvas learning company*. EnVision Math - Diagnostic Assessment – Savvas Learning Company. https://www.savvas.com/index.cfm?locator=PS3gKo

School of Education and Human Sciences, University of Kansas. (2023, April 25). Understanding response to intervention (RTI) and multi-tiered system of support (MTSS). University of Kansas School of Education and Human Services. https://educationonline.ku.edu/community/what-is-response-to-intervention#:~:text=Response%20to%20Intervention%20(RTI)%20is,common%20for%20students%20with%20disabilities.

Screencastify, LLC. (2023). Screen recording and video editing. Screencastify. https://www.screencastify.com/

Seesaw Learning, Inc. (2023). Elementary learning experience platform. Seesaw. https://web.seesaw.me/

Solution Tree Press. (2012). *Table 2.2: Mathematical practices—look-fors as classroom indicators*. Common Core Mathematics in a PLC Work. https://www.debbiewaggoner.com/uploads/1/2/9/9/12998469/9_table_2.2mathematicalpractices--look-forsasclassroomindicators.pdf

The Chocolate Teacher. (2021, August 16). *Teaching Resources & Lesson Plans*. TPT. http://www.teacherspayteachers.com/

The Nation's Report Card. (2022). *NAEP report card: Mathematics*. The Nation's Report Card. https://www.nationsreportcard.gov/mathematics/?grade=4

Unser, C. (2017). *A Study on The Positives and Negatives of Using Technology In The*

Classroom (thesis). Undergraduate Honors College Theses. https://digitalcommons.liu.edu/post_honors_theses/18

USAFacts. (2022, November 4). Covid disrupted decades of progress in math and reading. USAFacts. https://usafacts.org/articles/covid-disrupted-decades-of-progress-in-math-and-reading/

Vanderbilt University. (2023). *What is data-based individualization?*. IRIS Center. https://iris.peabody.vanderbilt.edu/module/dbi1/cresource/q1/p01/

Vassar, A. (2017). *The use of manipulative materials in early place value instruction: a cognitive load perspective* (dissertation). http://dx.doi.org/https://doi.org/10.26190/unsworks/19943

ViewSonic Corporation. (2020, February 25). *5 disadvantages of technology in the classroom (and how to overcome them)*. ViewSonic. https://www.viewsonic.com/library/education/5-disadvantages-of-technology-in-the-classroom-and-how-to-overcome-them/

Western Governors University. (2019, October 3). *Impact of technology on kids today (and tomorrow)*. https://www.wgu.edu/blog/impact-technology-kids-today-tomorrow1910.html

White, E. (2022, January 28). *Place value – how important is it really?* Maths Australia. https://mathsaustralia.com.au/math-u-see/is-place-value-important/#:~:text=Place%20Value%20is%20the%20most,as%20a%20basic%20concept%20first.

Wilkinson, M. (2017). *An Investigation of Place Value Understanding in Year 2 Children* (dissertation).

Williams, C. (2018, May 4). *Teaching to Mastery*. Center for Student Achievement Solutions. https://www.studentachievementsolutions.com/teaching-to-

mastery/#:~:text=Student%20performance%20can%20be%20evaluated,just%20a%20suggested%20starting%20point.

Zirogiannis, B. (2021). #Booklove in the time of COVID: How school librarians have worked to maximize students' access to books during a pandemic. *Literacy Today (2411-7862)*, *38*(6), 44–47.

Zoom Video Communications, Inc. (2023). *Zoom online video meetings.* Zoom. https://explore.zoom.us/en/lp/video-meetings/?creative=641116065753&keyword=best+virtual+meeting+platforms&matchtype=e&network=s&device=c&zcid=11933&utm_id=19247167429_641116065753&gad=1&gclid=EAIaIQobChMIt4mCwZ_r_wIV0vLICh1qyw_VEAAYASAAEgK7J_D_BwE

APPENDIXES

Appendix A

Savvas EnVision 2nd Grade Diagnostic Assessment Form A

Name _____ Diagnostic Test GRADE 2, FORM A

Numbers, Place Value, Money, and Patterns

Mark the best answer.

1. Which number does the model show?

Ⓐ 10
Ⓑ 50
Ⓒ 80
Ⓓ 100

2. Which is the number eighty-nine?

Ⓐ 79
Ⓑ 89
Ⓒ 97
Ⓓ 98

3. In her last 4 games, Erin's team scored 45, 50, 55, and 60 points.
Erin's team's points skip count by which number?

Ⓐ 100
Ⓑ 50
Ⓒ 10
Ⓓ 5

4. Which is the expanded form of the number shown by this model?

Ⓐ 60 + 3
Ⓑ 63
Ⓒ sixty-three
Ⓓ 36

Name _____ Diagnostic Test GRADE 2, FORM A

Numbers, Place Value, Money, and Patterns
(continued)

Mark the best answer.

5. Which shows an even number of counters?

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

6. Carley divides a rectangle into thirds. Which shows Carley's rectangle?

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

7. Ian cut a pie into two equal shares. How can the shares be described?

Ⓐ thirds
Ⓑ fourths
Ⓒ halves
Ⓓ eighths

8. Which shows two ways to divide these wholes into fourths?

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

Name _____ Diagnostic Test GRADE 2, FORM A

Numbers, Place Value, Money, and Patterns
(continued)

Mark the best answer.

9. Which correctly describes the whole?

Ⓐ one fourth
Ⓑ two fourths
Ⓒ three fourths
Ⓓ four fourths

10. The money Serena has is shown below.

How much money does Serena have?

Ⓐ $1.55 Ⓒ $1.35
Ⓑ $1.40 Ⓓ $1.20

11. Brian has these coins. He wants to buy a book for $1. How much more money does Brian need?

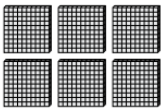
Ⓐ 25¢ Ⓑ 30¢ Ⓒ 35¢ Ⓓ 40¢

Name _____ Diagnostic Test GRADE 2, FORM A

Numbers, Place Value, Money, and Patterns
(continued)

Mark the best answer.

12. What number does the model show?



Ⓐ 6
Ⓑ 60
Ⓒ 600
Ⓓ 6,000

13. Which is the number word for 867?

Ⓐ eight hundred sixty-seven
Ⓑ eight hundred seventy-seven
Ⓒ sixty-seven
Ⓓ eighty-seven

14. Which comparison is true? Choose all that apply.

Ⓐ 845 = 857
Ⓑ 845 > 857
Ⓒ 845 < 857
Ⓓ 845 = 845

15. Which shows the number 508 in expanded form?

Ⓐ 5 + 0 + 8
Ⓑ 500 + 0 + 80
Ⓒ 50 + 0 + 80
Ⓓ 500 + 0 + 8

Name _____ Diagnostic Test GRADE 2, FORM A

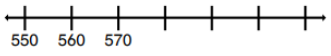
Numbers, Place Value, Money, and Patterns
(continued)

Mark the best answer.

16. What do the digits in the number 723 represent?

Ⓐ 7 hundreds, 3 tens, 2 ones
Ⓑ 7 hundreds, 2 tens, 3 ones
Ⓒ 3 hundreds, 2 tens, 7 ones
Ⓓ 3 hundreds, 7 tens, 2 ones

17. Ray skip counts 550, 560, 570 on this number line. Which numbers should he count next?



Ⓐ 571, 572, 573, 574
Ⓑ 580, 590, 600, 610
Ⓒ 575, 580, 585, 590
Ⓓ 580, 585, 590, 595

Name _____ Diagnostic Test GRADE 2, FORM A

Basic Facts

Mark the best answer.

18. Which number makes both addition sentences true?

4 + 5 = ___?___
5 + 4 = ___?___

Ⓐ 10 Ⓒ 8
Ⓑ 9 Ⓓ 7

19. Ellen and Joseph solve 8 + 8 + 2.

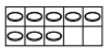
Ellen adds 8 + 8 to make a double then adds 2.

Joseph adds 8 + 2 to make a ten then adds 8.

Who finds the correct sum?

Ⓐ Ellen
Ⓑ Joseph
Ⓒ Neither of them
Ⓓ Both of them

20. Which fact with 10 can help you solve 8 + 9?



Ⓐ 10 + 6 = 16
Ⓑ 10 + 7 = 17
Ⓒ 10 + 8 = 18
Ⓓ 10 + 9 = 19

21. Andy has some stickers.
He gives 7 stickers away.
Now Andy has 9 stickers.
How many stickers did Andy have before?

Ⓐ 18 Ⓒ 16
Ⓑ 17 Ⓓ 15

Name _____ Diagnostic Test GRADE 2, FORM A

Basic Facts (continued)

Mark the best answer.

22. Look at the picture and number sentence. Which is a related subtraction fact? Choose all that apply.

$7 + 6 = 13$

Ⓐ $7 - 6 = 1$
Ⓑ $13 - 9 = 4$
Ⓒ $13 - 6 = 7$
Ⓓ $13 - 7 = 6$

23. Jenna has 15 crayons. 8 are out of the box. How many are in the box?

$8 + \_\_\_\_ = 15$

_____ are in the box.

Ⓐ 4
Ⓑ 7
Ⓒ 8
Ⓓ 9

24. Sam has 9 fish. Wendy has 4 fish. How many more fish does Sam have than Wendy? Draw a picture if you need to.

$9 - 4 =$ _____

Ⓐ 4
Ⓑ 5
Ⓒ 6
Ⓓ 7

Name _____ Diagnostic Test GRADE 2, FORM A

Basic Facts (continued)

Mark the best answer.

25. Which fact can help you solve $17 - 9$? Choose all that apply.

Ⓐ $8 + 9$ Ⓑ $8 + 8$ Ⓒ $9 + 8$ Ⓓ $17 - 8$

26. Which addition sentence matches the array?

Ⓐ $3 + 5 = 8$
Ⓑ $5 + 5 = 10$
Ⓒ $3 + 3 + 3 + 3 = 12$
Ⓓ $5 + 5 + 5 = 15$

27. Tammy, Jin, and Marcus are trying to find the addition sentence that matches this array.

Tammy wrote $4 + 4 + 4 = 12$.
Jin wrote $3 + 3 + 3 = 9$.
Marcus wrote $3 + 4 + 3 = 10$.
Who wrote the addition sentence that matches the array?

Ⓐ Tammy
Ⓑ Jin
Ⓒ Marcus
Ⓓ All three of them

Name _____ Diagnostic Test GRADE 2, FORM A

Computation with Whole Numbers

Mark the best answer.

28. Tyrone has 74 cubes. Emma has 22 cubes. How many cubes do they have in all?

71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Ⓐ 76
Ⓑ 86
Ⓒ 96
Ⓓ 99

29. Use snap cubes. Add on to subtract. Which shows the correct answer?

$13 + \_\_\_\_ = 29$

Ⓐ $29 - 13 = 16$
Ⓑ $29 - 13 = 15$
Ⓒ $29 - 13 = 14$
Ⓓ $29 - 13 = 12$

30. Which number sentence shows 7 tens minus 3 tens?

Ⓐ $70 - 10 = 60$
Ⓑ $73 - 30 = 43$
Ⓒ $73 - 33 = 40$
Ⓓ $70 - 30 = 40$

31. Janice has 65 beads. 24 of the beads are red. The rest are blue. How many blue beads does Janice have?

41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

Ⓐ 89
Ⓑ 49
Ⓒ 41
Ⓓ 31

Name _____ Diagnostic Test GRADE 2, FORM A

Computation with Whole Numbers (continued)

Mark the best answer.

32. Which shows the sum? Use models if you like.

	Tens	Ones
	□	
+	3	8
	4	6

Ⓐ 72
Ⓑ 74
Ⓒ 82
Ⓓ 84

33. Which shows the difference? You can use cubes to help.

	Tens	Ones
	□	□
−	8	4
	3	7

Ⓐ 47
Ⓑ 53
Ⓒ 57
Ⓓ 63

34. Which addition sentences can you use to check the subtraction? Choose all that apply.

$$\begin{array}{r} 34 \\ -\ 27 \\ \hline \end{array}$$

Ⓐ $57 = 27 + 30$
Ⓑ $27 + 7 = 34$
Ⓒ $27 + 40 = 67$
Ⓓ $34 = 7 + 27$

35. Tia scored 25 points in a game. Mick scored 27 points. Rob scored 23 points. Erica scored 14 points.

How many points did they score in all?

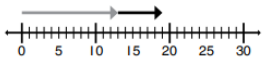
Ⓐ 70
Ⓑ 75
Ⓒ 89
Ⓓ 99

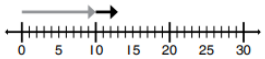
Name _____ Diagnostic Test GRADE 2, FORM A

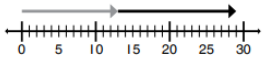
Computation with Whole Numbers
(continued)

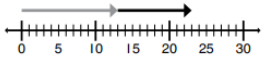
Mark the best answer.

36. Which number line shows 13 + 16?

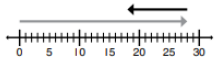
Ⓐ 

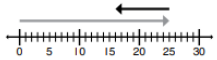
Ⓑ 

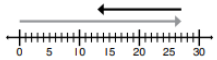
Ⓒ 

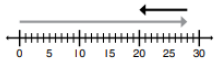
Ⓓ 

37. Which number line shows 28 − 8?

Ⓐ 

Ⓑ 

Ⓒ 

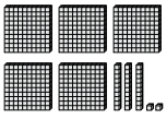
Ⓓ 

Name _____ Diagnostic Test GRADE 2, FORM A

Computation with Whole Numbers
(continued)

Mark the best answer.

38. What is 100 less than 532?



Ⓐ 500 Ⓒ 532
Ⓑ 531 Ⓓ 432

39. Find the sum.
You can use models to help. Regroup if you need to.

659
+ 334

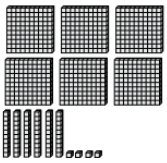
Ⓐ 993 Ⓒ 893
Ⓑ 983 Ⓓ 883

40. Find the difference.
You can use models to help. Regroup if you need to.

409
− 135

Ⓐ 374 Ⓒ 274
Ⓑ 334 Ⓓ 234

41. What is 10 more than 664?



Ⓐ 654 Ⓒ 700
Ⓑ 674 Ⓓ 764

Name _____ Diagnostic Test GRADE 2, FORM A

Measurement, Geometry, and Data Analysis

Mark the best answer.

42. Rita finishes school in the afternoon at the time shown below.

What time does Rita finish school?

Ⓐ 2: 45 A.M. Ⓒ 3: 45 A.M.
Ⓑ 2: 45 P.M. Ⓓ 3: 45 P.M.

43. Use a centimeter ruler. How long is the paper clip?

Ⓐ 1 centimeter Ⓒ 3 centimeters
Ⓑ 2 centimeters Ⓓ 4 centimeters

44. How much longer is the black line than the gray line?
Use a centimeter ruler to solve.

Ⓐ 2 centimeters Ⓒ 4 centimeters
Ⓑ 3 centimeters Ⓓ 5 centimeters

Name _____ Diagnostic Test GRADE 2, FORM A

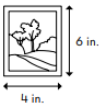
Measurement, Geometry, and Data Analysis
(continued)

Mark the best answer.

45. Tony measures the length of a table in inches and in feet.
Which of the following sentences is true?

Ⓐ The table will measure more feet than inches.
Ⓑ The table will measure fewer inches than feet.
Ⓒ The table will measure about the same inches and feet.
Ⓓ The table will measure more inches than feet.

46. What is the distance around this picture?



Ⓐ 20 in. Ⓑ 18 in. Ⓒ 10 in. Ⓓ 6 in.

47. Olivia has a ribbon that is 52 cm long.
Arif has a ribbon that 38 cm long.
How much longer is Olivia's ribbon than Arif's ribbon?

Ⓐ 10 cm Ⓑ 12 cm Ⓒ 14 cm Ⓓ 16 cm

Name _____ Diagnostic Test GRADE 2, FORM A

Measurement, Geometry, and Data Analysis
(continued)

Mark the best answer.

48. What would be a good estimate for the length of this pencil?

Ⓐ about 40 feet Ⓒ about 4 feet
Ⓑ about 40 inches Ⓓ about 4 inches

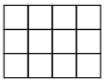
49. Shola's shape has 2 flat surfaces. It has 0 vertices. Which is Shola's shape?

Ⓐ  Ⓑ  Ⓒ  Ⓓ 

50. Which shape has 6 sides and 6 vertices?

Ⓐ  Ⓒ 
Ⓑ  Ⓓ 

51. How many squares cover this rectangle?



Ⓐ 3 Ⓒ 12
Ⓑ 10 Ⓓ 16

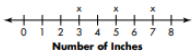
Name _____ Diagnostic Test GRADE 2, FORM A

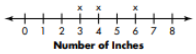
Measurement, Geometry, and Data Analysis
(continued)

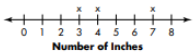
Mark the best answer.

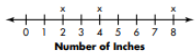
52. Sandy measured the length of different pencils in her classroom. She made this chart to show the data. Which line plot shows the data in Sandy's chart?

Sandy's Pencils	
Color	Length in Inches
Red	4
Blue	3
Yellow	6

Ⓐ 

Ⓒ 

Ⓑ 

Ⓓ 

53. How many stickers are there in all?

Number Of Stickers	
♡	☺☺☺
☆	☺☺☺☺
🧸	☺☺
🐻	☺
Each ☺ = 1 sticker.	

Ⓐ 12 Ⓒ 8
Ⓑ 10 Ⓓ 7

54. In which game did the team score the least number of goals?

Ⓐ Game 1 Ⓒ Game 3
Ⓑ Game 2 Ⓓ Game 4

Name _____ Diagnostic Test GRADE 2, FORM A

Problem Solving

Mark the best answer.

55. Mia makes 16 bracelets.
She gives 8 bracelets to her friends.
She then makes 5 more bracelets.
Which two number sentences show how many bracelets Mia has now?

Ⓐ $8 - 5 = 3$ and $3 + 13 = 16$
Ⓒ $16 - 8 = 8$ and $8 - 5 = 3$
Ⓑ $5 + 8 = 13$ and $13 - 8 = 5$
Ⓓ $16 - 8 = 8$ and $8 + 5 = 13$

56. Endia has 7 balls. Sam has 4 balls. How many balls do they have in all? Use counters and a workmat to solve.

Ⓐ $7 - 4 = 3$ Ⓒ $4 + 3 = 7$
Ⓑ $11 - 7 = 4$ Ⓓ $7 + 4 = 11$

57. Harry had 15 coins. He used 6 coins. How many coins does Harry have left? If Harry's dad gives him 7 more coins, how many will Harry have then? Which two number sentences solve both parts of the problem?

Ⓐ $15 - 6 = 9$; $9 + 7 = 16$
Ⓑ $15 + 6 = 21$; $21 + 7 = 28$
Ⓒ $15 - 6 = 9$; $9 - 7 = 2$
Ⓓ $15 + 6 = 21$; $21 - 7 = 14$

Name _____ Diagnostic Test GRADE 2, FORM A

Problem Solving
(continued)

Mark the best answer.

58. Josie's shape has 4 sides. Two of the sides are longer and are equal in length. The other two sides are shorter and are equal in length. Which could be Josie's shape? Choose all that apply.

Ⓐ square
Ⓑ rectangle
Ⓒ pentagon
Ⓓ quadrilateral

59. Dan paid 96¢ for 2 items. What did he buy? Try, check, and revise (if necessary) to solve each problem.

Snack Menu	
Food	Price
Sandwich	69¢
Soup	52¢
Apple	15¢
Juice	27¢

Ⓐ soup and apple
Ⓑ apple and juice
Ⓒ sandwich and juice
Ⓓ soup and sandwich

60. Jered has 8 plums. He has 5 apples. Then he buys more plums. How many plums does Jered have now? Is there enough information to solve? If so, solve the problem.

Ⓐ 17 Ⓒ 3
Ⓑ 13 Ⓓ missing information

(Savvas Learning Company, 2023)

Appendix B

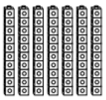
Savvas EnVision 2nd Grade Diagnostic Assessment Form B

Name _____ Diagnostic Test GRADE 2, FORM B

Numbers, Place Value, Money, and Patterns

Mark the best answer.

1. Which number does the model show?



Ⓐ 10
Ⓑ 30
Ⓒ 70
Ⓓ 90

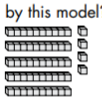
2. Which is the number seventy-two?

Ⓐ 56
Ⓑ 72
Ⓒ 39
Ⓓ 18

3. On her last 4 tests, Emma scored 65, 75, 85, and 95. Emma's test scores skip count by which number?

Ⓐ 10
Ⓑ 50
Ⓒ 15
Ⓓ 5

4. Which is the expanded form of the number shown by this model?



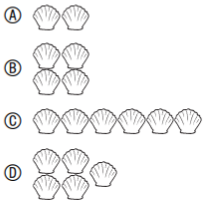
Ⓐ fifty-four
Ⓑ 54
Ⓒ 5 + 4
Ⓓ 50 + 4

Name _____ Diagnostic Test GRADE 2, FORM B

Numbers, Place Value, Money, and Patterns (continued)

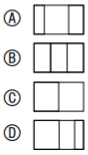
Mark the best answer.

5. Which shows an odd number of shells?



Ⓐ
Ⓑ
Ⓒ
Ⓓ

6. Korina divides a rectangle into halves. Which shows Korina's rectangle?

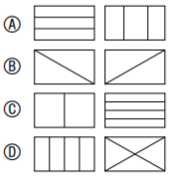


Ⓐ
Ⓑ
Ⓒ
Ⓓ

7. John cut a pizza into three equal shares. How can the shares be described?

Ⓐ thirds
Ⓑ halves
Ⓒ eighths
Ⓓ quarters

8. Which shows two ways to divide these wholes into halves?



Ⓐ
Ⓑ
Ⓒ
Ⓓ

Name _____ Diagnostic Test GRADE 2, FORM B

Numbers, Place Value, Money, and Patterns (continued)

Mark the best answer.

9. Which correctly describes the whole?

Ⓐ one half
Ⓑ one third
Ⓒ two halves
Ⓓ three thirds

10. The money Katherine has is shown below.

How much money does Katherine have?

Ⓐ $1.25
Ⓑ $1.85
Ⓒ $1.30
Ⓓ $2.30

11. Ryan has these coins. He wants to buy a candy bar for $1. How much more money does Ryan need?

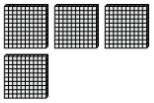
Ⓐ 27¢ Ⓑ 30¢ Ⓒ 37¢ Ⓓ 40¢

Name _____ Diagnostic Test GRADE 2, FORM B

Numbers, Place Value, Money, and Patterns (continued)

Mark the best answer.

12. What number does the model show?



Ⓐ 4
Ⓑ 40
Ⓒ 400
Ⓓ 4,000

13. Which is the number word for 245?

Ⓐ two hundred
Ⓑ forty-five
Ⓒ two-hundred fifty-four
Ⓓ two-hundred forty-five

14. Which comparison is true? Choose all that apply.

Ⓐ 326 > 758
Ⓑ 326 < 758
Ⓒ 326 = 758
Ⓓ 758 > 326

15. Which shows the number 823 in expanded form?

Ⓐ 8 + 2 + 3
Ⓑ 82 + 0 + 3
Ⓒ 80 + 20 + 30
Ⓓ 800 + 20 + 3

Name _____

Diagnostic Test
GRADE 2, FORM B

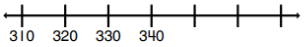
Numbers, Place Value, Money, and Patterns
(continued)

Mark the best answer.

16. What do the digits in the number 364 represent?

Ⓐ 3 hundreds, 6 tens, 4 ones
Ⓑ 6 hundreds, 4 tens, 3 ones
Ⓒ 4 hundreds, 3 tens, 6 ones
Ⓓ 3 hundreds, 4 tens, 6 ones

17. Ben skip counts 310, 320, 330, 340 on this number line. Which numbers should he count next?



Ⓐ 341, 342, 343, 344
Ⓑ 345, 350, 355, 360
Ⓒ 300, 290, 280, 270
Ⓓ 350, 360, 370, 380

Name _____

Diagnostic Test
GRADE 2, FORM B

Basic Facts

Mark the best answer.

18. Which number makes both addition sentences true?

6 + 2 = ___?___
2 + 6 = ___?___

Ⓐ 7
Ⓑ 8
Ⓒ 9
Ⓓ 10

19. Matt and Kelly solve 5 + 3 + 6.

Matt adds 5 + 3 to make an eight, then adds 6.

Kelly adds 3 + 6 to make a nine, then adds 5.

Who finds the correct sum?

Ⓐ Matt
Ⓑ Kelly
Ⓒ Both of them
Ⓓ Neither of them

20. Which fact with 10 can help you solve 7 + 6?

Ⓐ 10 + 3 = 13
Ⓑ 10 + 4 = 14
Ⓒ 10 + 5 = 15
Ⓓ 10 + 6 = 16

21. Clark has some candy.

He gives 3 pieces of candy away.

Now Clark has 12 pieces.

How many pieces of candy did Clark have before?

Ⓐ 6
Ⓑ 9
Ⓒ 12
Ⓓ 15

Name _____

Diagnostic Test
GRADE 2, FORM B

Basic Facts (continued)

Mark the best answer.

22. Look at the picture and number sentence. Which is a related subtraction fact? Choose all that apply.

6 + 5 = 11

Ⓐ 11 − 6 = 5
Ⓑ 11 − 4 = 7
Ⓒ 11 − 5 = 6
Ⓓ 6 − 1 = 5

23. John has ten discs. Three of them are white. The rest are gray. How many gray discs does John have?

Ⓐ 8
Ⓑ 7
Ⓒ 6
Ⓓ 5

24. 12 ants are on a hill. 7 walk away. How many ants are left? Draw a picture if you need to.

12 − 7 = _____

Ⓐ 3
Ⓑ 4
Ⓒ 5
Ⓓ 6

Name _____

Diagnostic Test
GRADE 2, FORM B

Basic Facts (continued)

Mark the best answer.

25. Which facts can help you solve 14 − 9? Choose all that apply.

Ⓐ 11 + 14
Ⓑ 9 + 5
Ⓒ 5 + 9
Ⓓ 14 − 11

26. Which addition sentence matches the array?

Ⓐ 5 + 5 + 5 = 15
Ⓑ 4 + 5 = 9
Ⓒ 4 + 4 + 4 + 4 = 16
Ⓓ 5 + 5 + 5 + 5 = 20

27. Brian, Jack, and Becky are trying to find the addition sentence that matches this array.

Brian wrote 4 + 4 = 8.
Jack wrote 2 + 4 = 6.
Becky wrote 4 + 5 = 9.
Who wrote the addition sentence that matches the array?

Ⓐ Brian
Ⓑ Jack
Ⓒ Becky
Ⓓ All three of them

Name _____

Diagnostic Test
GRADE 2, FORM B

Computation with Whole Numbers

Mark the best answer.

28. Tyrone has 81 cubes. Emma has 12 cubes. How many cubes do they have in all?

71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Ⓐ 69
Ⓑ 83
Ⓒ 91
Ⓓ 93

29. Use snap cubes. Add on to subtract. Which shows the correct answer?

11 + ____ = 34

Ⓐ 13
Ⓑ 19
Ⓒ 23
Ⓓ 32

30. Which number sentence shows 5 tens minus 2 tens?

Ⓐ 50 + 20 = 70
Ⓑ 50 − 20 = 30
Ⓒ 50 − 10 = 40
Ⓓ 50 − 40 = 10

31. Melissa has 58 buttons. 15 of the buttons are yellow. The rest are green. How many green buttons does Melissa have?

41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

Ⓐ 35
Ⓑ 73
Ⓒ 53
Ⓓ 43

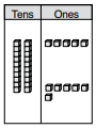
Name _____

Diagnostic Test
GRADE 2, FORM B

Computation with Whole Numbers
(continued)

Mark the best answer.

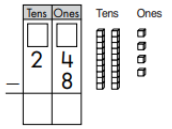
32. Which shows the sum?



25 + 6 = ____

Ⓐ 26
Ⓑ 30
Ⓒ 31
Ⓓ 41

33. Which shows the difference?



Ⓐ 26
Ⓑ 24
Ⓒ 16
Ⓓ 14

34. Which addition sentences can you use to check the subtraction? Choose all that apply.

39
− 12

Ⓐ 27 + 12 = 39
Ⓑ 27 + 39 = 66
Ⓒ 51 = 39 + 12
Ⓓ 39 = 12 + 27

35. Diane scored 20 points in a game. Matthew scored 17 points. Paul scored 26 points. Deb scored 12 points.

How many points did they score in all?

Ⓐ 57
Ⓑ 63
Ⓒ 67
Ⓓ 75

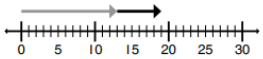
Name _____

Diagnostic Test
GRADE 2, FORM B

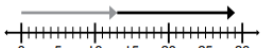
Computation with Whole Numbers
(continued)

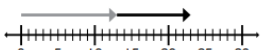
Mark the best answer.

36. Which number line shows 13 + 6?

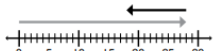
Ⓐ 

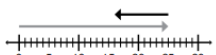
Ⓑ 

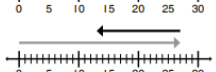
Ⓒ 

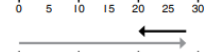
Ⓓ 

37. Which number line shows 25 − 9?

Ⓐ 

Ⓑ 

Ⓒ 

Ⓓ 

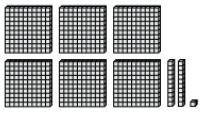
Name _____

Diagnostic Test
GRADE 2, FORM B

Computation with Whole Numbers
(continued)

Mark the best answer.

38. What is 200 less than 621?



Ⓐ 400 Ⓒ 521
Ⓑ 421 Ⓓ 432

39. Find the sum.
You can use models to help. Regroup if you need to.

397
+ 126

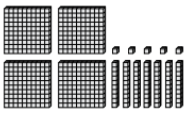
Ⓐ 532 Ⓒ 523
Ⓑ 271 Ⓓ 469

40. Find the difference.
You can use models to help. Regroup if you need to.

562
− 277

Ⓐ 324 Ⓒ 235
Ⓑ 233 Ⓓ 285

41. What is 10 more than 475?



Ⓐ 485 Ⓒ 575
Ⓑ 465 Ⓓ 500

Name _____

Diagnostic Test
GRADE 2, FORM B

Measurement, Geometry, and Data Analysis

Mark the best answer.

42. Steven eats dinner each night at the time shown below.

What time does Steven eat dinner?

Ⓐ 5: 50 A.M. Ⓒ 7: 50 P.M.
Ⓑ 6: 50 P.M. Ⓓ 8: 50 P.M.

43. Use a centimeter ruler. About how long is the dollar?

Ⓐ about 6 centimeters Ⓒ about 4 centimeters
Ⓑ about 5 centimeters Ⓓ about 3 centimeters

44. About how long is the piece of string?

Ⓐ 1 inch Ⓒ $1\frac{1}{4}$ inches
Ⓑ $2\frac{3}{4}$ inch Ⓓ 2 inches

Name _____

Diagnostic Test
GRADE 2, FORM B

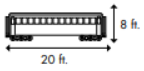
Measurement, Geometry, and Data Analysis
(continued)

Mark the best answer.

45. Rick measures the length of a picture frame in inches and in feet. Which of the following sentences is true?

Ⓐ The picture frame will measure more inches than feet.
Ⓑ The picture frame will measure fewer inches than feet.
Ⓒ The picture frame will measure more feet than inches.
Ⓓ The picture frame will measure the same number of inches and feet.

46. What is the distance around the train car?



Ⓐ 74 ft. Ⓑ 32 ft. Ⓒ 160 ft. Ⓓ 56 ft.

47. Peter has a string that is 43 cm long.
Walter has a string that 26 cm long.
How much longer is Peter's string than Walter's string?

Ⓐ 10 cm Ⓑ 13 cm Ⓒ 17 cm Ⓓ 25 cm

Name _____

Diagnostic Test
GRADE 2, FORM B

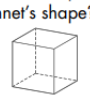
Measurement, Geometry, and Data Analysis
(continued)

Mark the best answer.

48. What would be a good estimate for the length of this carrot?

Ⓐ about 60 inches
Ⓑ about 60 feet
Ⓒ about 6 inches
Ⓓ about 6 feet

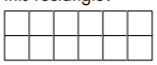
49. Jannet's shape has 6 flat surfaces. It has 8 vertices. Which is Jannet's shape?

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

50. Which shape has 3 sides and 3 vertices?

Ⓐ 
Ⓒ 
Ⓑ 
Ⓓ 

51. How many squares cover this rectangle?



Ⓐ 2
Ⓑ 4
Ⓒ 6
Ⓓ 12

Name _____

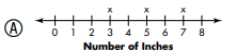
Diagnostic Test
GRADE 2, FORM B

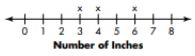
Measurement, Geometry, and Data Analysis
(continued)

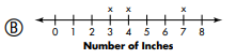
Mark the best answer.

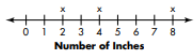
52. Alex measured the length of different pieces of string in his pocket.
He made this chart to show the data.
Which line plot shows the data in Alex's chart?

Alex's Strings	
Color	Length in Inches
Blue	3
Green	7
Yellow	4

Ⓐ 

Ⓒ 

Ⓑ 

Ⓓ 

53. How many ☆ and 🧸 stickers are there in all?

Number Of Stickers	
♡	☺☺☺
☆	☺☺☺☺
🧸	☺☺
🧸	☺
Each ☺ = 1 sticker.	

Ⓐ 6
Ⓑ 4
Ⓒ 5
Ⓓ 3

54. In which game did the team score the greatest number of goals?

Ⓐ Game 1
Ⓑ Game 2
Ⓒ Game 3
Ⓓ Game 4

Name _____

Diagnostic Test
GRADE 2, FORM B

Problem Solving

Mark the best answer.

55. Haley has 21 flowers.
She gives 9 flowers to her friends.
She then picks 3 more flowers.
Which two number sentences show how many flowers Haley has now?

Ⓐ 21 − 9 = 12 and 12 + 3 = 15
Ⓑ 21 + 9 = 30 and 30 − 3 = 27
Ⓒ 21 − 9 = 12 and 12 − 3 = 9
Ⓓ 9 − 3 = 6 and 18 + 6 = 24

56. Karla has 13 roses. She gives 5 to her friend. How many roses does Karla have now? Use counters and a workmat to solve.

Ⓐ 13 + 5 = 18
Ⓑ 13 − 5 = 8
Ⓒ 8 − 5 = 3
Ⓓ 13 − 8 = 5

57. Jason has 17 cars. He gives away 8 cars. How many cars does Jason have left? If Jason buys 4 more cars, how many will he have then? Which two number sentences solve both parts of the problem?

Ⓐ 17 − 8 = 9; 9 − 4 = 5
Ⓑ 17 + 8 = 25; 25 + 4 = 29
Ⓒ 17 − 8 = 9; 9 + 4 = 13
Ⓓ 17 + 8 = 25; 25 − 4 = 21

Name _____

Diagnostic Test
GRADE 2, FORM B

Problem Solving
(continued)

Mark the best answer.

58. Amy's shape has 4 sides, 4 vertices, and 4 angles. Which could be Amy's shape? Choose all that apply.

Ⓐ quadrilateral
Ⓑ triangle
Ⓒ square
Ⓓ hexagon

59. Dan paid 87¢ for 2 items. What did he buy? Try, check, and revise (if necessary) to solve each problem.

Toy Shop	
Item	Price
Truck	74¢
Car	46¢
Whistle	13¢
Yo-yo	21¢

Ⓐ yo-yo and whistle
Ⓑ car and whistle
Ⓒ truck and car
Ⓓ truck and whistle

60. Tara has 7 cards. Then she buys 6 more cards. She buys 3 stamps. How many cards does Tara have in all? Is there enough information to solve? If so, solve the problem.

Ⓐ missing information
Ⓑ 16
Ⓒ 13
Ⓓ 9

(Savvas Learning Company, 2023)

Appendix C

Savvas EnVision Independent Record Form- Grade 2

Student Name _____

Individual Record Form

GRADE 2

		Assessment and Diagnosis			Intervention
	Grade 2 Content	Circle items missed on Test Form A __ or Test Form B __	Proficient Score	Actual Score	Circle Intervention Lessons assigned.
Numbers, Place Value, Money, and Patterns	Numbers and Place Value to 100	1 2 3 4 5	12/17	__/17	A13, A20, A21, A30, A34
	Fractions	6 7 8 9			A48, A49
	Money	10 11			A67, A69
	Greater Numbers, Comparing, and Ordering	12 13 14 15 16 17			A33, A34, A36, A40
Basic Facts	Addition and Subtraction: Basic Facts to 20	18 19 20 21 22 23 24 25	7/10	__/10	B13, B15, B16, B30, B31
	Addition: Equal Groups	26 27			B31
Computation with Whole Numbers	Two-Digit Addition and Subtraction	28 29 30 31 32 33 34 35 36 37	10/14	__/14	C4, C9, C12, C20, C22, C23, C24, C34
	Addition and Subtraction of Greater Numbers	38 39 40 41			C32, C33
Measurement, Geometry, and Data Analysis	Time	42	9/13	__/13	D3
	Length	43 44 45 46 47 48			D5, D9, D13, D14, D16
	Geometry	49 50 51			D19, D37, D40
	Data Analysis	52 53 54			D50, D51, D54
Problem Solving	Problem-Solving Skills and Strategies	55 56 57 58 59 60	4/6	__/6	E1, E2, E4, E14, E18
		Total Score	**42/60**	__/60	

Appendix D

CITI Training Certification

CITI PROGRAM

Completion Date 08-Apr-2023
Expiration Date 08-Apr-2025
Record ID 55321049

This is to certify that:

Alyssa Swartzfager

Not valid for renewal of certification through CME.

Has completed the following CITI Program course:

Human Subjects Research
(Curriculum Group)
Students Conducting No More than Minimal Risk Research
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Slippery Rock University

CITI
Collaborative Institutional Training Initiative

101 NE 3rd Avenue, Suite 320
Fort Lauderdale, FL 33301 US
www.citiprogram.org

Verify at www.citiprogram.org/verify/?wf75be625-332d-441d-8d3c-6678620244a1-55321049

Appendix E

Superintendent Approval Letter

SCHOOL PERMISSION TO CONDUCT RESEARCH

April 6, 2023

Dear Institutional Review Board,

The purpose of this letter is to inform you that I give Mrs. Alyssa Swartzfager, under the direction of Dr. Jeremy Lynch, permission to conduct the research titled, *The Effects of an Interactive Online Learning Platform on 2nd Grade Students' Mathematics Performance* at Elementary School. This also serves as assurance that this school complies with requirements of the Family Educational Rights and Privacy Act (FERPA) and the Protection of Pupil Rights Amendment (PPRA) and will ensure that these requirements are followed in the conduct of this research.

Mrs. Swartzfager will conduct her research within the "Enrichment" scheduled time frame for the first six weeks of the 2023-2024 school year. She will utilize the STAR Math Assessment, along with IXL Learning Math for the 2nd grade students of 2023-2024.

Sincerely,

Mr. Brian Weible

Superintendent

Area School District

Mission Statement: "The School community is committed to providing students with a quality education in preparation for success in a diverse world."
"An Equal Rights and Opportunities School District"

Pride in Character & Success

Appendix F

Parent/Guardian Phone Consent Script

Hello! As you know, I am one of the 2nd grade teachers. I am excited to spend some time with your child over the next year or so. I was wondering if you would give me permission to share your child's IXL Math data with other faculty, educators, and professionals in order to help educational practices in the future and to meet my dissertation requirements through Slippery Rock University. In the fall, I'll hold an intervention class during the Enrichment time period each school day. Within that time, students will be focusing on specific skills they have demonstrated a need for remediation in. If you do not want to participate in the study, no consequences will be put in place. Your child will still be given the IXL Math intervention as this is a typical practice in 2nd grade, I just won't share the information. You or your child may quit the study at any time if desired.

Do you give permission for your child to participate in the study? "yes" or "no"
Thanks so much!

Alyssa Swartzfager

Appendix G

IRB Application Slippery Rock University of Pennsylvania

Appendix G- Assent Script and Parent/Guardian Consent Form

College of Education

SlipperyRock University of Pennsylvania

Approved
5/24/2023
Slippery Rock University
Institutional Review Board

Departments at:
Counseling and Development
Elementary Education/Early Childhood
Physical and Health Education

VOLUNTEER ASSENT TO PARTICPATE IN RESEARCH
IXL Math Intervention in 2nd Grade Students

Alyssa Swartzfager
: Area School District

alm1065@sru.edu

Dr. Jeremy Lynch
Professor of Special Education
Slippery Rock University
Jeremy.lynch@sru.edu

Hello future 2nd grader, do you remember when I gave you that long test and I told you I wanted to see what was easy for you and what we needed to work on in 2nd grade? We are going to start looking at some of those skills as you start 2nd grade. In the Enrichment class, we will be working on all kinds of math skills. I was actually wondering if you would want to participate in a special study I am doing on IXL Math. The name of the study is IXL Math Intervention for 2nd Grade Students. You and your parents would need to give me permission to look at your IXL information and scores. Would you be willing to let me use your scores on IXL Math over the next six weeks to see if it is helping you and some of the other 2nd graders? Everyone in the Enrichment class is going to be using IXL Math, but I want to know if I can use your scores to test how well it works or doesn't work. This study may help you to feel good about helping other kids because we may be able to find out more about IXL and how it works. If IXL If IXL Math does not help your skills, we may be able to find other ways to help you and your classmates. We do not know for sure if you will be helped by being doing IXL but, we could learn something that will help you and other children with their 2nd grade math skills.

Have you ever been frustrated in math. [Yes, me too!] Guess what, I'm going to try to help you to not get frustrated in math. There is a chance that during the research you could feel uncomfortable, challenged, or frustrated. We will take steps to help you with these feelings. You can take a break at any time if you want to. Don't worry, we will work through it and get you back on track to being a STAR student!

After we are done with the study, I'll be able to help other first and second grade students. You can help teachers know if IXL is a good program for kids or not. Do not worry if you don't want to participate in my study. You will still get to work on IXL Math skills during my Enrichment class. I just won't write about it to other students, teachers, and parents. Nobody will be mad if you don't want to be in the research study. You can say okay now, and you can change your mind later. Just tell me or your parents if you want to stop at any time. Do you have any questions?

Do you want to participate in the study?

Please check one box:

☐ Yes, I want to be in the study and understand I can change my mind later.

☐ No, I do not want to be in this study.

Child's Name: _____ **Date:** _____

Child's Signature: _____

The following should be completed by the Principal Co-Investigator conducting the assent process if the child agrees to be in the study. Check all that apply.

☐ The child is capable of understanding the assent form script and has signed above as documentation of assent to take part in the study.

☐ The child is not capable of reading the assent form script, but the information was verbally explained and signed as documentation of assent to take part in the study.

☐ The child had ample opportunity to have his/her questions answered.

Principal Co-Investigator: Alyssa Swartzfager **Date:** 5/17/23

Signature of Principal Co-Investigator: Alyssa Swartzfager

SlipperyRock University of Pennsylvania

Approved
5/24/2023
Slippery Rock University
Institutional Review Board

PARENT/GUARDIAN CONSENT TO PARTICPATE IN RESEARCH

THE EFFECTS OF AN INTERACTIVE ONLINE LEARNING PLATFORM ON 2ND GRADE STUDENTS' MATHEMATICS PERFORMANCE

Mrs. Alyssa Swartzfager
PA
Alm1065@sru.edu

Dr. Jeremy Lynch
Professor of Special Education
Slippery Rock University
Jeremy.lynch@sru.edu, 724-738-2463

Invitation to be Part of a Research Study

As we prepare for your student's 2nd grade year, I would like to do a quick study on some math programs we currently use in the district. I would like to invite your student to participate. I have done a quick assessment with students preparing for 2nd grade and wish to invite them to participate in the study with your permission. The study will take place the first six weeks of the 2nd grade year, 2023-2024. This is an optional study and there is no pressure for you to agree.

Important Information about the Research Study

Things you should know:

- The purpose of the study is to examine IXL Learning as an intervention for mathematics skills with 2nd grade students. All students in the 2nd grade Enrichment class will be asked to complete IXL Math skills at the start of the year. The study is scheduled to start the first day of school and end in early October of 2023.
- The study will provide skills practices, encourage students to set goals, and hopefully, improve math skills. Your student may benefit from this intervention even if you choose to not let me use their data for this study. But, if you do let me use their data, it may help us make better choices when helping students like yours to improve their math skills in future practices.
- Taking part in this research project is voluntary. Your student does not have to participate, or they can stop at any time. All students in 2nd grade will receive mathematical intervention for their targeted skills whether they participate in this study or not. Please take time to read this form and ask questions before deciding whether to allow your student to take part in this research project.

What is the Study About and Why are We Doing it?

The purpose of the study is to see if IXL Learning helps students to grow their math skills in 2nd grade. The goal of any intervention is to support student success in grade level skills, especially for students

who may struggle. Improving teaching practices is one of the benefits of this project. Research-based practices can help us improve interventions in elementary school. That is the goal of this study.

What Will Happen if Your Student Takes Part in This Study?

All 2nd grade students will use IXL Math as intervention in 2nd grade. IXL has been shown to help some students with their math skills. If you let your student participate in the study, I will be allowed to share their data, but not their name, with other teachers, administrators, and researchers through some presentations and articles on the study. During the Enrichment time each day, 2nd grade students will work on IXL Math skills. The fifth day will be an electronic free day where students will take a break from the specific skills of the study and the computer-based instruction. At the end of the six-week study, participants will be asked to complete the EnVision 2nd Grade Mathematics Diagnostic Assessment Form B. The study should end in October. Information collected from this study will be compared to current research on COVID-19's effects on education and other possible reasons for struggling math skills in second grade. You will have access to your student's documents upon request throughout the study. At the end of the study, student paperwork will be shredded for student privacy.

How Could Your Student Benefit From This Study?

All students will participate in IXL Math during the 2nd grade year. We hope using IXL will improve their math skills. If we are able to study IXL Math, our teaching practices may be improved. If IXL Learning improves students' scores, IXL may be considered an effective intervention that could be used to help other students. Your student may benefit from being in this study because of the continuous math practice on tough skills and in their ability to set and work towards their own goals. If we find that IXL does not work as well as we hoped, your student may benefit from another intervention that is better.

How Will We Protect Your Student's Information?

I plan to publish the results of this study including student scores and IXL data collection. To protect your student's privacy, I will not include any information that could directly identify your student. Specific names will not be published, and all documents will be shredded at the conclusion of the study and publication.

I will protect the confidentiality of your student's records by numbering your student rather than naming them within the results. Your student's name and any other identifying information will be stored separately from the data published.

What Will Happen to the Information We Collect About Your Student After the Study is Over?

I will **NOT** keep your student's research for future projects or other purposes. Your student's name and other information that can directly identify your student will be kept secure and stored separately from the research data collected as part of the project. Confidential information will be deleted/shredded from the research data at the conclusion of the study.

What Choice Does Your Student Have if They Don't Take Part in this Study?

If you choose to not allow us to use your student's data, your student will still participate in the Enrichment intervention time frame scheduled by administration during the 2023-2024 school year. Your student will still be given the diagnostic assessments and IXL Math interventions, as they are common practices within 2nd grade. I just won't include their scores in the study.

Your Student's Participation in this Research is Voluntary

It is totally up to you and your student to participate in this study. Participating in this study is voluntary. Even if you or your student decide to be part of the study now, you both may change your mind and stop at any time. If your student decides to withdraw before this study is completed, all documents will be shredded and deleted from data collection. If a student is identified as requiring special education services during the six-week intervention time frame, they will be excluded from the study. Alternative special education services will replace the IXL Math intervention practices. If a student moves school districts within the six-week intervention time frame, their data will be shredded/deleted and excluded from the study.

Contact Information for Questions about Your Student's Rights as a Research Participant

If you have questions about your student's rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the following:

Institutional Review Board
Slippery Rock University
104 Maltby, Suite 302
Slippery Rock, PA 16057
Phone: (724)738-4846
Email: irb@sru.edu

Contact Information for the Study Team and Questions about the Research

If you have questions about this research, you may contact me at 814- , ext. 110, or alm1065@sru.edu.

Thank you for your time and consideration!

Mrs. Alyssa Swartzfager
2nd Grade Teacher
Elementary

Dr. Jeremy Lynch
Professor of Special Education
Slippery Rock University

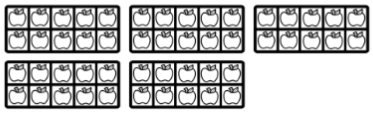
Appendix H

Researcher Created Weekly Assessments

Assessment #1

Name_____ Date_____

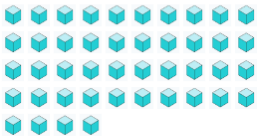
1. Count by 10s. How many apples are there in all?



a. 20
b. 90
c. 50
d. 70

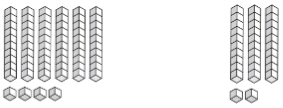
2. Which number completes the sentence?

44 is ___?____ groups of 10 and 4 left over.



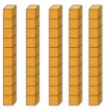
a. 1
b. 2
c. 3
d. 4

3. Derek has 64 candies. Joe has 32 candies. Which correctly compares the number of candies Derek and Joe have?



a. 64 = 32
b. 64 > 32
c. 32 > 64
d. 64 < 32

4. Count by 10s. Which number completes the sentence?
5 tens is __?__.



a. 55
b. 25
c. 50
d. 5

5. Allen is counting forward by 1s. He has counted to 40. Which are the next 5 numbers he counts?

a. 41, 42, 43, 45, 46
b. 45, 50, 55, 60, 65
c. 41, 42, 43, 44, 45
d. 45, 46, 47, 48, 49

6. Sue is thinking of a number. It has 3 ones. It has 6 tens. Which number is Sue thinking of?

a. 6
b. 3
c. 63
d. 36

7. Which number is 10 and 2 ones?

a. 12
b. 21
c. 22
d. 102

Assessment #2

Name_____ Date_____

1. Count by 10s. How many apples are there in all?

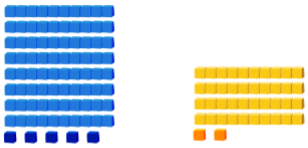
a. 20
b. 30
c. 50
d. 70

2. Which number completes the sentence?

23 is ___?____ groups of 10 and 3 left over.

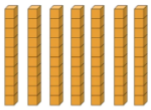
a. 1
b. 2
c. 3
d. 4

3. Mia has 85 puzzles. Janet has 42 puzzles. Which correctly compares the number of puzzles Mia and Janet have?



a. 85 = 85
b. 42 > 85
c. 88 > 89
d. 83 < 42

4. Count by 10s. Which number completes the sentence?
7 tens is __?__.



a. 77
b. 57
c. 70
d. 7

5. Hannah is counting forward by 1s. She has counted to 62. Which are the next 5 numbers she counts?

a. 61, 60, 59, 58, 57
b. 65, 70, 75, 80, 85
c. 62, 72, 82, 92, 102
d. 63, 64, 65, 66, 67

6. Bill is thinking of a number. It has 7 ones. It has 1 tens. Which number is Bill thinking of?

a. 71
b. 7
c. 17
d. 710

7. Which number is 10 and 9 ones?

a. 99
b. 91
c. 19
d. 109

Assessment #3

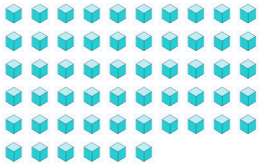
Name_____ Date_____

1. Count by 10s. How many apples are there in all?

a. 20
b. 80
c. 50
d. 70

2. Which number completes the sentence?

56 is ___?____ groups of 10 and 6 left over.

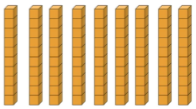


a. 6
b. 5
c. 3
d. 4

3. John has 42 grapes. Randy has 57 grapes. Which correctly compares the number of grapes they have?

a. 42 = 57
b. 42 > 57
c. 57 > 42
d. 75 < 42

4. Count by 10s. Which number completes the sentence?
9 tens is __?__.



a. 90
b. 99
c. 19
d. 9

5. Rich is counting forward by 1s. He has counted to 76. Which are the next 5 numbers he counts?

a. 77, 78, 79, 80, 81
b. 76, 75, 74, 73, 72
c. 74, 75, 76, 77, 78
d. 63, 64, 65, 66, 67

6. Mike is thinking of a number. It has 3 ones. It has 4 tens. Which number is he thinking of?

a. 340
b. 7
c. 43
d. 34

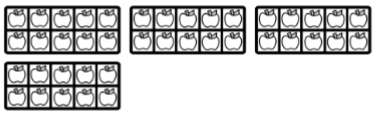
7. Which number is 10 and 1 ones?

a. 101
b. 1
c. 11
d. 111

Assessment #4

Name_____ Date_____

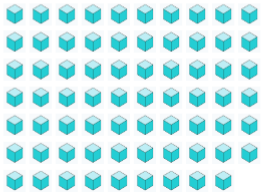
1. Count by 10s. How many apples are there in all?



a. 20
b. 40
c. 50
d. 70

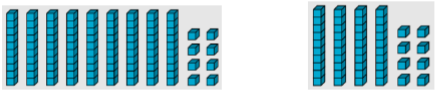
2. Which number completes the sentence?

69 is ___?____ groups of 10 and 9 left over.



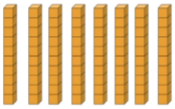
a. 6
b. 5
c. 7
d. 4

3. Mia has 98 cookies. Maddock has 48 cookies. Which correctly compares the number of cookies they have?



a. 98 = 48
b. 98 > 48
c. 48 > 98
d. 84 < 84

4. Count by 10s. Which number completes the sentence?
8 tens is __?__.



a. 90
b. 88
c. 18
d. 80

5. Dave is counting forward by 1s. He has counted to 37. Which are the next 5 numbers he counts?

a. 38, 39, 40, 41, 42
b. 36, 35, 34, 33, 32
c. 34, 35, 36, 37, 38
d. 33, 34, 35, 36, 37

6. Shane is thinking of a number. It has 8 ones. It has 7 tens. Which number is he thinking of?

a. 87
b. 78
c. 870
d. 807

7. Which number is 10 and 2 ones?

a. 102
b. 1
c. 12
d. 112

Assessment #5

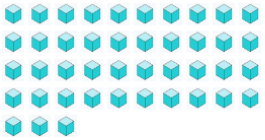
Name_____ Date_____

1. Count by 10s. How many apples are there in all?

a. 20
b. 40
c. 50
d. 70

2. Which number completes the sentence?

43 is ___?____ groups of 10 and 3 left over.



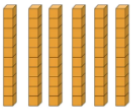
a. 6
b. 5
c. 7
d. 4

3. Elena has 24 cookies. Sam has 48 cookies. Which correctly compares the number of cookies they have?

a. 24 = 48
b. 24 > 48
c. 48 > 24
d. 84 < 24

4. Count by 10s. Which number completes the sentence?
6 tens is __?__.

a. 70
b. 66
c. 60
d. 6



5. Robert is counting forward by 1s. He has counted to 89. Which are the next 5 numbers he counts?

a. 38, 39, 40, 41, 42
b. 96, 95, 94, 93, 92
c. 90, 91, 92, 93, 94
d. 93, 94, 95, 96, 97

6. Wayne is thinking of a number. It has 3 ones. It has 7 tens. Which number is he thinking of?

a. 37
b. 73
c. 370
d. 307

7. Which number is 10 and 4 ones?

a. 104
b. 41
c. 14
d. 114

Assessment #6

Name_____ Date_____

1. Count by 10s. How many apples are there in all?

a. 20
b. 40
c. 50
d. 30

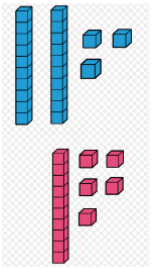
2. Which number completes the sentence?

22 is ___?____ groups of 10 and 2 left over.

a. 2
b. 3
c. 22
d. 4

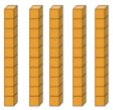
3. Toni has 23 doughnuts. Karen has 15 doughnuts. Which correctly compares the number of doughnuts they have?

a. 23 = 15
b. 23 > 15
c. 15 > 23
d. 84 < 23



4. Count by 10s. Which number completes the sentence?
5 tens is __?__.

a. 50
b. 56
c. 55
d. 5



5. Jayden is counting forward by 1s. He has counted to 70. Which are the next 5 numbers he counts?

a. 71, 72, 73, 74, 75
b. 69, 68, 67, 66, 65
c. 70, 71, 72, 73, 74
d. 73, 74, 75, 76, 77

6. Josh is thinking of a number. It has 4 ones. It has 9 tens. Which number is he thinking of?

a. 49
b. 94
c. 490
d. 940

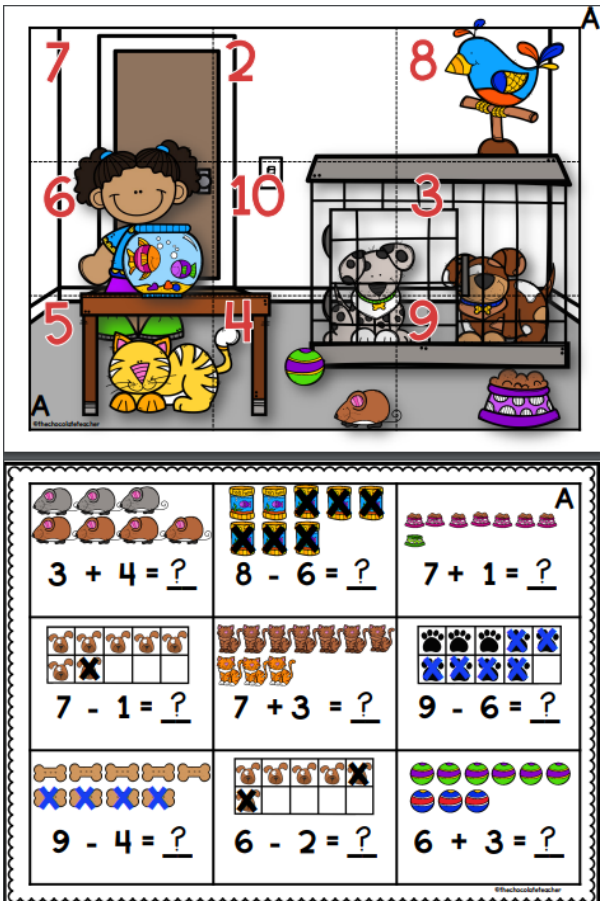
7. Which number is 10 and 8 ones?

a. 108
b. 81
c. 18
d. 118

Appendix I

Games and Puzzles

	
Researcher-Created Ice Cream Addition- Students were encouraged to stack the ice cream scoops on top of the cone in small groups of up to three students. As they were able to stack the scoops, students were to add the numbers written on the scoops. Some groups were able to add two numbers, three numbers, four numbers, or even five numbers, depending on how steady their stack of ice cream scoops were before they tumbled.	Researcher-Created Addition Mini-Bowling- Students were encouraged to use the mini bowling ball to knock down as many pins as they could. Students would then add up the numbers written on the bowling pins that they knocked down. Students could add up to nine single-digit numbers at a time in a small group of up to three students.



Basic Fact Puzzle (The Chocolate Teacher, 2021)-

Students were encouraged to solve the addition facts first, then glue the matching card with the appropriate sum on top of the fact worksheet. This created the pet shop animal picture. Puzzle pieces were cut out and mixed up prior to student engagement to create difficulty. This activity was utilized during the four-day week of the study, as students were assessed and engaged in the puzzle activity within the same day to meet the study's schedule expectations.