2023

Instructional Practices Teachers Use to Improve Elementary School Students' Mathematics Achievement

Kwanza Lee Atkinson
Walden University

Walden University

College of Education and Human Sciences

This is to certify that the doctoral study by

Kwanza. L. Atkinson

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Kimberley Alkins, Committee Chairperson, Education Faculty
Dr. Mary Howe, Committee Member, Education Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2023

Abstract

Instructional Practices Teachers Use to Improve Elementary School Students' Mathematics Achievement

by

Kwanza. L. Atkinson

EdS, Nova Southeastern University, 2011

MA, Central Michigan University, 2009

BS, University of West Georgia, 2006

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

October 2023

Abstract

Since 2016, third to fifth-grade students at a Title I elementary school have not met adequate yearly progress because 70% of students have not scored proficient on the end-of-grade mathematics assessment. The purpose of this qualitative case study was to explore the instructional approaches that elementary school teachers use to teach mathematics to students at the Title I school and to investigate which instructional strategies teachers believed to be the most effective in improving mathematics test scores. This study was grounded in social constructivism, based on the impression that the individual creates knowledge based on mental ability. Data for this study consisted of interviews with 10 third- to fifth-grade mathematics teachers and one instructional lead teacher from a Title I elementary school and the review of two lesson plans from each participant except the lead teacher. The interviews were analyzed by coding the unstructured text, leading to two themes: Grade 3-5 mathematics teachers used the Concrete Representational Abstract (CRA) model and Universal Design for Learning (UDL) approach to teach elementary students and Grade 3-5 mathematics teachers used differentiation, experiential learning, mnemonics, and mathematics fluency to teach elementary students. The lesson plans aligned with the themes. Teachers wanted more professional development in effective district-recommended mathematics strategies to improve students' mathematics achievement. A 3-day professional development training was designed to strengthen the mathematics instructional strategies mentioned by participants in this study. This study may contribute to the school district by providing useful information to administrators and teachers seeking effective mathematics instruction techniques to improve student achievement.

Instructional Practices Teachers Use to Improve Elementary School Students' Mathematics Achievement

by

Kwanza. L. Atkinson

Ed. S, Nova Southeastern University, 2011

BS, University of West Georgia, 2006

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

October 2023

Table of Contents

List of Tables

Section 1: The Problem

The primary objective of teaching mathematics is to give students the fundamentals to succeed in their education and careers (Baker & Cuevas, 2018). Students who can develop an understanding of mathematics are likely to succeed in the subject (Hima et al., 2019). Long et al. (2020) stated that using innovative teaching approaches helps students to promote the development needed to help them process the knowledge being learned. Peng and Lin (2019) considered mathematics vocabulary a single component in a student's success in mathematics. According to Lin et al. (2021), higher-order mathematics activities that required students to use multistep procedures showed a stronger correlation with mathematics vocabulary and students' mathematics performance.

Additionally, Berrett and Carter (2018) noted that elementary students might perform poorly in mathematics due to a lack of proficiency in mathematics fact fluency. Students who struggle to master mathematics fact fluency after fifth grade are doubtful to develop automaticity in future grades (Berrett & Carter, 2018). Students who are provided computer-aided instruction in mathematics fluency have a better chance of success in mathematics (Lindeman, 2019). The computer-assisted instruction differentiates the instruction at the learner's level, offers additional practice, and enhances the learner's interest (Lindeman, 2019). Elementary students showed deficits in mathematics fluency but with the aid of computer-based instruction in mathematics fluency growth in the area showed potential growth.

The Local Problem

The Problem

The problem addressed through this study was that since 2016 third to fifth-grade students at a Title I elementary school, Hickory Low Elementary School (HLES; pseudonym), have not met adequate yearly progress because 70% of students have not scored proficient on the end of grade mathematics assessment. At HLES, during the 2016-2017 school year, 39% of third- fifth-grade students were proficient on the end-of-grade mathematics assessment (Georgia Department of Education, 2019b). This percentage was below the mandated average of 70% (Georgia Department of Education, 2019b). During this school year, 61% of HLES students scored below proficient in mathematics. For the 2017-2018 school year, 56% of students scored below proficient in mathematics, and for the 2018-2019 school year, 58% scored below proficient in mathematics (Georgia Department of Education, 2019b). Although the percentage of students below proficiency has decreased over the years, there is still concern that the percentage of proficient students is below the mandated 70%.

Low mathematics scores have affected students, teachers, and administrators because students cannot move to the next grade level if they cannot improve their mathematics test scores. Students were required to score in the 70th percentile in the school district (Georgia Department of Education, 2019b). This requirement has affected educators because school funding has been reduced due to low test scores. This reduction has led to schools not having enough money to fund vital academic programs to increase student achievement. Teachers are held accountable for students' low scores and placed

on a professional development plan if student performance is low on standardized mathematics tests (Georgia Department of Education, 2020). For example, teachers have been viewed as incompetent when they fail to teach students the mathematics skills they need to achieve academically. The HLES school improvement plan related to mathematics for third through fifth-grade students was to show a 6% growth on the Georgia Milestones Assessment System for the 2018-2019 school year (Georgia Department of Education, 2019b). For the 2016-2017 school year, 61% of students scored below proficiency in mathematics and 56% scored below proficiency in 2017-2018. During the 2018-2019 school year, 58% scored below proficiency in mathematics. There was a 3% percentage increase from 2016-2017 to the 2018-2019 academic year.

Addressing the Problem

HLES, a Title I school of 476 students in Grades K-5, uses tutoring and a mathematics software called iLearn Math to increase student mathematics scores. iLearn Math is an online system for supplementing mathematics instruction for students in Grades 1 through 9 in mathematics, with a complete Algebra I course for ninth grade (Hardman & Lilley, 2023). iLearn Math is offered only to Title I schools in the local district as a supplemental mathematics tool. The school district purchased the software to help Title I schools improve scores on end-of-the-year assessments. The mathematics software was introduced at HLES during the 2016-2017 school year. Since the program's implementation during the 2016-2017 school year, HLES has shown a 3% increase in students who score at or above proficiency in mathematics. According to an HLES administrator on March 15, 2018:

> Although iLearn has been provided as a supplemental tool to help students improve their mathematics problem-solving skills, there is still a concern in the limited primary resources available to help teachers when creating lessons with effective research-based instructional strategies delivered during lessons.

To improve students' mathematic scores, the school district offered various mathematics workshops that all elementary school teachers, including HLES teachers, were required to attend.

In the workshops, teachers are taught how to teach mathematics, especially to students whose native language is not English. The workshops provided teachers with performance task assignments, such as teaching students how to use mathematics in real-world situations. For instance, when teaching students how to determine the area of an object, teachers presented tasks related to a house redesign. At the workshops, teachers learned how to teach students how to find the dimensions of walls and the size of windows to determine how much space is left for the wallpaper. These workshops aimed to guide teachers in engaging students in conversations about mathematics problems and have them describe why they solved a problem in a certain way (Georgia Department of Education, 2019b). Exploring the instructional strategies that elementary school teachers used in teaching mathematics to students at HLES prepared them to improve students' achievement in mathematics to assist teachers and administrators in reaching their goal of improving mathematics test scores on the end-of-the-year assessment by 6%.

The Problem in the Larger Context

Low mathematics scores indicated third- to fifth-grade elementary school students' mathematics scores in a Georgia school district failing to meet the mandated state standard of a passing score of 70% or greater in mathematics since 2016. In 2013, Georgia's fourth graders demonstrated a mathematics score of 210 on a 0-to-500 scale on the Georgia Milestones Assessment System (Georgia Department of Education, 2019b). In 2016, eighth-grade students in Georgia earned a mathematics score of 245, below the U.S. average of 274 (Georgia Department of Education, 2019b). Other reports indicated that third to fifth-grade elementary school students in Georgia performed under 59% and did not meet the standard set for an end-of-course test after they took a new algebra course connected to the common core (Georgia Department of Education, 2019b).

In 2018, the U.S. average mathematics score was below the Organization for Economic Co-operation and Development (OECD) average at 478, with the OECD average at 489 (OECD, 2018). Seventy-three percent of U.S. students scored at a Level 2 or higher in mathematics, 4% lower than the OECD average of 76% (OECD, 2018). Level 2 students could solve simple mathematical situations. In the United States, 8% of students scored at a Level 5 or higher in mathematics, 3% lower than the OECD average of 11% (OECD, 2018). The OECD stated that students who scored at a Level 5 or higher could solve complex mathematical situations using problem-solving strategies. Countries that outscored U.S. students in mathematics in 2018 included Hong Kong, parts of China, the Republic of Korea, and Singapore (OECD, 2018). Educators, researchers, and

policymakers have increased their attention and concerns about the quality of U.S. mathematics education compared to other countries (W. Wang et al., 2018).

Rationale

The problem addressed through this study is that since 2016 third to fifth-grade students at a Title I elementary school have not met adequate yearly progress because 70% of students have not scored proficient on the end-of-grade mathematics assessment. Teachers and administrators at HLES, a Title I school serving K-5 students, were concerned that third to fifth-grade elementary school students' mathematics scores since 2016 have failed to meet the mandated state standard in mathematics. Examining the lack of proficiency by third to fifth-grade students at HLES is worthy of examining based on the limited improvement being met since 2016.

During a conversation with an HLES administrator on March 15, 2018, the administrator stated that:

> The lack of primary resources available for teachers in mathematics to create lesson plans is stressful. Given that test scores have been lower than the state-mandated 70% proficiency, teachers are consistently searching for effective research-based instructional strategies to teach mathematics content.

The local school district proposed in the school improvement plan to address the lack of progress shown since 2016 by setting a goal of 6% growth in mathematics each year on the end-of-the-year assessment. While the school came close to that mark with 5% growth from 2016-2017 to the 2017-2018 school year, the growth decreased to 2% from the academic years 2017-2018 to 2018-2019. The purpose of this case study was to

explore the instructional approaches that elementary school teachers use to teach mathematics to students at the Title I school and to investigate which instructional strategies teachers believed to be the most effective in improving mathematics test scores. This study may provide first-hand insight from teachers to help other third to fifth-grade teachers improve their instructional strategies in mathematics.

Definition of Terms

Content knowledge: Principles, facts, theories, and concepts taught and learned in specific academic (Liggett, 2017; W. Wang et al., 2018).

Elementary school: Refers to a school designed for students who are in Grades 1-5 and, in some cases, for students who are also in kindergarten (Georgia Department of Education, 2019a).

Pedagogy knowledge: Refers to teachers' knowledge about the processes and methods used for teaching students (Lee et al., 2018).

Students' academic performance: This term refers to the degree to which students have attained their academic goals (Macdonald et al., 2020).

Significance of the Study

Although third to fifth-grade students at HLES have failed to meet the mandated state standard of 70%, exploring the instructional strategies teachers use when teaching mathematics provided insight into why the mandated standard has not been met. Charalambous et al. (2020) found that teacher knowledge positively influences student achievement gains in mathematics achievement. With only 58% of third to fifth-grade students at HLES meeting the state standard in mathematics on standardized tests in the

2018-2019 school year, this was significantly lower than the 70% mandated by the state. Educators and teachers needed to provide students with the mathematical resources they needed in class to help them excel in mathematics tests and assignments. Althauser (2018) stated that due to unsuccessful amendments in mathematics education, teachers focus on teaching mathematics content that is most comfortable to them, and U.S. teachers lack the necessary knowledge for teaching mathematics. Simply teaching students random mathematical information will not help them much but teaching them how to use critical thinking and real-world mathematics application helps to better prepare students for the future (Benson-O'Connor et al., 2019). When students are given real-life mathematical problems, a deeper connection is made, and growth is shown in the students' mathematical understanding (Benson-O'Connor et al., 2019).

Research Questions

Teachers and administrators at HLES, a Title I school serving K-5 students, were concerned that third to fifth-grade elementary school students' mathematics scores for the past 3 years have failed to meet the mandated state mathematics standards. The purpose of this case study was to explore the instructional approaches that elementary school teachers use to teach mathematics to students at the Title I school and to investigate which instructional strategies teachers believed to be the most effective in improving mathematics test scores. The following research questions are derived from the problem statement and attached to the purpose statement.

RQ1: What instructional approaches do teachers use when teaching mathematics to HLES students?

RQ2: What instructional strategies do HLES teachers use and believe are most effective for teaching mathematics to students to improve mathematics test scores?

Review of the Literature

This literature review focuses on the problem addressed in this qualitative study of how teachers and administrators at HLES, a Title I school serving K-5 students, were concerned that third to fifth-grade elementary school students' mathematics scores since 2016 have failed to meet the mandated state standard in mathematics. Third to fifth-grade elementary school students' mathematics scores during the 2016-2017 school year were 39% proficient. This percentage was below the mandated average of 70%. During this school year, 61% of students scored below proficient in mathematics. For the 2017-2018 school year, 53% of students scored below proficient in mathematics, and for the 2018-2019 school year, 49% scored below proficient in mathematics (Georgia Department of Education, 2019b).

The review of literature related to this qualitative study presents an overview of the conceptual framework and the topics related to elementary mathematics achievement. While researching the broader problem, I researched the following key terms to define better the search results: *mathematics achievement*, *mathematics conceptual knowledge*, *mathematics instructional practices*, *knowledge of curriculum-embedded mathematics*, *mathematics problem-solving approach*, and *mathematics content knowledge.* I conducted literature research by using research databases, such as ERIC, ProQuest, Google Scholar, and Education Research Complete, and found 61 sources ranging from 1978 to 2020. Most of the older sources were used to support the conceptual framework.

By entering *social constructivism theory, mathematics achievement, mathematics conceptual knowledge, mathematics instructional practices, knowledge of curriculum embedded mathematics framework, mathematics problem-solving approach,* and *mathematics content knowledge in the databases,* specific journals were provided which contributed to this study.

Conceptual Framework

The conceptual framework for this study was *the social constructivism theory* (Vygotsky, 1978, 1987). Vygotsky (1978,1987) described social constructivism as based on the impression that the individual creates knowledge based on mental ability. Vygotsky, considered by many to be the founder of the social constructivism theory, believed a child internalizes external and social encounters, including communication, with more experienced activities (Steiner, 2014). While social speech is internalized in adulthood, Vygotsky struggled with the concept that it still preserves its essential collaborative character (Riegler & Steffe, 2014).

Cottone (2017) found that individuals who construct new knowledge from their experiences rather than depending on knowledge from outside resources were more successful in the classroom. These experiences with the environment and others make the knowledge more relevant (Cottone, 2017). Gupta (2008) conducted a study to determine if peer collaboration influences student achievement in elementary mathematics. In the elementary setting, Gupta found that peer collaboration is an extension of instruction, not a replacement. The explanation of the social constructivism theory as it relates to learning is that learners develop knowledge through socially interacting with other humans,

experiences, phenomena, and the environment (Kusuma et al., 2021). Wood et al. (2012) stated mathematics is useful when it is a cognitive activity; it is useful to see mathematics as both a cognitive activity reserved by social and cultural practices and a sociocultural experience created by a community of active persons. Each process serves as the background against which the other is created.

The logical connection between the framework's key elements is that learning can be accomplished based on how one views and understands the information they are learning about (Cottone, 2017). Panthi and Belbase (2017) stated that teachers might not be trained to apply social and radical constructivism theories in teaching mathematics. Due to this lack of training, there is a lack of instructional materials and aids, and technological tools to encourage students to construct new knowledge from their experiences individually or in heterogeneous groups (Cottone, 2017). Because third to fifth-grade elementary students are still in their formative years in which they are learning how to make sense of the world around them, they can use their mental faculties to visualize how to respond to mathematical problems (Panthi & Belbase, 2017).

Social and radical constructivism can be achieved through visual aids in class that relate to something, or activities students are familiar with. Then teachers can use such examples to teach students how to respond to the various mathematical problems they present in the academic classroom. Newton et al. (2012) examined the relationship between mathematics content knowledge and teachers' ability to deliver instruction effectively. A positive association between content knowledge and teaching efficacy was found in the conclusion of the study. Throughout the study, the researchers gained a

better understanding of teachers' mathematical approach by receiving their perspectives through individual interviews (Newton et al., 2012). Skaalvik et al. (2015) described mathematics achievement as achieved when students become self-sufficient and internally motivated to become problem solvers. In Skaalvik et al.'s study, mathematics achievement also relied on the support of teachers who were confident in their content knowledge to provide effective mathematics instruction. Therefore, it is important to determine how teachers of third to fifth-grade elementary students describe their instructional practice in teaching mathematics.

Social constructivist theorists such as Vygotsky (1987) maintained that learning is an active and constant process that transpires through interactions. Lacy (2019) posited that learning alters the learners' wish to learn, and Hyslop-Margison and Strobel (2008) maintained that the learner's motivation has intrinsic and extrinsic origins. Intrinsic motivation is created through inquisitiveness about the world, and extrinsic motivation is created by the return one receives when knowledge is gained. Using the social constructivism theory to assess teachers' instructional practices to improve elementary school students' mathematics achievement allowed me to examine how individuals build new knowledge from their experiences instead of acquiring new knowledge from external influences.

Review of the Broader Problem

In this study, I aimed to explore the instructional approaches that elementary school teachers use to teach mathematics to Title I students and investigate which instructional strategies teachers believed to be the most effective in improving

mathematics test scores. In this review of the broader problem, I explored the following topics: mathematics achievement, mathematics conceptual knowledge, mathematics instructional practices, knowledge of curriculum-embedded mathematics framework, mathematics problem-solving approach, and mathematics content knowledge. The broader review helped me gain insight into the current research on the factors that influence mathematics instruction and the potential disparities in instructional practices at the site where this study occurred.

Mathematics Achievement

Iglesias-Sarmiento et al. (2020) described mathematics achievement as when children can simultaneously process, count, process numbers, and comprehend concepts taught in mathematics. To solve problems, students must understand the steps and carry out simple calculations (Hajovsky et al., 2020). Students must decide which mathematical operation to choose and which data to use to solve mathematical calculations (Hajovsky et al., 2020). These studies supported the importance of students gaining mathematics competency at an early age to help them to be successful in mathematics in elementary education.

Meiri et al. (2019) described mathematics fluency as automatically reading and answering mathematics questions. A case study of 104 elementary-aged students was conducted to determine how well mathematical fluency influenced success in their classrooms. This study supported the concept that mathematical fact fluency promotes success in mathematics, as students must have a solid foundation of mathematics facts that stem from fact fluency. With time and exposure, students can recall basic operational

mathematics facts, deepening their understanding of higher-order mathematics skills (Meiri et al., 2019).

Maghfirah and Mahmudi (2018) described number sense as a person's common comprehension of numbers and flexibility in using numbers to solve operations to make reasonable mathematical judgments. Mathematics achievement is determined by how students process the mathematics procedures to solve problems. For students to comprehend concepts, they must understand mathematics conceptual knowledge.

Mathematics Conceptual Knowledge

For decades there has been a debate surrounding the conceptual and procedural knowledge in mathematics. Questions concerning how students learn mathematics, and especially about how incorporating higher-order thinking problems in mathematics lessons is more important (Lee et al., 2018). Lee et al. (2018) described conceptual knowledge in mathematics as prior knowledge that can be transferred to new knowledge to influence students' mathematical academic achievement. Paul et al. (2018) believed mathematics and reading abilities could help to alleviate doubts about individuals' cognitive abilities in key primary mathematics skills. Conceptual knowledge is characterized by an abstract or generic idea that is generalized by comprehending mathematical concepts, operations, and relations (Rittle-Johnson, 2019). Rittle-Johnson (2019) also described conceptual knowledge as requiring knowledge of countless concepts to lead to understanding how to solve mathematical tasks. Students with conceptual mathematics knowledge can solve problems by applying their understanding of operations with whole numbers.

Mathematics Instructional Practices

Merritt et al. (2017) described the instructional practices used by two highly effective teachers in their classrooms. The researchers used quantitative data to pick two fifth-grade classrooms. The students selected were average-performing and made great gains on mathematics achievement tests. The scores and teaching practices were then examined and presented in each classroom. The results suggested that multiple demonstrations of mathematics concepts, vocabulary building, checking for understanding in individual and small groups, and error analysis were dominant practices in both classrooms where high gains were made. Charalambous and Delaney (2019) stated that engaging students in theoretical practices which influence them to share their ideas and analyze others' ideas to further their understanding of mathematical concepts is critical to students' achievement. Encouraging this form of mathematical community within instructional practices develops and encourages the use of appropriate mathematical vocabulary. Educators use mnemonics to bridge a learning gap that many students exhibit because, at times, there seems to be a difference in learning styles between the teacher and the student (Farrokh et al., 2021). Teachers influence students' mathematics achievement when repeated exposure to practice-based pedagogies is demonstrated in the classroom (Charalambous & Delaney, 2019).

Differentiation is a unique form of educating students to ensure they are taught concepts at their learning level (Tomlinson et al., 2003). There are numerous ways to differentiate a lesson, but teachers must understand and implement effective instructional strategies to best support all students. Differentiated instruction allows teachers to modify

curriculum, instructional practices, learning tasks, and student resources to address the needs of students using individual and small group settings to capitalize on students' learning opportunities in classrooms (Tomlinson et al., 2003). Anthony et al. (2019) argued that differentiation in mathematics may or may not be necessary for mathematics instruction. Differentiation in the mathematics classroom needs to be revised and not be based on students' cognitive performance but on the student's well-being and productive mathematical disposition (Anthony et al., 2019).

In the classroom, teachers use other evidenced-based instructional strategies and practices, explicit mathematics instruction, universal design for learning (UDL), and manipulatives to instruct students and improve students' mathematics performance effectively. Doabler et al. (2018) examined the long-term effects of a core kindergarten mathematics program (Early Learning in Mathematics [ELM]) on teachers' use of evidence-based practices related to explicit mathematics instruction. One group used the traditional mathematics program in Year 1 and the ELM program in Year 2. The second group used the ELM program for both years. Teaching practices that were the study's focus entailed teacher models, opportunities for students to practice, and academic conferences provided by the teacher. In Year 2, the ELM program increased the mean teaching performance rate of teachers who used the traditional program in Year 1 (Doabler et al., 2018). Evmenova (2018) studied 70 educators serving general and special education students using the UDL framework, an evidence-based framework supporting diverse learners. Participants recognized explicit UDL guidelines, which were easier and more efficient in providing multiple means of engagement, action, and representation in

lesson plans to address specific learning outcomes and learners' variability (Evmenova, 2018). Finally, Dwijanto and Istiandaru (2018) examined how effective manipulatives were when integrated into assessments with written and oral problems in concrete geometry. The one-group pretest-posttest study contained 32 fifth-grade elementary students and their teacher. The manipulatives assisted students' understanding of concrete geometry concepts by 54% in the average category, and when integrated with the series of written and oral problems manipulatives improved the students' conceptual understanding of solid geometry (Dwijanto & Istiandaru, 2018). Differentiation, manipulatives, UDL, and explicit instruction are a few of the instructional practices and strategies mathematics teachers can use to improve their practices and students' understanding of mathematical concepts.

Knowledge of Curriculum Embedded Mathematics Framework

Knowledge of curriculum-embedded mathematics (KCEM) is a term used by researchers Remillard and Kim (2017), which references teachers' mathematics knowledge. Teachers can implement mathematical tasks and instructional designs into the mathematics curriculum. Using the KCEM framework, teachers can learn the necessary knowledge by identifying the differences between their perceptions and curriculum (Cho et al., 2019). The KCEM framework used current research on teachers' knowledge in a specific content area. Through investigating elementary mathematics teachers' guides, the researchers identified components of curriculum resources teachers use when using the framework to plan instruction. The researchers recommended four interrelating dimensions of KCEM: representations and connections among these ideas;

foundational mathematical ideas; mathematical learning pathways; and problem complexity (Cho et al., 2019). Representations and connections are used in visual models, symbolic notations, and conventions. Hao et al. (2020) stated that using complex basic models and key algorithms is a necessity for the achievement of students in mathematics. Problem complexity requires identifying why a learner struggles with a task (Remillard & Kim, 2017). According to Hao et al., KCEM students' acquired knowledge weighs heavily on teachers' time studying a content area outside the classroom. Mathematical learning pathways teachers implement help develop the mathematical ideas and related skills needed to solve new mathematics concepts successfully.

Mathematics Problem-Solving Approach

Conceptual knowledge may support the building, selecting, and appropriately implementing problem-solving procedures. Practice implementing procedures may help students cultivate and understand concepts, specifically if the practice is designed to bring light to principal concepts (Rittle-Johnson, 2019). Through a quantitative study, Behlol et al. (2018) investigated the effectiveness of the problem-solving approach to teaching mathematics to students in public schools. A pretest-posttest comparable unit design was used to conduct the study. The results suggested that the mathematics achievement level of those students who were taught using the problem-solving approach was considerably different, with about a 20% increase in the posttest, compared to the performance of those students who were taught using traditional instructional practices. The same was the case regarding the performance of high and low achievers taught through the problem-solving approach compared to traditional mathematics teaching.

High and low-achieving students surpassed on the posttest compared to those taught through traditional mathematics teaching (Behlol et al., 2018).

In Behlol et al.'s (2018) research, students excelled due to a approach that was student-centered and provided students the opportunities to think, reflect and use the results of the problem in learning tasks when using the project-solving approach. Gibbs et al. (2018) investigated the effects of children who struggle to understand the foundational mathematics processes. Gibbs et al. found that proficiency in numeracy knowledge was at high risk for students with mathematics disabilities. As Rittle-Johnson (2019) stated, the student-centered learning approach describes conceptual knowledge where students use knowledge learned to attain new concepts and develop a multi-dimensional idea to solve multiple tasks.

Nugroho and Jailani (2019) described the concrete representational abstract (CRA) learning process as a better representation to help students become problem solvers rather than using the conventional approach. The CRA model provides three explicit stages, concrete, representation, and abstract, to apply when solving mathematical equations (Nugroho & Jailani, 2019). Paul et al. (2018) provided a conceptual framework for understanding the development of mathematics competence: acquiring and using mathematical thinking to solve mathematical problems in day-to-day situations. The researchers verified the hypotheses that the speed of accuracy in mathematics fluency predicts the mathematics scores of individuals, whereas number transcoding fluency predicts individuals' general reading scores. Dot enumeration and general mathematics ability foresaw individual distinctions in number fact speed. In

contrast, general reading and general mathematics foresaw individual distinctions as one can transcode number strings over time. The researchers suggested when students entered school to combine mathematics and reading standardized assessments to measure students' numerical ability, that doing so early on would offer essential information about mathematical skills (Paul et al., 2018).

Björklund et al. (2020) argued that correlations between mathematics and reading should be treated with thoughtfulness because many mathematics tasks require an ability to read. Paul et al. (2018) found that the relationship between mathematics and reading abilities would clarify if mathematics achievement depended on the relationship between transcoding and mathematics facts fluency or compressed skill sets. As mentioned by Lee et al. (2018), possessing these cognitive abilities is related to the conceptual knowledge needed in linking relationships as information is being learned to solve complex mathematics problems. It would be imperative to determine what inferences can be drawn about differences in important early mathematics skills from an individual's differences in cognitive capabilities.

Stereotype threat theory suggests that minority and female test-takers perform poorly on assessments due to pressure from negative stereotypes about their ability be perform (Stoevenbelt et al., 2022). Researchers have examined the effect of gender and racial stereotype threats on students' mathematics test performance and found varying results. Analyzing data from 31 stereotype threat studies, Stoevenbelt et al. (2022) examined the stereotypes of testing situations where mathematics tests were administered to examine if gender played a factor in students' success on mathematics assessments.

The researchers predicted that stereotypes, such as gender and racial, would affect students' mathematics achievement on mathematics assessments. Vallée et al. (2020) explored whether stereotype threats would threaten the outcome of real-world testing when mathematics and verbal skills are on tests. Stoevenbelt et al. found that a student's gender did not affect their mathematics performance, while Vallée et al. found that girls performed lower on the mathematics test than boys in the mathematics-verbal order administration; but performed similarly to boys in the verbal-mathematics order administration. Vallée et al., addressing educational practices, further discussed the implications of test administration affecting the mathematics experience of women and the need for further research as to stereotype effects.

Mathematics Content Knowledge

Reid and Reid (2017) conducted a study to examine the mathematics content knowledge of teacher aspirants enrolled in a 2-year education program to attain a master's degree in education. The study showed that teachers required a solid mathematics knowledge foundation to support students' mathematical achievement. Due to declining scores in Ontario, Canada, examining provincial and international mathematics assessments is a concern. The basic numeracy skills of 151 teacher candidates were analyzed through a pretest and posttest. Also, eight teacher candidates shared their experiences in the Master of Teaching mathematics program in semi-structured interviews.

The test results from Reid and Reid's (2017) study showed improvements in many areas, but all numeracy skills did not significantly improve. Interviews discovered

that teacher candidates ' views of instructors, courses, mathematics tests, and the importance of teaching mathematics during their practicum placements influenced their pursuit of teaching mathematics. Recommendations were made by the researchers to teacher education programs in the following areas: launching minimum mathematics proficiency standards, improving consistency between Master of Teaching mathematics courses and practicum placements, and aiding those teacher candidates who have shown low mathematics proficiency.

Having the ability to master mathematical knowledge and knowing how to organize knowledge into a design to instruct students effectively is key for teachers to deliver effective instruction in the classroom (Fitriani et al., 2020). Alrajeh and Shindel (2020) examined the relationship between organizational, emotional, and instructional support and the characteristics of teachers on student engagement. The years of teaching experience and gender of the teacher were among the characteristics examined. Alrajeh and Shindel found that when emotional and organizational support was the focus, the connection between instructional support and student engagement weakened. However, the gender and years of experience of the teacher played a significant influence on student engagement (Alrajeh & Shindel, 2020). Most of the teachers who displayed these characteristics were female teachers.

Conclusion

In this study, I used the conceptual framework of social constructivism theory to study teachers' instructional practices and strategies to improve elementary school students' mathematics achievement. The social constructivism theory allows one to

examine how individuals construct new knowledge from their experiences instead of acquiring new knowledge from external influences. The key terms mathematics achievement, mathematics conceptual knowledge, mathematics instructional practices, knowledge of curriculum embedded mathematics, mathematics problem-solving approach, and mathematics content knowledge were used in the literature review to support exploring the instructional practices teachers use to improve elementary students' mathematics achievement.

Mathematics achievement is determined by how well students can process mathematical procedures to solve problems. For students to comprehend concepts, they must have understood mathematics conceptual knowledge. Students with mathematical conceptual knowledge solve problems by applying their understanding of operations with whole numbers. Manipulatives, concrete representations, vocabulary walls, and visuals are mathematics instructional practices that help students increase their mathematical understanding of mathematics concepts. Mathematical learning pathways teachers implement help develop the mathematical ideas and related skills needed to solve new mathematics concepts successfully. The mathematics problem-solving approach depends on the mathematics conceptual knowledge of students and how teachers use effective mathematics instructional practices to help develop students deepen their understanding of concepts. When preparing teacher candidates to support students' mathematical achievement, teachers need a solid mathematics knowledge foundation.

Implications

Based on anticipated findings, some implications for possible project direction are for teachers who teach third- to fifth-grade elementary school students to participate in professional development. Because third to fifth-grade elementary school students from 2016-2019 have scored 61% to 58% below proficiency in mathematics, the study's findings could have led to a professional development project for elementary teachers highlighting effective instructional strategies in mathematics. Because elementary school students learn differently, they must be taught how to approach mathematics problems differently.

Educators should consider implementing instructional practices geared towards students based on their learning capabilities and then assess such students based on how they were taught how to respond to mathematical problems. Behlol et al. (2018) suggested that the achievement level of students who are taught based on their level of achievement is different compared to those students who are taught in heterogeneous groups. Educators may also introduce teachers to professional development training and seminars that would refine their knowledge of instructional practice as it relates to teaching mathematics. Corkin et al. (2018) suggested that receiving additional training affects teachers' outlook on their value as a teacher beyond their years of experience, mathematics background, and what grade level(s) they've taught.

Teaching third to fifth-grade elementary school students mathematics test-taking skills may lead to positive results, especially for lower-achieving students in mathematics. Educators can achieve this by teaching students how to narrow their options

in a mathematics test by eliminating answers they know that are wrong. Furthermore, providing third- to fifth-grade elementary school students the opportunity to implement the skills they need to succeed on a mathematics test is also important (Ansari Ricci et al., 2021). Most school districts adopt various third-party software that prepares students with the depth of knowledge questions that appear on state mathematics tests (Pellegrini et al., 2021). Pellegrini et al. (2021) suggested that student achievement increases when third-party software offer personalization, engagement, and motivation.

Summary

According to Z. Wang et al. (2018), poor student achievement in mathematics is a major concern in U.S. schools because mathematics difficulties appear cumulative and worsen over time. The problem addressed through this study is that since 2016 third to fifth-grade students at a Title I elementary school have not met adequate yearly progress because 70% of students have not scored proficient on the end-of-grade mathematics assessment. Learning mathematics in elementary school can be challenging because students do not have enough experience at a young age to make sense of mathematics problems (Ansari Ricci et al., 2021). Hence, it is important to implement instructional practices that educators can use to approach mathematical problems in an academic classroom (Pellegrini et al., 2021). The purpose of this case study was to explore the instructional approaches that elementary school teachers use to teach mathematics to students at the Title I school and to investigate which instructional strategies teachers believed to be the most effective in improving mathematics test scores. I used the social constructivism theory as a conceptual framework for this project study because I

examined instructional strategies that elementary school teachers use in teaching mathematics to students at HLES. In this section, I also discussed literature related to the problem. The keywords that were used in the study are also mentioned. In Section 2, I explain the methodology that I used to gather the data. Section 3 of this project study provides the project. Section 4 consists of reflections and conclusions of the study.

Section 2: The Methodology

Since 2016, third to fifth-grade elementary school students at HLES have not met the mandated state standard in mathematics. Third to fifth-grade students at a Title I elementary school did not meet adequate yearly progress because 70% of students have not scored proficient on the end-of-grade mathematics assessment. A qualitative research design was used to understand how teachers of third to fifth-grade elementary students described their instructional practices relative to teaching mathematics. Creswell and Creswell (2018) noted that qualitative research inquiry gathers in-depth information about a phenomenon. I conducted individual interviews discussing teachers' instructional practices and collected two lesson plans from each participant.

Qualitative Research Design and Approach

I used a qualitative case study research approach to study the problem. The qualitative research approach is used to collect detailed nonnumerical information (Camfield & Palmer-Jones, 2013). Case studies consist of extensive views of individuals, organizations, or other social constituents (Stake, 2005). Through a case study, I explored the instructional strategies that elementary school teachers use and are most effective in teaching mathematics to students at HLES. Case studies are beneficial when researchers show interest in uncovering specific experiences in rare circumstances (Merriam & Tisdell, 2016).

A qualitative research design was appropriate because I could better understand how third- to fifth-grade teachers taught mathematics. Using a quantitative research design through the implementation of a survey would have restricted responses and

would not have yielded the in-depth responses needed to investigate this phenomenon. Rather a qualitative case study, featuring interviews and document review, was the best choice to study the problem. Case study research grants flexibility not offered in other qualitative approaches, such as phenomenology and grounded theory (Hyett et al., 2014). Using a grounded theory approach would result in an emerging theory based on prolonged engagement with participants in the field (Khan, 2014). This design was rejected because I would not develop a new theory. A phenomenology approach aims to develop human lived experiences from new understandings (Gentles et al., 2015) and requires the researcher to use prolonged engagement in the field. Once again, this approach was considered but rejected based on the two identified factors.

Hyett et al. (2014) believed researchers using case studies are urged to seek out what is common and particular about the case. While observing common or cases, they consider the physical setting, historical background, and other institutional aspects. Because of the nature of case studies, this research design was useful to discover how third to fifth-grade teachers teach mathematics. Therefore, a qualitative case study approach was selected and used to study the problem, because case studies consist of extensive views of organizations, individuals, or other types of societal constituents (Stake, 2005).

Participants

This study's sample consisted of 11 participants, 10 third to fifth-grade teachers, and one instructional lead teacher with at least 3 years of experience teaching elementary mathematics to third to fifth-grade students. Creswell and Creswell (2018) indicated that

qualitative research methods require fewer participants because collected data have a greater quality of data, which are then analyzed and given a detailed description. Selecting teachers with 3 or more years teaching mathematics was preferred because they have more experiences upon which to draw and are more knowledgeable of the phenomenon. Purposeful sampling was used to recruit a small participant sample who met the selection criteria. Purposeful sampling is used when the researcher selects participants based on their experience and knowledge of each subject (Onwuegbuzie & Collins, 2007).

To access participants, I sought permission from Walden University's Institutional Review Board (IRB) to conduct my study, and then I obtained permission from the human resources department of a Georgia school district. After acquiring the required approvals, I emailed the HLES principal to request the distribution of my study invitation to third and fifth-grade teachers to participate in the research study. The invitation contained my contact information. In the invitation, I asked interested participants to contact me through email or by phone to discuss possible participation and to reaffirm if they met the initial criteria for the study. I emailed a welcome letter and consent letter to the interested participants who contacted me and met the criteria to sign before participating in the study. For those participants who showed interest, but the number of participants needed for the study had been met, I sent an email thanking them for their interest.

Data Collection

Marshall et al. (2013) recommended 10 interviewees for a case study. Taking their recommendation based on the inquiries needed, 10 participants would provide a broader range of data sought for this study. Interviewing 10 teachers and one instructional lead teacher with at least 3 years of experience provided "information power" (see Malterud et al., 2016). According to Malterud et al. (2016), information power is when the study participants possess enough relevant information that fewer participants are needed to address the research questions. I conducted interviews with the participants and reviewed their mathematics lesson plans. Each teacher participant provided two lesson plans, and the instructional lead teacher did not provide lesson plans. Interview Question 1 addressed Research Question 1, and Interview Questions 2-8 addressed Research Question 2. Along with interviews, I used teachers' mathematics lesson plans to address Research Question 1, which addressed instructional strategies used by HLES teachers in mathematics.

Interview Protocol

I created an interview protocol to gather the data for this study (see Appendix B). The interview protocol consisted of nine open-ended questions. The interview questions were guided by the framework and related literature and were designed to help answer the research questions. Qu and Dumay (2011) suggested using open-ended questions to allow the interviewer to remain open and flexible during the interview. Using open-ended questions, Qu and Dumay believed, would allow creativity and flexibility to learn about the participants' beliefs and experiences teaching mathematics. Finally, the interview

questions were reviewed for accuracy, clarity, and face validity by my committee members.

Lesson Plan Protocol

In addition to the interview data, I analyzed two mathematics lesson plans from each teacher from the 2020-2021 school year to align with findings for RQ1 and RQ2 in addressing the instructional practices and strategies used by third- to fifth-grade teachers in mathematics. The instructional lead teacher did not provide lesson plans. I used a lesson plan protocol (see Appendix C) to indicate the number of occurrences in each lesson plan of the UDL approach, CRA model, differentiation, experiential learning, mnemonics, and math fluency in the lesson plans. I also noted the content taught and if the teacher only named the approach/strategy or provided detail about using the approach/strategy. The local school district requires teachers at HLES to design lesson plans using best practices. According to the local school district, the components of a best practice lesson consist of an essential question used to guide the standard being taught, key vocabulary, an activating strategy, modeled instruction, guided instruction, independent practice, and a summarizing strategy.

Data Collection Procedures

I collected interview and lesson plan data for this study. Eleven participants were interviewed for this study, with data collection beginning in the fall of 2021 after IRB approval. I scheduled the interviews to take place Monday through Friday. The interviews were completed in 3 weeks, from August 16 to September 10, 2021. I scheduled the interviews based on when I received the consent form from the participant.

Available dates and times were emailed to the participants, and they selected the date and time that worked best for them. I conducted three interviews in Week 1, four in Week 2, and four in Week 3.

Each interview was scheduled for approximately 30-45 minutes, and the participants were interviewed after working hours. I interviewed the participants using video conferencing due to COVID-19 restrictions. Participants were encouraged to sit in a quiet environment and turn off their cellular phones to avoid distracting calls. I received permission from the participants to audio record the interview process. I told the participants that the interviews would be transcribed and returned to them. I used a Sony ICD-PX470 Stereo Digital Voice Recorder with built-in USB to record the interviews.

Before I started each interview, I stated the purpose of the study and reviewed the interview process with the students. I asked one question at a time. If a participant gave a detailed answer to a question that also answered the following question, I reiterated the question to ensure this was the participant's answer. I facilitated the dialogue to keep the interviews on the topic and to ensure that all participants' responses, especially those relevant to the research questions. If a participant needed more clarification on a question being asked, I repeated and probed the question if it was needed. At the end of the interview, I thanked the participants and told them that I would be sending a transcript of the interview for them to check for any discrepancies. Each interview lasted for about 30-35 minutes.

Lodico et al. (2010) suggested using a composition notebook to record the dates of interviews, participants' information, and the duration of each interview. During the

interview process, I documented information, such as the participant's name, years of experience, interview date, interview duration, body language, and nonverbal cues, by writing the information in a composition notebook. I used the same alphanumeric code to identify the participant interview and corresponding lesson plans (e.g., Participant 1, Participant 2).

The participants sent their lesson plans electronically before the interview. To make the interview authentic, I did not mention the content of their lesson plans during the interview. I used what was mentioned in the interview and the content in the lesson plans to check for validity. The electronic lesson plans and interview data were stored on a flash drive. I created a folder on the flash drive for each participant to store their interview and lesson plan data. The participant's alphanumeric code was used to name the folder. When I printed the lesson plans, I placed them in a binder for storage.

Role of the Researcher

I was in my 16th year of teaching during this study. Of those 16 years, I taught mathematics for 5 years for the third grade and 2 years for Grade 5. In the remaining years, I taught all content areas in a self-contained kindergarten classroom for 5 years and second grade for 4 years. I am not currently teaching at HLES and was not teaching at that school during this study. During the 3 years I taught at HLES, I was a third-grade mathematics and science teacher, a grade-level chair, and a lead teacher mentor. I am currently a third-grade teacher at another school in the local school district. I had a professional rapport with the study participants as I am known in the district as a teacher at a Title I school; however, I did not have a supervisory role in the local school district at

the time of this study and never held a supervisory role over any of the participants. My professional relationship with the participants did not affect the data collected for this study.

Measures Taken to Protect Participants' Rights

Before conducting research for this study, I obtained approval from the IRB of Walden University (IRB Approval No. 06-11-21-0367549) and the local school district to recruit participants. Once approval was granted, I emailed the HLES principal who distributed my study invitation letter to all teachers in the school. After interested participants contacted me and I confirmed that they met the study criteria, I emailed them a welcome letter and consent form explaining the nature of the study. I asked the participants to send me their voluntary participation with "I consent". The consent form contained participants' rights, my contact information, and their right to leave the study. I informed participants that participation in the study was voluntary, and they had the option to terminate their role as a volunteer without being penalized. After permission was granted and qualified participants had given consent to participate in the study, I conducted interviews to begin collecting data.

I secured all data on a password-protected USB drive and laptop. All printed study documents, informed consent emails and interview and lesson plan protocols, were stored in a locked cabinet in my home. I am the only person who has access to the documents. I will destroy the documents and erase the audio-recordings within 5 years of completing my study and per Walden's IRB requirements.

Data Analysis

Interview

Before analysis began, I identified all the participants by typing an alphanumeric code in bolded capital letters on a Microsoft Word document. I transcribed the audio-recordings verbatim in a Microsoft Word document once all interviews were completed. Transcriptions were checked with the audio-recordings to ensure accuracy of the transcripts. After accuracy of the transcripts were ensured, I removed filler words, such as, "hm," "um," and "uh," and word repetitions since these words do not give meaning to the transcript. I explained within the transcript if the interview was interrupted, or the tape recorder was turned off. The explanation was placed in brackets inside the document. After I transcribed the interviews, the participants received a copy of the transcript to check for accuracy as the first part of member checking. The participants reviewed the transcripts and responded through email that no changes were necessary.

I used thematic analysis to analyze the interview data. I hand-coded each interview transcript and then used NVivo to code each interview transcript. I purchased a student license for the NVivo software program to assist me with storing and managing the interviews that I transcribed verbatim. Although the NVivo software was used to assist me in gaining deeper insights into the interview data, I played a vital role in analyzing the data.

According to Glesne (2011), data analysis involves organizing what the researcher has read, heard, and observed. I read the transcriptions several times to familiarize myself with the data before coding commenced. As I read the transcribed

interviews, I identified similarities and differences in their responses to the interview questions. I selected and highlighted words, phrases, and concepts on a hard copy of each transcript. I made footnotes of key information mentioned in the interview and how the information related to the research questions.

My next step was to import the transcripts into NVivo software. I used NVivo software to gain further insight into the data, to code the data, assess developing major themes from the interview data, determine the validity of the developing themes, and classify codes into dominant themes. Thematic data analysis using NVivo involved the following steps:

1. The researcher reads the collected data to become familiar with the data.
2. The researcher codes the data by recognizing key descriptions that can be used to answer the research questions. Once these key descriptions are identified, they can be placed into nodes.
3. The researcher examines the themes as they arise by surveying the nodes to recognize patterns of significance.
4. The themes are assessed by examining participants' themes with the data set to determine if the themes have a common narrative.
5. The themes are then designated by preparing a thorough analysis of each theme.
6. The last stage contains summarizing the findings. (Guest et al., 2011, p. 49)

I used NVivo to label specific data and sort the information into distinct categories. I created a case node for this case study to keep the individual data of the 11 participants' interview transcripts. After using NVivo to find codes of the 11 participants' responses, I compared the NVivo codes to the ones I found manually. I hand-coded and used NVivo to code each interview transcript resulting in 36 codes (see Appendix D). Examples of the hand codes and transcript excerpts (see Appendix E) and the NVivo codes and transcript excerpts (see Appendix F) are included in the appendices. Next, I searched for categories among the first-cycle codes and used NVivo to organize the 36 codes into categories (see Appendix G & H). This process allowed me to find the emergent themes from the transcript data. As emerging themes were identified, I used the NVivo highlighter tool to code important words used frequently during the interview. This process allowed me to analyze the data further and to check for consistency to determine the final themes (see Appendix I), which are Grade 3-5 mathematics teachers used the CRA model and UDL approach to teach elementary students, and Grade 3-5 mathematics teachers used differentiation, experiential learning, mnemonics, and mathematics fluency to teach elementary students. Table 1 contains the categories and themes by research question.

Table 1

Categories and Themes by Research Question

Research Question	Categories	Themes
Research Question 1: What instructional approaches do teachers use when teaching mathematics to HLES students?	CRA model UDL approach	Theme 1: Grade 3-5 mathematics teachers used the CRA model and UDL approach to teach elementary students.
Research Question 2: What instructional strategies do HLES teachers use and believe are most effective for teaching mathematics to students to improve mathematics test scores?	Differentiation: Experiential learning Mnemonics Mathematics fluency	Theme 2: Grade 3-5 mathematics teachers used differentiation, experiential learning, mnemonics, and mathematics fluency to teach elementary students.

Lesson Plan Analysis

To prepare the lesson plan data for analysis, I used a blank lesson plan protocol created in Word to record and save the raw data (see Appendix C). I analyzed the lesson plans using a three-step process. I identified which teaching strategy or approach participants listed and provided a frequency count of the occurrence in each lesson plan. The most frequently listed strategy or approach were the UDL approach, CRA model, differentiation, experiential learning, mnemonics, and mathematics fluency. In the next two steps, I identified the content or concept taught and noted whether the participant provided detail in using the approach and strategy or just named them. The strategies and approaches were reflected in participant interviews and were used to confirm the categories and support the themes.

Evidence of Quality

An important aspect of the data analysis process is providing evidence of the quality of the findings. Researchers use several validity strategies to ensure accuracy and credibility in qualitative research (Creswell & Creswell, 2018). I collected multiple data sources in this study, used transcript review which is the first step in member checking, provided detailed and thick descriptions, and reported negative or discrepant cases. Using multiple data sources, such as interviews and lesson plans, limits biases and improves the findings' trustworthiness (see Glesne, 2011). Additionally, the findings become more credible and richer by including many viewpoints related to a theme (Creswell & Creswell, 2018).

I used transcript review to determine whether the findings were credible. Although transcript review is part of member checking, transcript review on its own is less rigorous than member checking. Through email, each participant was sent the interview transcription and instructed to review the transcript and inform me whether the interview represented the interviewee's intent.

Discrepant Cases

Using results from the data collection and analysis of the project study helped refine my assumptions about the instructional strategies teachers use when teaching mathematics in Grades 3 through 5. During the data collection, one participant's response could have altered the exposition of the data. Participant 5 believed that mathematics fluency did not affect students' success when multiplying and dividing multidigits. I again met with Participant 5 by video conferencing to clarify the participant's response. I reviewed the transcript for discrepancies with Participant 5 and asked more questions until I understood their response. I noted any discrepancies and revised and transcribed the new data.

Data Analysis Results

I interviewed 11 participants through videoconferencing for this qualitative study. I transcribed the recordings from the videoconferencing into Microsoft Word. Next, I transcribed the interviews verbatim and reviewed the transcripts and recordings for accuracy. I analyzed the interviews for dominant themes. In addition to the interview transcripts, I analyzed the lesson plans to determine use of the approaches and strategies mentioned during the interviews. Two themes emerged from the data analysis of the

interview transcripts and lesson plans (see Table 1). Theme1: Grade 3-5 mathematics teachers used the CRA model and UDL approach to teach elementary students (RQ1) and Theme 2: Grade 3-5 mathematics teachers used differentiation, experiential learning, mnemonics, and mathematics fluency to teach elementary students (RQ2). In presenting the results, I discussed the themes and connected the themes to the research questions. Excerpts from participants' interviews provide evidence to support these themes. In addition to using quotes from participants' interviews to support the themes of this study, I used the participants' lesson plan data to support the approaches and strategies teachers used in their daily mathematics lessons.

Theme 1: Grade 3-5 Mathematics Teachers Used the CRA model and UDL Approach to Teach Elementary Students

Participants were asked one question about the district-approved instructional approaches they used to teach their elementary students. This question and participant responses were aligned with RQ1. All of them were familiar with and infused the CRA model and UDL approach in their instruction. The CRA model is useful for teaching concrete to abstract mathematical concepts, using manipulatives in the initial learning stage, drawing representations in the following stage, then removing these aids in the abstract stage (Nugroho & Jailani, 2019). The CRA model supports students in moving through learning math concepts (Nugroho & Jailani, 2019). Through the CRA model, students physically manipulate objects to solve mathematics problems, drawing images to represent the problems, and finally, using numbers and symbols to solve mathematics problems (Nugroho & Jailani, 2019). The UDL approach is used so all students can be

academically successful. UDL is a framework that guides the development of flexible learning environments to accommodate the differences of individuals (Craig et al., 2022). The focus is on learners accessing resources and demonstrating what they have learned (Craig et al., 2022). The research district recommends both approaches for teaching mathematics regardless of the grade taught and will be described in detail below.

CRA Model

All 11 participants discussed the importance of using manipulatives and modeling, components of the CRA model, when teaching mathematical concepts. Participants referred to the CRA model as one of the best practices in their daily instruction. Participant 5 described the model as a strategy that allowed students to use concrete materials to model the concept, followed by students observing the teachers drawing pictures to model the concept and trying independently, and lastly, students using numbers and mathematical symbols to solve mathematics equations. Participant 5 stated:

> The CRA model definitely provides the necessary steps to help guide students to become learners who explore more than one way to solve mathematical concepts. This approach is used most when teaching the domains numbers and base ten, operations and algebraic thinking, and fractions. Having experience in teaching third and fifth grade, once students reach these grades, I try to take physical modeling objects away in preparation for the state standardized test. Students will only have the opportunity to draw figures on scratch paper, and I teach students to model figures on paper.

Participant 5 indicated that despite the usefulness of the CRA model, they needed more training on different representational approaches related to the Georgia Standards of Excellence (GSE). Participant 5 elaborated,

> Although the representational and abstract stage of the CRA model is used more frequently in third through fifth grades, receiving more training in different representational approaches students can use to solve mathematics equations for GSE standards would be helpful. Focusing on domains focusing on GSE standards for numbers and base ten, fractions, and operations, and algebraic thinking is important to student success since these domains carry the most weight on the state's summative assessment. Students need to learn representational approaches that would be time friendly on assessments.

According to Participant 4, abstract representations like equations and numbers are taught after students have gained a conceptual understanding to improve their mathematical reasoning skills. Participant 4 stated that "The CRA model gives students the opportunity to begin their initial and foundational understanding of concepts. The model better prepares students for effective strategies to use on state standardized tests to assess Georgia Standards of Excellence (GSE) standards." Due to students not using hands-on manipulatives and calculators during the state-mandated summative assessment, students use the representation model as a mental image to solve mathematical equations.

Even though participants recognized the benefit of using the CRA model in daily instruction, nine out of 11 participants spoke about time playing a factor in how effectively they used the CRA model. According to Participant 9, there are so many

components to an effective lesson that time is critical to how teachers execute their lessons effectively.

Participant 4 addressed the stress this placed on mathematics teachers because each lesson builds on the next lesson. Participant 4 stated:

> Using the CRA model is an effective model but there are components within this model that requires time that is not allotted for mathematics. In mathematics, each concept builds on the other. Without having enough time to teach these concepts effectively, it is hard to close the achievement gap for those struggling learners. Teachers are not given the time needed to teach so many mathematics concepts.

Participant 4 believed that more time is needed to teach mathematics effectively and implement approaches like CRA.

UDL Approach

Ten out of 11 participants in the study stated that teachers who taught mathematics should know about implementing district-approved approaches to increase students' mathematics achievement. The school district adopted UDL to help teachers provide an equal opportunity for all diverse learners to succeed. Participant 1 described this approach as being flexible regarding how students access content, absorb content introduced, and show what they have learned from the content standards introduced by the teacher. However, the Participant 1 wanted to receive more training in strengthening the components of the UDL approach. Participant 7 revealed, "What I appreciate most about the UDL approach is the flexibility it allows students to learn individually, with

collaborative groups (small and large), and in the whole group instruction setting." Participant 6 stated:

> Collaborative groups allow students to learn from their peers. Strategically placing students in groups that will allow them to fill in gaps by learning from their peers is exciting. When I place students in collaborative groups, I like to use homogeneous and heterogenous groups. Therefore, students will not be in the same group each time. This allows higher students to not only be the teacher but to learn from their peers who are on the same cognitive level.

According to Participant 1, the UDL framework allows teachers to help those students in need in a small group setting while having confidence that other students are effectively engaged collaborating with other students on lessons. Participant 6 stated:

> Rather than simply allowing one or two students to come up to the board to share with the whole class, I would ensure that students are able to collaborate in small groups so that all students are afforded the opportunity to participate. This way, students are exposed to various methods of interpretation and can develop a deeper understanding of the concept and use mathematical language in conversation, helping to embed it in their vocabulary.

The UDL framework allows students to take ownership of their learning. According to Participant 7, students can decide which strategies work best when solving mathematical equations.

Eight out of 11 participants discussed the importance of peer collaboration during mathematical lessons. Peer collaboration in the UDL framework allows students to develop higher-level thinking skills while collaborating with peers. Participant 7 stated:

> Peer collaboration is used as a critical tool to encourage mathematics-language skills and to allow learning to become a collaborative effort. This concept not only is effective in the classroom but also help[s] students understand team building outside of the classroom.

Participant 3 stated:

> Peer collaboration makes learning fun without the teacher being involved. Many times, students can feel ashamed if they do not understand a concept immediately. By using peer collaboration, students can collaborate with their peers to fill in the missing gaps of what they are misunderstanding. As a teacher I enjoy seeing the students become problem solvers.

Participant 3 also stated that peer collaboration allows the students to have ownership of their learning by pulling knowledge from the UDL approach.

Theme 2: Grade 3-5 Mathematics Teachers Used Differentiation, Experiential Learning, Mnemonics, and Mathematics Fluency to Teach Elementary Students

Participants were asked interview questions about the instructional strategies they used and found most effective to teach mathematics. By consensus, they differentiated instruction and used experiential learning, mnemonics, and mathematics fluency in their instruction. Instruction is differentiated to accommodate students' learning styles and considered for students' readiness to learn a new concept (Anthony et al., 2019).

Teachers can differentiate instruction by planning lessons including students' learning styles, using a variety of assessments as well as ongoing assessments to determine students' level of understanding, plus developing a classroom conducive to learning. Students, who are taught using differentiated instruction, may demonstrate learning through various ways, including paper and pencil tasks.

Differentiated instruction can change their learning from passive to active when coupled with experiential learning. Experiential learning adds that dimension not included in differentiated instruction. When teachers use experiential learning, students not only "learn by doing" but by reflecting on their understanding and taking ownership of their learning; students learn from making mistakes and accepting responsibility for their learning (Ghofur et al., 2022). Teachers in this study stated experiential learning as one strategy they used to teach mathematics.

Participants were not limited to differentiation and experiential learning; they also used mnemonics to help students learn fundamental skills. Mnemonics are useful for students to use basic mathematics facts, so they do not rely on fact charts or any other physical device. Teachers can have students learn and practice keywords and acronyms when learning new concepts in context (Nazihovna & Ibrokhimjon kizi, 2022). The teachers in this study used a variety of mnemonics to memorize basic mathematics skills.

Mathematics fluency, where students automatically read and answer mathematics questions (see Meiri et al., 2019), was another strategy the participants taught. Teachers who teach students mathematics fluency want them to accurately, automatically, quickly, and selectively choose the best method to solve problems (Meiri et al., 2019).

Mathematics fluency is achieved over time and will not be reached at the same time for all students.

Teachers in this study used the four strategies. Below is an account of the strategies and how they used them. Their choices were supported by their interviews.

Differentiation

A district-approved strategy that all teacher participants use in daily instruction is differentiation. Differentiation was a theme in the interviews and the lesson plans. Participant 2 spoke about differentiation in daily instruction and planning strategic seating charts during the interview. Participant 2 differentiates seating (flexible seating) in the classroom. The participant seats students based on their level of understanding. Participant 8 stated:

> Throughout the year, I seat students based on how I need to better serve them. Students may be strategically placed in homogeneous groups and later in the term heterogeneous groups. This allows me to create a flexible seating chart that allows me to help more students at one time. Flexible seating will also change based on the mathematics concept being taught at that time because some mathematics concepts are harder than others.

Since the pandemic, flexible seating has looked different. The participant tried to seat students 3 feet apart, but the area they were seated in was close to other students with the same level of understanding.

Teacher participants stated that the beginning of their differentiation starts with the results of the beginning of the year district assessment, STAR assessment. The STAR

assessment identifies gaps in learning to increase student learning, supports the best practices used during mathematics instruction (Martin et al., 2022), and is administered to all students as a benchmark. STAR provides teachers with achievement levels, beginning learner, developing learner, proficient learner, and distinguished learner (Ponisciak & Dallavis, 2022), that they can use to differentiate instruction. Teachers differentiate their lessons based on a student's performance in mathematics domains. These domains are then used to help the teacher to create small groups to reteach mathematics concepts in each domain where students' performed below grade level. Participant 3 stated:

> What I love most about the STAR assessment is as teachers, we can immediately begin differentiating in the classroom based on students' performance. Differentiation not only occurs in how teachers are able to design their daily lessons but using the results from the assessment allows teachers to provide parents with activities that can be completed at home to help strengthen those mathematics concepts students are struggling to master in preparation for the state assessment.

Six of the 10 teacher participants believed that differentiation is key to mathematics achievement. However, some teachers indicated that the school district did not provide resources for teachers to differentiate mathematics concepts, and time was limited to differentiate mathematics effectively. According to Participant 10, they seek to gain more insight and resources in differentiating lessons.

Teacher participants stated that they rely on online teacher resources to find activities to differentiate. Differentiation often requires teachers to spend their own money to purchase these resources. Participant 3 stated:

> Teachers may have to spend their money for resources they find to be the most effective differentiation. These resources may not be best practices strategies but what the teacher found.

Participant 6 stated that,

> Differentiation also takes time to effectively complete in the classroom and mathematics teachers are stretched thin with time teaching a great number of mathematics standards throughout the year. Gaining more knowledge on how to effectively differentiate lessons in a timely manner would be beneficial to student success.

Out of the 11 participants, all teachers agreed that the allotted instructional time limits the different components needed to deliver an effective lesson. Participant 9 stated:

> There are so many components to an effective lesson that time is critical to how teachers execute their lessons effectively. As a teacher I have to navigate my lessons by trying not to include everything in one day. Therefore, differentiation occurs three times out of the week. I have allotted days that I differentiate lessons and use peer collaboration.

Participant 2 revealed that simply checking an instruction strategy off the list is not the goal but effectively executing the strategy to improve student achievement is the goal.

The desire to receive training in effectively differentiating lessons more frequently in daily mathematics lesson plans is evident.

Experiential Learning

Experiential learning is a form of learning in which direct experience drives student learning. Indriayu (2019) found that experiential learning-based teaching material in mathematics effectively improves elementary school students' cognitive mathematics ability. Through experiential learning, students learn to solve mathematics problems precisely, efficiently, and accurately through experience in the learning process (Indriayu, 2019). Out of the 11 teacher participants, nine of the participants used a form of experiential learning to help with planning and executing mathematics lessons. The nine participants expressed the need for more training in using experiential learning components to increase students' mathematics achievement.

The forms of experiential learning used by the participants were journaling, manipulatives, games, and peer-led instruction. Four out of 11 teacher participants encouraged their students to use a journal to reflect on their math work and any misconceptions they need to improve in mathematics instruction. Participants used student journals to collect data on what worked best for their students in their mathematics class. Participant 9 stated:

> Using student journals allow me to record pros and cons of my lessons. I write notes on lesson plans for future references to strengthen my lessons year to year. By recording my thoughts about the lessons, I can clarify any misconceptions my

students may have had on the lesson. This allows for reteaching of those mathematics concepts before formative and summative assessments. Journaling allowed the participants to reflect on past experiences, be they good or bad, which would allow them to prevent similar problems from occurring again and hindering students' achievement on formative and summative assessments.

Three out of the four participants used peer tutoring, a form of instruction that allowed students to learn from one another, which allowed the teachers to facilitate learning all at once. Participant 10 showed evidence of peer tutoring during a mathematics lesson on multiplication. The performance task required students to use multiplication to buy a given number of items for a price rounded to the nearest dollar. At the opening of the lesson, the students discussed in groups what items and the quantity of those items they would normally see in the grocery cart when shopping with their parents. The students drew a picture of the items in the cart and wrote multiplication problems to find the total for each product and the total cost of the items in the grocery cart. Students' interactions during peer tutoring can play a significant role in students' mathematics achievement (Alegre et al., 2020). According to Alegre et al. (2020), peer tutoring makes learning more experiential and offers academic achievement for the learner. These engaging experiences allow students to become more engaged with the material they have learned in their real-life experiences. Therefore, students learn by doing instead of listening. Journaling played a factor in helping participants to group students for peer tutoring because of the student's strengths and weaknesses. Peer tutoring could also be considered a form of differentiated instruction.

Participants 1, 3, 4, and 5 used manipulatives to support student learning. Manipulatives are hands-on learning tools that provide students with a hands-on approach to mathematics (Ghofur et al., 2022). Many students struggle with mathematics, and manipulatives can bridge that gap in areas where many students have deficits. By bridging the gap, students can use Bloom's Taxonomy of remembering, understanding, applying, analyzing, evaluating, and creating when solving mathematics problems (Hidayah & Asikin, 2021). According to Hidayah and Asikin (2021), once students can create, they have mastered previous stages of Bloom's Taxonomy, and success on assessments is achievable. Participant 3 stated:

> Manipulatives allows students to explore learning through an active experience. When students can touch and draw in mathematics lessons, they become creative in the learning process. In my years of teaching, this form of experiential learning helps students to gain and master concepts being learned.

Participants realized that many of their students benefited from hands-on learning as they better understood mathematics facts when they used hands-on manipulatives. The participants were provided supportive instruction with the help of professional development at their school but desired to receive more training to strengthen using manipulatives in daily lessons. Several participants created games or used games to promote and support fact fluency. Participants 1, 2, 5, and 8 used games in lessons, such as basketball and Scrabble, to support fact fluency, as this was a form of experiential learning. Participant 4 stated:

> I found that when I incorporated games that were relatable to the students, they drew connections to the mathematics concepts being taught to their daily lives. Throughout the year they would often reference these games, and therefore, I knew there was a great chance they would master the content when they saw it again.

The participants' experience played a factor in that they knew how the game worked and how it would affect students' learning at the same time. Various participants also brought up small group instruction several times. From an experiential perspective, Participant 7 stated:

> Educators understand that some students can work best with the help of peers in a smaller setting. Small groups ease students' minds in that they can relate to others who may be on their level of learning as opposed to the whole class instruction.

Participants 2, 5, 7, 9, and 10 discussed this perspective during their interviews. They felt that small group instruction was vital in how well some students could learn. Small group instruction would often be followed by peer instruction in which students can provide what they have learned to other peers. The participants expressed wanting to gain knowledge by using the small group and peer instruction workshop more frequently in their mathematics lessons. Small group instruction allows students to integrate new knowledge from what they have learned in the past in a smaller setting amongst their peers. Cai et al. (2020) found a positive effect on peer instruction workshops when students are challenged with challenging problems. Participant 8 stated:

> Peer instruction is a great summarizing strategy to use in the middle and end of a lesson. Students discuss what they have learned from the lesson, and you are able to walk the room to see if students are confused or have misconceptions about the lesson. By circulating the room, I am able to journal any misunderstandings that need to be addressed before moving on in the lesson.

Peer instruction helps students improve their conceptual knowledge and problem-solving skills that they can use in their mathematics classes and other classes.

Experiential learning helps students solve mathematical problems using their prior knowledge to connect to new knowledge being taught. As teachers use journaling to document the pros and cons of a lesson, peer tutoring is created to group students on their strengths and weaknesses. During peer tutoring and independent work, students use manipulatives as concrete objects to model mathematical concepts before independently using drawings and equations to solve mathematical concepts.

Mnemonics

Participants 2, 6, and 10 provided unique mnemonic devices to support student learning. They used mnemonics to support student learning, making their learning a little more feasible and easier to follow. The teachers taught the mnemonic as a chant or song to help students to remember the steps of solving mathematics concepts. Participant 2 stated:

> Using mnemonics to reach all learners is a clever way that would hold more memory in day-to-day use. Using P.E.M.D.A.S. to solve equations with order of

> operations helps students to remember the necessary steps to solve order of operations equations correctly.

The participant made chants and songs with mnemonics to stress the importance of specific mathematics facts for students to learn. Participant 2 described mnemonics as a tool to learn important information on more complex mathematics standards. Participant 1 spoke highly of mnemonics when teaching upper elementary-grade levels mathematics. Participant 1 stated that with so many complex steps needing to be taken when multiplying multi-digits and using long division with fractions, mnemonics is an approach to make these steps memorable and fun in the classroom.

Participant 5 stated that although mnemonics was not a tool their students used in the past, it was a strategy that produced long-term achievement when used with consistency. The participants understood that mnemonics support long-term learning as much learning is short-term. They expressed their desire to learn and create more relevant mnemonics that would be more engaging for students to learn when solving mathematics problems. Long-term learning can be used in the future, but it all started with mnemonic devices.

Mathematics Fluency

During the interviews, several participants voiced how they implemented mathematics fluency into daily practices. Participants 1, 2, 5, 7, 9, and 10 spoke on the effect mathematics fluency had on students' performance in solving mathematics problems. Participant 9 stated:

> Math fluency is the foundation for mathematics. Over the years, students who had a strong foundation in math performed at or above grade level on formative and summative assessments. As students' progress and enter upper grades in elementary, mathematics fluency becomes a non-negotiable and is needed for student achievement.

The participants have included fluency tasks in their daily instruction to support student learning and utilize anchor charts, reminding students of mathematics facts they may struggle with. These programs challenge students' automaticity in mathematics fluency. Students are presented with mathematics facts and concepts and are challenged by how much time they accurately answer a mathematics problem. Participants have used XtraMath and iLearn as best as possible to ensure their students succeed in standardized testing. Participant 8 stated:

> Mathematics fluency needs to be introduced and revisited in each elementary grade level to assure mathematics facts are being retained from grade to grade. To increase mathematics fact fluency, I believe elementary schools should give a mathematics fluency grade on report cards, so parents are aware of their child's mathematics fluency.

Most of the students who struggle with mathematics fact fluency have a challenging time understanding complex mathematics skills. All teacher participants mentioned that they used educational games to support mathematics fact fluency.

Lesson Plan Findings

The approaches and strategies that appeared in the two themes were also evident in the lesson plans. All 10 participants who provided lesson plans had at least one occurrence of the UDL approach and math fluency in both lesson plans (see Table 2). The CRA model appeared the most across the lesson plans, although Participant 3 did not list the model in one of their lesson plans. Differentiation, experiential learning, and mnemonics appeared the least across the lesson plans. While most participants listed these three strategies at least once in one of their two lesson plans, Participant 5 was the only participant who did not include differentiation in either plan. Participants 2 and 8 did not list experiential learning in either lesson plan and Participants 5, 7, and 8 did not include mnemonics in either lesson plan.

Table 2

Number of Occurrences of Approaches and Strategies in Lesson Plans

	UDL Approach	CRA Model	Differentiation	Experiential Learning	Mnemonics	Math fluency
P1, LP1	3	2	1	1	1	1
P1, LP2	1	3	1	1	1	1
P2, LP1	1	2	1	0	1	1
P2, LP2	1	1	1	0	1	2
P3, LP1	1	0	1	0	3	2
P3, LP2	1	2	0	1	1	1
P4, LP1	1	1	1	1	1	1
P4, LP2	1	1	0	1	1	1
P5, LP1	1	1	0	0	0	1
P5, LP2	1	2	0	1	0	1
P6, LP1	2	1	1	1	1	1
P6, LP2	1	1	0	1	0	1
P7, LP1	1	1	1	1	0	1
P7, LP2	1	2	1	1	0	1
P8, LP1	1	1	1	0	0	1
P8, LP2	1	2	1	0	0	1
P9, LP1	1	1	1	0	1	1
P9, LP2	1	1	1	1	0	1
P10, LP1	1	1	1	0	0	1
P10, LP2	1	1	1	0	1	1
Total	23	27	15	11	13	22

Note. P = participant, LP = lesson plan

Additionally, the teachers were more likely to just name the approach/strategy than provide details about the approach or strategy. The approach or strategy was named 58% of the time compared to 42% of time when detail was provided across the lesson plans. The content taught varied and included concepts such as fractions, multiplication, decimals, and volume.

Within the UDL approach, components, such as collaborative groups and peer collaboration, were accounted for in teachers' mathematics lesson plans. These components were used as summarizing strategies to check for students understanding of the mathematics lesson taught that day. For the CRA model the lesson plans included using manipulatives, drawings, and equations to solve mathematics equations. The

teachers' lesson plans showed evidence of differentiation based on students' performance on formative assessments. Teachers used data from the STAR formative assessment to target specific standards students struggled with to close the achievement gap. The teachers showed evidence of using the STAR assessment to create groups based on the students' achievement level on the formative assessment. Experiential learning was evident in lessons where mathematics is used in day-to-day activities. A few programs the district implemented and included in the participants' lesson plans were XtraMath and iLearn for Title I schools.

Connecting the Findings and Themes to the Research Questions

Research Question 1

The first research question was*:* What instructional approaches do teachers use when teaching mathematics to HLES students? The findings related to Research Question 1 focused on the district-recommended approaches used by mathematics teachers at HLES. The local school district recommended these approaches to improve student mathematics achievement, but they were not required. The findings indicate that the CRA model and the UDL approach are used to increase students' mathematics achievement. Participants in this study indicated that although they used these instructional strategies and teaching practices, more professional development is needed to implement the components that provided the most effective support in helping students achieve in mathematics.

The findings indicate that teachers preferred professional development that would strengthen components of CRA and UDL to help students be more successful in

mastering mathematics concepts. Participants indicated that the lack of adequate and detailed professional development might be a reason for the gap in mathematics achievement. The teacher participants of this study expressed the importance of using the district-recommended instructional strategies to improve students' mathematics achievement. The participants' wanted relevant and effective professional development to guide their daily instruction in delivering effective instructional strategies. The participants expressed they wanted to continue learning and gaining knowledge on delivering effective mathematics strategies to students to improve mathematics achievement.

Research Question 2

The second research question was. What instructional strategies do HLES teachers believe are most effective for teaching mathematics to students to improve mathematics test scores? The findings focused on the instructional strategies teachers found most effective when teaching mathematics. Still, nothing in the findings supported effective strategies to improve test scores. These research-based strategies are incorporated into daily lessons to increase students' knowledge of mathematics concepts—Theme 2 addresses Research Question 2. The strategies and practices identified in this present study are differentiation, experiential learning, mnemonics, and mathematics fluency. Teachers in this study used these practices differently in their daily lessons but incorporated them in their daily lessons.

Theme 2 addresses the need to differentiate lessons to accommodate students' learning styles to help them succeed when learning mathematics concepts. In the

interviews, teachers expressed concerns that allotted time for mathematics instruction was a factor in how often they could effectively differentiate mathematics instruction. Theme 2 addresses experiential learning and how teachers can incorporate prior strategies with new strategies learned from professional development provided by the local school district. The teachers expressed concerns about the local school district adopting new programs and not giving adequate time to measure what strategies work or do not work for students to increase their mathematics achievement. Theme 2 addresses the unique strategy of using mnemonic devices to support student learning in mathematics instruction. Teacher participants described this unconventional strategy as helping students to identify the steps to take when solving complex mathematics concepts. During the interviews, all participants believed mathematics fluency should be an ongoing skill practice and mastered throughout elementary grades to ensure students are fluent in mastering mathematics facts. Their beliefs on mathematics fluency stem from mathematics fluency being the foundation for mathematics. The participants expressed concerns that students would struggle to perform on grade-level tests if these facts were not mastered.

Relationship of Findings to the Prior Research

This element supports, refutes, or extends knowledge of teaching mathematics to elementary students. The participants in this study were seasoned teachers who had experienced professional development using recommended teaching approaches and strategies to improve instruction and student learning. Based on this study's findings, two

themes emerged to confirm or disconfirm what is known in the peer-reviewed literature on this topic.

Theme 1: Grade 3-5 Mathematics Teachers Used the CRA Model, and UDL Approaches to Teach Elementary Students

The teachers in this study used two approaches when teaching mathematics to their elementary students. The CRA model is an instructional approach teachers in this study used to increase students' mathematics achievement. The CRA approach teaches students to solve mathematical concepts through three learning stages: concrete, representation, and abstract. Teachers who use this approach bring forth a learning process that allows students to solve problems through concrete object influence, followed by learning using an illustration of concrete object manipulations, concluding with mathematical problem solving through abstract notation (Nugroho & Jailani, 2019). Teachers in the current study revealed that more training, more time allotted for teaching mathematics, and more resources are needed to implement mathematics instructional strategies to help students to improve their mathematics achievement.

The second approach the teachers used in their instruction was UDL. The UDL approach is an instructional method teachers HLES third through fifth-grade teachers use to increase students' mathematics achievement. Teachers in the present study found the UDL approach flexible in how it allows students to learn individually, with collaborative groups, and in the whole group setting. Charalambous and Delaney (2019) stated that engaging students in practices that influence them to share and analyze others' ideas to further their understanding of mathematical concepts is critical to student achievement.

Although teachers found the UDL approach flexible, they sought more professional development in condensing the instructional strategies to reach learners in the allotted time for mathematics.

When teachers deliver effective instruction to students, designing standard-based lesson plans to reach all learners is key. Evmenova (2018) addressed the eagerness of participants wanting to use the UDL approach to develop a curriculum to support diverse learners. Evmenova's findings revealed that although the participants believed in adapting the UDL principles in their lessons, more professional development is needed to model UDL principles before the approach is implemented in learning environments.

Theme 2: Grade 3-5 Mathematics Teachers Used Differentiation, Experiential Learning, Mnemonics, and Mathematics Fluency to Teach Elementary Students.

The participants in this study used four instructional strategies to teach mathematics. Strategies are supported by literature and, if used appropriately, can result in students understanding complex mathematics concepts. Each of these strategies are described in detail.

Differentiation

Differentiation allows teachers to support diverse learners in their classrooms (Paul et al., 2018). Similar to how participants in this study used state assessments to differentiate their mathematics lessons, Participants in Paul et al.'s study applied differentiation based on the students' reading and mathematics assessments. The researchers suggested when students enter school, examining both mathematics and reading standardized assessments early on would offer valuable information about

mathematical skills. In the present study, the teachers use the formative assessment, STAR assessment, to bridge students' strengths and weaknesses in reading and mathematics. This study supports using both heterogenous and homogeneous groups to support students' mathematics abilities using peer instruction because reading is integrated into all content areas.

Tomlinson et al. (2003) stated that teachers should modify their teaching practices to address an extensive range of interests, readiness levels, and learning modes. Teachers in the current study support this concept of differentiation as they understand that differentiated instruction using the UDL approach must be planned and implemented with various learning levels in mind to meet the needs of all students at once. As differentiated instruction is planned for, teachers can make sound instructional decisions to analyze student data to meet the needs of all students regardless of their learning level. Planning can lead to differentiated instructional content, instruction time, assignments, and learning materials, which address diverse learning needs (Tomlinson et al., 2003). Teachers in the present study also found that differentiation supports how they can effectively implement and understand the importance of differentiation in their lessons and if students are showing academic growth by the use differentiation.

Experiential Learning

Teachers encourage students to use their prior knowledge and experiences when approaching new mathematics concepts to understand better the new mathematical concepts taught in the classroom. Doabler et al.'s findings supported the claims that students gain more content knowledge from project-based learning and peer collaboration

than from traditional teaching. Motivation and developing a positive relationship with peers from diverse backgrounds positively influenced students who interacted with their peers when learning new concepts (Doabler et al., 2018). In the present study, participants used peer learning, a form of instruction that allowed students to learn from one another when learning new mathematics concepts. The participants believed that experiential learning created a healthy dialogue for students to connect through their prior experiences and learn that there are different solutions to solve problems.

Teachers in the present study believed that when students can use manipulatives, visuals, and prior knowledge, they are more successful in executing new mathematical concepts. Dwijanto and Istiandaru (2018) examined how effective manipulatives were when integrated into assessments with written and oral questions in solid geometry. The researchers suggested that manipulatives assisted fifth-grade students' understanding of solid geometry concepts. When integrated with the series of written and oral questions, manipulatives improved the students' conceptual understanding of solid geometry (Dwijanto & Istiandaru, 2018). Using mathematics instructional strategies, such as manipulatives, concrete representations, vocabulary walls, and visuals, helps improve students' understanding of mathematical concepts.

Mnemonics

Mnemonics is an instructional strategy used in mathematics classrooms to help students to memorize complex mathematics concepts. Teachers in the present study used mnemonics as a mathematics strategy to simplify complex mathematics equations. The teachers taught the mnemonic as a chant or song to help students to remember the steps

of solving mathematics concepts. Yan (2020) found that using mnemonics as an instructional strategy provided students with a visual or verbal prompt that helped to increase students' retention of information. Complementary approaches, such as mnemonics, help keep students interested, build their confidence, and improve participation. Iglesias-Sarmiento et al. (2020) described mathematics achievement as when children can simultaneously process, count, process numbers, and comprehend concepts taught in mathematics. To solve problems, the students must identify the appropriate method and execute relatively simple calculations (Hajovsky et al., 2020). The use of mnemonics in the participants lessons was a helpful strategy teachers taught students to use when solving multiple step mathematics equations. Students must decide the correct mathematical operations to use and which data to include in the calculation when problems include extraneous information (Hajovsky et al., 2020). These studies support the current study because students must know which mathematics concepts support others to solve mathematics equations.

The current study used the mnemonics strategy to help students connect newly taught content to information they already understand. Educators use mnemonics to bridge a learning gap that many students exhibit because, at times, there seems to be a difference in learning styles between the teacher and the student (Farrokh et al., 2021). In the current study, teachers found using mnemonics an instructional strategy for students to remember steps to take when solving complex mathematics problems. Using mnemonics make these steps enjoyable and memorable for students to use daily.

Mathematics Fluency

Once students can answer mathematics equations fluently, they increase their processing speed, visualize attention, working memory, and ability to shift their mathematical thinking to using multiple operations to solve mathematics equations (Meiri et al., 2019). Mathematics fluency is a strategy that many teachers in the current study mentioned during their interviews as they understood the importance of mathematics fluency and the influence it has on their student's success in their mathematics classes. As students mature, mathematics fluency shifts from counting strategies to automatic retrieval of arithmetic facts (Berrett & Carter, 2018).

Relationship of Findings to Conceptual Framework

The conceptual framework that guided this study was the social constructivism theory (see Vygotsky, 1978, 1987). I used social constructivism theory to examine teachers' instructional practices to improve elementary school students' mathematics achievement. According to Wood et al. (2012), it is useful to see mathematics as a cognitive activity made by a sociocultural phenomenon that a group of actively knowing individuals creates. The participants believed that experiential learning (Theme 2) created a healthy dialogue for students to connect through their prior experiences and learn that there are different solutions to solve problems. This form of learning also allows students to strengthen their foundational mathematics skills and boost higher-order thinking skills. The higher-order thinking skills cultivated by experiential learning encourages students to be self-directed learners and support the social interactions between students and teachers (Indriayu, 2019).

The CRA model and UDL approach (Theme 1) are mathematics instructional approaches that create opportunities for students to use different models to collaborate to understand mathematics better. A study by Gupta (2008) determined that peer collaboration influences student achievement in elementary mathematics. In the elementary setting, peer collaboration is an extension of instruction, not a replacement. The explanation of the social constructivism theory as it relates to learning is that learners gain knowledge through social interaction with other people, phenomena, experiences, and environments (Kusuma et al., 2021). These interactions can also be performed by differentiating instruction. Lev Vygotsky believed that children gradually embrace external and social activities, including interaction, with more experienced activities (Steiner, 2014). Differentiated instruction (Theme 2) strengthens communication between students and teachers as teachers can provide social experiences and scaffolding by implementing instructional strategies and best practices to help students master mathematics concepts. The study participants unanimously stated that it is a challenge to implement best-practice instructional strategies to improve students' mathematics achievement when little to no professional development is provided to teachers in the local school district. Due to the need for more professional development, there is a lack of training on the instructional materials and aids, and technological tools used to encourage students to construct new knowledge from their experiences individually or in heterogeneous groups (see Cottone, 2017). All teacher participants and the instructional lead teacher interviewed for this study expressed concerns about implementing district-approved instructional strategies in the classroom. The participants' perceptions of the

district-approved instructional strategies were that students in Grades 3-5 could make sufficient progress in mathematics when classroom instruction is aligned with the curriculum and state standards. Participants of this study wanted to gain more knowledge from professional development on how to help students who may struggle with district-approved instructional strategies. Identifying and understanding students' mistakes allows the teacher to understand the characteristics of a student's mistakes, which helps the student to increase their knowledge through mistakes (Kusuma et al., 2021). However, the participants believed that effective alignment of the curriculum would be successful when support is given from the local school district by providing adequate professional development on effective instructional district-approved strategies.

Project Deliverable

The findings of this study addressed the two research questions and signified that professional development is needed to provide effective mathematics instructional strategies to improve students' mathematics achievement. After transcribing interviews, analyzing data, and finding themes, I categorized each theme based on how close it was to the research question. Although teachers are using district-approved instructional strategies, teachers seek to develop more expertise in the instructional strategies being implemented in the classroom. Participants agreed that best practices instructional strategies were effective in teaching students. The participants wanted more support from the school district to elaborate on the best practices recommended by the school district to support the rigor of the Georgia Standards of Excellence. They expressed the need for

training on these best practices to help students to improve their mathematics achievement.

Teacher participants in the study stated that they rely on the instructional lead teacher to redeliver information from the local school district. The instructional lead teacher is a valuable resource to the teachers, but 8 out of the 10 participants seek more direct professional development to draw their own conclusions on district-approved mathematics instructional strategies. Seven out of the 10 teachers expressed concern over the time of redelivery of professional development. Professional development is delivered during teachers' planning time, and teachers found this time rushed and less effective. On average, the seven participants believed that a 30-minute professional development redelivery was not effective for teachers to implement in their classrooms. Three out of the 10 teacher participants were fifth-grade teachers and received their redelivery at the end of the day. Their time would often be cut short due to emergency drills or canceled due to scheduling conflicts. The teacher participants expressed concerns that their professional development did not equal their peers. The teachers believed this was not intentional. They believed due to the many roles the instructional lead teacher was assigned, and professional development was not delivered effectively to help teachers with instructional strategies in mathematics to improve students' mathematics achievement.

All 11 participants in this study exhibited an eagerness to learn more effective mathematics strategies and to strengthen the district-approved strategies being used in the classroom. Based on the data collected, I designed a professional development project for

elementary mathematics teachers to address their gap in practice and the problem at the research site. The professional development content is designed to augment existing instruction, strengthen teachers' mathematics instruction and improve students' mathematics achievement.

Section 3: The Project

The purpose of this case study was to explore the instructional approaches that elementary school teachers use to teach mathematics to students at a Title I school and to investigate which instructional strategies teachers believed to be the most effective in improving mathematics test scores. The findings of this case study demonstrated that teachers were concerned with the lack of effective professional development in mathematics instruction provided to teachers in the local school district. The findings of this case study provide details about the desired professional development teachers in Grades 3 through 5 wanted in mathematics instruction. The findings were based on the mathematics instructional strategies teachers use and the mathematics instructional strategies they found to be most effective.

The participants have monthly content meetings at the local school where this case study was conducted. Although instructional strategies were discussed at these meetings, there was a lack of detailed demonstration on how to use these strategies effectively during mathematics instruction. Based on the findings, teachers desired more professional development on the mathematics instructional strategies they found to be effective: using the CRA model, the UDL approach, differentiation, experiential learning, mnemonics, and mathematics fluency. The teachers believed that receiving more effective professional development in these mathematics strategies would help close the student achievement gap.

Based on the findings of this study, I designed a 3-day professional development to address the effective strategies believed to be effective in delivering mathematics

instructional strategies in Grades 3 through 5. Teachers participating in the professional development will learn how to deliver these instructional strategies and design lesson plans incorporating effective instructional strategies. Teacher participants in the study believed ineffective strategies contributed to low student achievement in mathematics. During professional development, teachers can share ideas on how they will use or use effective mathematical instructional strategies in their classrooms.

Description and Goals

The professional development for this study is planned for teachers in Grades 3 through 5. This professional development aims to strengthen the instructional strategies teachers use in mathematics for Grades 3 through 5. The 3-day professional development will be divided into three quarters. One professional development day will be committed at the beginning of the first, second, and third quarters to address the units being covered during the quarter. A school administrator or instructional lead teacher will supervise the professional development.

The professional development for this case study focuses on the data collected from teacher participants. Those mathematics instructional strategies teacher participants believed to be effective in students' mathematics achievement will be modeled in the professional development. Another goal for this professional development is to allow teachers to collaborate to create full lesson plans incorporating the mathematics instructional strategies presented in the professional development. Professional development will be offered at the site where I conducted the case study.

The purpose of this professional development is to allow teachers to gain a more in-depth understanding of the instructional strategies discussed in this case study and how to implement these strategies in mathematics instruction effectively. The goal is to make teachers aware of those mathematics instructional research-based strategies that are effective in improving student achievement. Teachers participating in the professional development will engage in discussions, modeling, and peer observations.

Rationale

I developed the professional development as an outcome of the findings in which teachers expressed concerns about ineffective mathematics instructional strategies used with students in classrooms. Teacher participants in Grades 3 through 5 who participated in the case study communicated a need for professional development to strengthen district-recommended mathematics instructional strategies. Due to ineffective instructional practices used during instruction, teachers saw little to no improvement in students' mathematics achievement.

As teachers progress in their careers, they always need to grow professionally. Teachers who participated in the case study expressed needing more training in effective research-based strategies. In the interviews, teachers wanted to collaborate with their peers to strengthen their daily lessons' instructional strategies. The participants were concerned with the lack of in-depth feedback and follow-up from the school district after professional development training. Often training was held after school, and a great deal of information was crammed into a brief time of 2 hours or less. Participants stated that some professional training would have been more beneficial if they had been scheduled

for a full day of professional learning. The teacher participants wanted more time to have vertical planning to collaborate with their peers to plan effective lessons with effective research-based instructional strategies.

Using data collected from teacher interviews, I created a professional development training to help strengthen the instructional strategies used by mathematics teachers in Grades 3 to 5. The 3-day professional development will address the mathematics instructional strategies: CRA model, UDL approach, differentiation, experiential learning, mnemonics, and mathematics fluency. The professional development was designed to allow teachers to collaboratively plan with other teachers to plan mathematics lesson plans featuring the mathematics instructional strategies developed from the data collection as effective research-based instructional strategies.

Review of the Literature

I searched the prior literature review to locate peer-reviewed, scholarly articles with publication dates within 5 years of the completion of this study. I included some older studies because the research was important to this study and was discussed in recent studies. I completed the literature review using ERIC, ProQuest, EBSCO, Google Scholar, and Education Research Complete databases. I used the following search terms: *concrete representation abstract model*, *universal design learning*, *differentiation*, *experiential learning*, *mnemonics*, *mathematics fluency*, and *professional development*. Each term listed serves as a topical heading for the literature review.

CRA Model

The CRA model allows students to grasp mathematical concepts using concrete artifacts, which deepen their mathematical knowledge (Fries et al., 2021). Researchers Fries et al. (2021) concluded that hands-on, visual representations are critical to students' understanding of mathematical concepts. CRA can be implemented into professional development as teachers can better know how to use concrete mathematical models in their classrooms. This model supports long-term memory in an attempt to understand mathematical concepts better. During professional development, teachers can gain a deeper understanding of the influence of CRA models. They can use this model to support student learning of basic and complex mathematical concepts. Once students can understand the importance of CRA, they can solve mathematical problems with a great deal of understanding. Multiple representations are needed to support mathematical concepts, but concrete models have been the most effective in ensuring students can master those concepts (Samsuddin & Retnawati, 2018). Samsuddin and Retnawati (2018) stated that the CRA model could be a barrier for teachers as they often see the product of the CRA model, not the process behind understanding mathematics.

I chose the CRA model as it provides three explicit stages, concrete, representation, and abstract, to apply when solving mathematical equations (see Nugroho & Jailani, 2019). Students can understand concrete examples, which heightens active learning. Purwadi et al. (2019) supported the three explicit stages as they felt concrete learning worked best for elementary-aged students. The model can also be used to support my professional development for teachers. Students who learned with concrete

objects had a deeper understanding of the mathematical concepts that would be taught (Samsuddin & Retnawati, 2018). The researchers also stated that those students who used concrete representational abstract models were more engaged in mathematical lessons than those who did not. This study provides support for my professional development project as it promotes concrete representational abstract models to deepen students' understanding of mathematics.

UDL Approach

In every classroom, each student learns differently, and there is no one way to teach to the academic levels of all students at once. There is no one size fits all approach to teaching; therefore, UDL is beneficial to this study and is relevant for teachers' professional development (Lambert et al., 2021). Through the three main principles of the UDL approach of representation, action and expression, and engagement, teachers create an environment that is lucrative for all learners (Lambert et al., 2021). The UDL approach promotes learning for all students and is easily accessible to all, according to Nieminen and Pesonen (2019). The UDL approach promotes posting lesson goals to help students know what they are working to achieve, providing a variety of ways for students to complete assignments, flexible workspaces, regular feedback, and digital and audio text for non-readers (Kieran & Anderson, 2019). UDL supports instructional design where information is accessible by all learners in multiple ways, students can engage in personalized needs and interests, and students can express their understanding of mathematical concepts in various ways (Abrahamson et al., 2019). Abrahamson et al. (2019) also stated that UDL provides learning experiences that are accessible to all.

According to Chambers and Coffey (2019), UDL can pertain to all aspects of the curriculum, including instruction, materials, and assessment. These are just a few examples of why I would implemented UDL in my project to help develop educators professionally.

During my professional development sessions, I would stress the importance of UDL as it is a goal-driven, student-centered process regardless of their current learning levels (see Basham et al., 2020). UDL helps educators reduce learning barriers as it supports learning for all types of learners at once. Universal design is a great guide for all, providing new challenges and opportunities for all to learn (Westine et al., 2019). UDL promotes inclusive education and aims to eliminate barriers so students can learn and participate (García-Campos et al., 2020). García-Campos et al. (2020) stated that UDL improves the learning process for all students regardless of their learning ability. When these learning opportunities are available, students learn better when participating. I will incorporate this research into professional development as it supports teachers need to understand the importance of universal design and its influence on student achievement in mathematics.

Differentiation

Differentiation is a teacher's approach to adjusting their instructional strategies to meet the needs of various learning styles simultaneously with the assistance of data and research-based instructional strategies (Awofala & Lawani, 2020). Awofala and Lawani (2020) stated that teachers must consider the various learning styles when planning and implementing lessons for their students. Differentiated lessons tap into the diversity of

students and their ability to learn. Differentiation is not a strategy that can be used alone, as it leads to integrating multiple strategies to support student learning (Awofala & Lawani, 2020). According to Mavidou and Kakana (2019), "differentiation by interest and flexible grouping are effective strategies on student's performance" (p. 537). Using differentiation with flexible grouping is one of the most effective ways to promote student learning, as teachers will understand this approach when we discuss it during professional development.

During my professional development, the teachers will begin to understand and comprehend the aspects and effects of differentiated instruction. Teachers will be able to identify areas of intervention to implement effective differentiated instruction. Prast et al. (2018) evaluated the outcomes of a teacher professional development program regarding differentiated instruction and students' mathematics achievement. The professional development program showed that teachers learned how to change their instructional methods to meet the mathematics educational needs of diverse learners and improve student achievement (Prast et al., 2018). An increase in student achievement was shown in low, average, and high-performing students of those teachers who participated in the professional development. Teachers will also understand that the ultimate goal of differentiation is to ensure that all students can learn and grow (see Brigandi et al., 2019). During the professional development, teachers will be encouraged to use student data to modify content based on student readiness. Brigandi et al. (2019) used studies that supported differentiated instruction and its influence on student achievement. Effective differentiated instruction enhances the rigor of students' learning experiences.

Differentiation is a great approach that significantly impacts student mathematics achievement.

Experiential Learning

Experiential learning is simply learning from experience. This form of learning is attained through personal experience and authentic engagement in prior learning (Indriayu, 2019). Ghofur et al. (2022) described experiential learning as influencing students to think logically, systematically, critically, and creatively. Student-centered learning stimulates students' learning experiences which build during the learning process.

Effective experiential learning encourages students to think, discover, and apply what they have learned in the past to what they are currently learning. According to Indriayu (2019), the basis of experiential learning is to provide students with a comprehensive learning experience that they can use now and in the future. When students learn from their past experiences, they are encouraged to learn at higher levels. Polman et al. (2021) described experiential learning as an important approach to making mathematics meaningful for students. Experiential learning makes what students learn concrete and visible in their day-to-day learning experiences (Polman et al., 2021). Effective experiential learning is designed to give students an ultimate and complete learning experience.

Mnemonics

Mnemonics are great instructional strategies educators use to support learning new information. When mnemonics are established and implemented into daily

instructional strategies, they improve students' memorization and development of cognitive processes (Drushlyak et al., 2021). Mnemonics increase the longevity of a student's memory to support their ability to reproduce acquired information (Drushlyak et al., 2021). Mnemonics help students make associations with prior learning connections. Not only do mnemonics help students connect to prior learning, but they also help students improve their academic performance in their classes (Boon et al., 2019). Mnemonic devices are created to meet the educational needs of all learners regardless of their learning level. Using mnemonics has been proven to drive memory by associating facts and clever cognitive strategies (Ni & Hassan, 2019). Each mnemonic device is different and gravitates toward various learners and their learning styles. Keywords and phrases are used, and chunking helps students remember complex facts.

The term mnemonics is related to psychology as it refers to the optimal use of one's memory. Mnemonics replaces complex associations with visual, auditory, and kinesthetics to simplify memorization (Nazihovna & Ibrokhimjon kizi, 2022). Using mnemonics allows students to visualize an object, term, or mathematical concept so they can understand and comprehend it a little easier. Mnemonics also allow learners to remember information from association and prior knowledge to build on current knowledge (Nazihovna & Ibrokhimjon kizi, 2022). Using mnemonics in mathematics encourages students to learn concepts they may not have learned with traditional teaching techniques. Using mnemonics and mnemonic devices supports teachers in their attempt to reach students in ways they can gravitate towards (Ishak et al., 2021). Due to students traditionally having weak foundational skills in mathematics, using mnemonics can assist

students with higher-order thinking skills and sharpen their problem-solving skills (Ishak et al., 2021). Mnemonics can make learning fun and attractive to all learners.

Mathematics Fluency

Fluency in mathematics is associated with memory recall and the ability to display foundational mathematics skills quickly (Morano et al., 2020). When students can fluently recall mathematical facts, they have a greater understanding of mathematical concepts that they can apply to any form of mathematics (Morano et al., 2020). Students with strong mathematical fluency can focus more energy on solving complex and simple mathematical tasks (Akkan, 2021). When students are fluent mathematically, they better understand memorizing and remembering facts quickly (Qushem et al., 2022). Acquiring automaticity in mathematical fluency also allows mental flexibility for students to become proficient in mathematics. When students attain fluency, it also taps into their mathematical creativity; thus, creativity allows students to flourish and demonstrate proficient skills in mathematics.

Students who are fluent in mathematics can solve problems faster by quickly recalling facts that will help solve those problems. Students who have become fluent in mathematics have a greater sense of automation and generalization, developing a stronger foundation in mathematics (Karnes et al., 2021). Karnes et al. (2021) stated that students with a solid foundation in mathematics fluency could grasp difficult and abstract mathematical concepts in the future. Those students who are not fluent in their mathematical skills often struggle from grade to grade.

Summary

Effective professional development is critical in aiding teachers to deliver instructional strategies effectively. A successful professional development training provides participants with active learning opportunities, peer collaboration, resources needed to meet all expectations, and resources and activities they can return to their academic settings. Incorporating key research-based instructional strategies that reflect the curriculum is essential for student success. Participation in effective professional development can help to increase student academic achievement. The professional development goal is for teachers to feel confident in integrating what they have learned from the professional development and applying it to their daily instruction.

Project Description

This project will be a 3-day professional development offered during the school year, lasting six hours each day. One professional development day will be committed at the beginning of the first, second, and third quarters to address the units covered during the quarter. The professional development will be held at the beginning of three frameworks: Numbers and Operations in Base Ten, Operations and Algebraic Thinking, and Numbers and Fractions. These three frameworks were chosen because they comprise over 80% of the mathematics standards and are weighted most on the state standardized assessment.

The professional development will include modeling, videos, and presentations. During professional development, collaborative planning and discussions will lead most of the meetings. Teachers will collaborate to create lesson plans using the CRA model,

UDL approach, differentiation, experiential learning, mnemonics, and mathematics fluency. Teachers will use the state standards, district curriculum map, and district-approved lesson plan template when designing lesson plans. Other resources I will use as the facilitator will be a post-evaluation form to reflect on the pros and cons of professional development at the end of each day and a monthly virtual meeting for participants to discuss the mathematical instructional strategies used during lessons.

In the data collected for this study, teacher participants voiced their concerns about ineffective professional development, which targeted using effective mathematical instructional strategies. By providing professional development at the local school, teachers will be supplied with the support they need to deliver effective mathematics instructional strategies.

Potential Resources and Existing Supports

The professional development support team to guarantee the success of this professional development will include the local principal and assistant principal, grade-level mathematics representatives, the instructional lead teacher, and myself, the facilitator. The principal, assistant principal, and facilitator will meet to discuss the date and time for the professional development. The local school will provide the location and materials needed for the professional development project. When the local administration approves a date, time, and location, a calendar reminder will be sent to those individuals invited to participate in the professional development project. This professional development will be free of charge to those teachers invited to participate in the project. The local administration will state the expectations and positive outcomes upon the first

professional development session. As a facilitator, I aim to facilitate the sessions and deliver materials needed for the professional development. For each session as the facilitator, I will deliver the organization of each professional development session and deliver workshop evaluations to the school.

Potential Barriers and Solutions

During the professional development, I do not anticipate significant barriers that will prevent the professional development project from taking place. Time and collaboration are possible barriers that could affect the effectiveness of the professional development project. Within the typical workday, teachers' instructional time and instructional planning are interrupted for Individual Education Plan (IEP) meetings, parent conferences, and other meetings with staff. To decrease these interruptions from occurring, the local administration will add the professional development project to the school calendar to help lessen interruptions for the teachers participating in the professional development project. Another barrier is collaboration amongst participants in the professional development project. For the outcome of the professional development project to be successful, collaboration is key for participants to share and reflect on their experiences when delivering mathematics strategies in the classroom. The facilitator cannot force participants to participate, but expectations of collaboration with others will be communicated in expectations before the start of the professional development project. Collaboration with peers can help teachers to learn how to effectively deliver mathematical instructional strategies discussed in professional development when they return to their classrooms.

Project Evaluation Plan

As the professional development facilitator, I will provide evaluation forms to be completed at the end of each professional development day. The evaluation form will measure the effectiveness of the professional development to determine the strengths and weaknesses of the training and any recommendations the teachers may have for the following professional development day (see Appendix A). The teachers who participated in the professional development will evaluate the instructional strategies and their effectiveness based on the local school district assessment data. Based on the progress of the local school, the administration team will decide if this professional development training should be a yearly professional development to help improve students' academic achievement in mathematics.

Project Implications

Local School Implications

Effective professional development to promote social change is critical to students' academic achievement. The problem addressed through this study is that since 2016 third to fifth-grade students at a Title I elementary school have not met adequate yearly progress because 70% of students have not scored proficient on the end-of-grade mathematics assessment. Teacher participants voiced their concerns about the lack of professional development in using effective mathematics instructional strategies. The participants believed that having professional development on effective research-based mathematics instructional strategies will increase students' mathematics achievement.

Effective training to improve the mathematics instructional strategies used in classrooms can help boost teachers' confidence in delivering mathematics instruction.

Most importantly, teachers can collaborate with their peers to improve the mathematics achievement of their student body. Closing the achievement gap in mathematics can lead to positive social change at the local school for Grades 3 through 5 students. Students can gain confidence in mathematics by delivering effective instructional mathematics strategies, which can also influence their success in other content subjects. District stakeholders can also examine the local school's success and implement the professional development for all schools in the district.

Larger Context Social Implications

Upon the success of the professional development at the local district, the 3- day professional development training can extend to other local school districts for implementation to help teachers explore successful mathematics instructional strategies. Other school districts can adapt the professional development developed from my case study to their local school district professional development curriculum. This research can provide insight to local school districts about the importance of providing effective professional development to guide teachers in providing effective instructional strategies. There is an opportunity for students' mathematics achievement to increase and continue throughout grade levels by using effective mathematics instruction.

Conclusion

In this section, I outlined a professional development project based on the data analysis and themes retrieved from the research questions of this case study. This section

addressed current literature to support the themes of this study, potential barriers and solutions, project evaluation, and implications for social change. Section 4 will address the project's strengths, limitations, alternative approaches, scholarship, and impact on future research.

Section 4: Reflections and Conclusions

Section 1 of this case study addressed the problem at a local elementary school where third to fifth-grade students at a Title I elementary school have not met adequate yearly progress since 2016 because 70% of students have not scored proficient on the end-of-grade mathematics assessment. In my literature review for this case study I found that ineffective instructional practices and strategies are factors in the mathematics academic performance of third to fifth-grade students.

I used a qualitative case study approach to gain knowledge from 10 teacher participants and the instructional lead teacher at the local school site. I designed a project based on those mathematics instructional strategies the participants found most effective when delivering mathematics instruction. I will share a synopsis of this case study with the principal of the local school site in hopes that they will use the findings from this case study to provide staff development training. The project will be accessible for others to use for staff development training as well.

Project Strengths and Limitations

Strengths

There were a few strengths that I found in the completion of this case study. The first strength is the opinions of an important stakeholder, the teachers. The data collected for this case study are solely the beliefs of teachers and which instructional strategies they find to be the most effective when delivering mathematics instruction. Elementary teachers participating in this project study will gain effective mathematics strategies they can immediately take back to their classroom to apply in daily instruction. Another

strength of this project is the collaboration that can take place with teachers collaborating to design engaging mathematics lessons. The professional development sessions designed for this case study may help teachers strengthen their pedagogy when delivering effective mathematics strategies. The other strength derived from this project study was how it was created from the point of view of teachers firsthand. The project may appeal to other teachers because it is based on data derived from interview responses from other elementary teachers. Lastly, the professional development designed from this case study is cost-efficient for a local school district. The materials needed for this professional development are at the local schools. The sessions for this professional development can be held during teacher workdays when teachers come to school but do not have students, eliminating the need for substitute teachers.

Limitations

A project limitation in addressing the success of this project study is the limited scope of teachers targeted for this study. This study was limited to teachers who teach Grades 3 through 5. Increasing the targeted teachers to all elementary teachers in Grades kindergarten through 5 could broaden the success of effective mathematics strategies delivered to the students. Broadening the professional development in mathematics for kindergarten through Grade 5 will bring cohesiveness to the local school site when delivering instruction effectively to increase student achievement schoolwide. When new teachers come to Grades 3 through 5, they can collaborate with the new teachers to help train them on the mathematics instructional strategies used in classrooms. The number of stakeholders in this project study is limited as well. This project study not only can be

beneficial to teachers and students but to parents as well. Offering a mathematics curriculum night can help parents better serve their students outside the classroom.

Recommendations for Alternative Approaches

An alternative approach to the findings of this study could be to develop a curriculum plan for teachers to increase students' mathematics achievement in Grades 3 through 5. The 9-week curriculum plan would include lesson plans, materials, and assessments for the mathematics lessons. I could also address the research problem by developing a training video for third to fifth-grade mathematics teachers focusing on the themes developed from the findings. I would recruit speakers and facilitators to be part of the video, with interactive segments where teachers would have tasks to complete with team members or alone related to the themes of this study. I would provide the participants with all the materials needed to complete the tasks and handouts of what was discussed during the training video.

Scholarship, Project Development and Evaluation, and Leadership and Change

This doctoral project study has been a unique and challenging experience as a researcher. As a researcher, I was required to view the educational process and how it promotes social change. I have gained a new appreciation as a scholar and practitioner. As a teacher leader, I have a new fond of appreciation for educational research and the milestones that lead to greater educational change. Professional development is ongoing and is needed for educators to improve their professional learning experiences and strengthen their pedagogy.

Deciding to further my education and obtain a doctoral degree has been a rollercoaster. Experiencing changes in the local school district, the obstacles that came with COVID-19, and approaching education differently due to the pandemic has been challenging. These events have taught me to be flexible and stay steadfast in reaching my goals.

There have been a lot of tears during this process. Learning how to write a scholarly paper at this level and editing were the most challenging aspects of the process. The best part about this process was interviewing other teachers and learning their perspectives on issues in education. After interviewing the teacher participants, I found the common themes related to mathematics instructional strategies in Grades 3 through 5. Research-based mathematics instructional strategies must be cohesively used to promote change in increasing student achievement.

Analysis of Self as Scholar

As a scholar, there is a great deal to learn when completing a doctoral program. This process has given me a greater appreciation for dedicated teachers and district leaders who understand the importance of effective instructional strategies at the elementary level concerning mathematics. As an elementary educator, I see the problem many students deal with daily as they struggle with foundational mathematics skills. Before the COVID-19 pandemic, students struggled with foundational mathematics skills, and this gap widened after the pandemic. I see this deficit and want to continue researching effective learning strategies and professional development for teachers to close the learning gap in elementary mathematics classes.

As a scholar, I was intrigued by the number of counties worldwide that struggle with the same concept of improving student achievement in mathematics with effective instructional strategies. The struggle in elementary mathematics in other countries showed that the problem is an issue in a larger context. Reading articles that focused on the problem in this case study taught me that this study could benefit other school districts and counties. By reading these articles and attaining knowledge, I could create a proposal, conduct research for this study, and develop a project.

Analysis of Self as Practitioner

As an elementary school teacher, I am passionate about teaching and helping students succeed. This process has helped me to share my love for teaching and learning with other teachers to help their students to flourish and succeed in the classroom. When conducting this type of research, communication skills are important. Before conducting research for this study, I naturally communicated well with others. This skill was beneficial during this study.

I believe a true leader makes leaders, based on my past experiences as a teacher leader. This professional development allows teachers to collaborate to develop effective lesson plans to implement in their classrooms and teach other teachers. Teacher professionals are lifelong learners, and must grow and flourish to inspire learners who will grow to be lifelong learners.

As a practitioner, I see that my role as an educator is vital to student success rates at my school. What I do daily significantly influences how well my students learn mathematics. I must ensure that I can explain and execute effective instructional

strategies to minimize the achievement gap for my students. I have this charge as a practitioner, and I charge my colleagues to do the same when they create their lesson plans. This study has encouraged me to continue to search for and implement effective instructional strategies to deepen students' knowledge of elementary-level mathematics. This study has also encouraged me to explore professional development opportunities to increase my awareness of students' deficits in mathematics and the many ways I can improve their skills in my mathematics class.

Analysis of Self as Project Developer

As a project developer, I have learned that the researcher is not the only support needed for successful project implementation. Many perspectives are needed to make professional development effective for all stakeholders. This project was developed to answer the research questions that were the heartbeat of this research study. As the project developer, I needed to be receptive to beliefs and opinions. Most importantly, I understood that as a project developer, the project would not be perfect initially. Feedback from participants who participate in the professional development would be critical to the success of the professional development.

As I completed this study, I have a greater understanding and appreciation for effective professional development that can be taken at face value and broken down to impact successful student learning of elementary-level mathematics. I feel that the process of developing projects can be rather complex. Still, I can successfully implement effective professional development sessions for teachers to improve their instructional strategies. I have some experience developing projects for my colleagues, but this has

encouraged me to continue developing projects that could possibly lead to future endeavors in education.

Leadership and Change

Designing professional development training where teachers can collaborate and design lesson plans using these instructional strategies is exciting. Most importantly, this professional development training allows teachers to plan lessons immediately to deliver them back to their classrooms. As a teacher leader and researcher, I understand the importance of effective professional development that you can immediately use in your classroom. Although leadership has had minimal changes over the last few years, the various initiatives set forth by the district have hurt the outcome of this study. The district continues to focus on improving mathematics standardized test scores, but their changes in implementing the curriculum have led to stagnant growth. Unfortunately, with minimal professional development, I am unsure how to improve effective instructional strategies. With the completion of this study, I would like to inform the district on how we can improve upon providing consistent and relevant instructional strategies to improve our approach to minimizing the achievement gap in elementary mathematics. I am excited at my research's influence on the local school site, district, and other school districts that adopt this professional development training.

Reflection on the Importance of the Work

During this study, I learned quite a bit about myself and how dedicated I am to help minimize the achievement gap students display with their ability to master elementary-level mathematics. I have also learned more about myself concerning

implementing professional development for teachers to take and promote in their classes immediately after they have been trained. This body of work has shown, when you directly address the needs of the stakeholders who will be impacted the most, professional development can be designed successfully.

Implications, Applications, and Directions for Future Research

Implications

Professional learning drives the success of the culture of a school and students' success. Designing professional development training, which solely depends on teachers' perspectives of what they believe to be affecting mathematics instructional strategies, is the change that is needed in professional development. This project of implementing instructional practices for teachers to improve elementary school students' mathematics achievement can potentially impact social change for local teachers within the school district, other school districts, and on the societal level. Despite the achievement gap in elementary mathematics students display daily, I am faithful that this project will impact social change. This experience has given me a unique perception and appreciation for educational research and its impact on bettering educational ventures for the future.

Local Change

This study will impact social change locally as teachers will be aware of current educational trends that will support our students better while learning mathematics. Educators outside my local region could use this study to see how well professional development promotes and supports effective instructional practices to improve elementary school students' mathematics achievement. I am confident that my research will impact not only our local school district but other schools around the nation and possibly the world.

Locally, district stakeholders will have a deeper understanding of effective instructional practices that teachers and students can use to improve elementary school students' mathematics achievement. Despite the academic gap observed during the study, I am confident that with the help of district leaders, teachers will be provided with more relevant and meaningful professional development to help students and improve their mathematics skills. Many teachers will be able to strengthen their instructional strategies to improve students' success rates in elementary-level mathematics classes. I also realize that when teachers are encouraged to support their students' needs with trendy instructional practices, students gravitate towards easier than traditional methods. As professional development becomes successful in the local school district, teachers can collaborate and train other teachers to implement these mathematics strategies in their classrooms.

Societal and Policy Change

This study can be applied to all fields of education as it provides a sample of professional learning and various effective instructional strategies that can be used in multiple content areas. Professional learning helps to support the learning within a school. Often, educators must design their approach based on the culture of learning of the population at the school. Professional development helps support teachers with current research, instructional practices, and content knowledge to help increase student achievement. As I conducted interviews for this project study, it was evident that asking teachers what they find to be most effective and what they need to help students succeed is the key to effective professional development training. Students will perform at higher achievement levels by implementing these effective, in-depth instructional strategies.

This project study can promote positive societal change by providing Grades 3 through 5 teachers with professional development to improve how these teachers deliver effective, research-based mathematics instructional strategies to increase students' mathematics achievement. Providing teachers with the professional development training to deliver effective mathematics strategies will help improve students' mathematics understanding, which helps prepare students for success in grade school, readiness for college, and future careers.

Applications

As data were collected for this project study, teachers recognized that the current professional development training in the local school district needed some improvement to help increase student achievement. Teachers wanted to collaborate more with their

peers to create effective lessons collectively. Creating a professional development designed as the one for this study will allow teachers to collaborate in vertical team planning to create lesson plans that will be effective for students' current grade level and the next grade level. As for strengthening the professional development training, using the feedback questions after each session will address what the teachers need to increase students' mathematics achievement. With collaboration being a key component of this professional development training, teachers can create a community with other teachers or stakeholders to learn effective mathematics instructional strategies. The professional development designed in this study may be helpful to other school districts as well. I plan to collaborate with other schools in the local school district to provide this mathematics professional development training to other teachers in Grades 3 through 5.

Future Research

Technology has become a norm since the COVID-19 pandemic. Therefore, creating a technology component within this professional development training would benefit future research. As this project study was based on qualitative research, a mixed-method approach can be implemented to examine the influence of professional development on students' mathematics scores.

Conclusion

Mathematics permits children to complete daily tasks if they have received effective strategies effectively. For students to have the skills to complete these tasks, teachers must have the pedagogy to deliver effective mathematics instruction. Developing professional development that the findings for this research study suggest are

effective mathematics strategies, such as the CRA model, UDL approach, differentiation, experiential learning, mnemonics, and mathematics fluency, can influence the academic achievement of elementary students in Grades 3 through 5. Participants in this study provided their perceptions on what instructional strategies they believe to be effective in increasing students' academic achievement.

The case study focused on the gap in mathematics instructional strategies and students' achievement. I developed professional development training from interviews with participants to provide teachers with effective mathematics instructional strategies and practices to improve students' mathematics achievement. I wish to present the project to the local school site administrators and implement the professional development project for Grades 3 through 5. Cohesiveness is needed in the mathematics strategies and practices being delivered at the local school site to improve student achievement. This project study and professional development should bring social change to close the gaps in mathematics achievement.

References

Abrahamson, D., Flood, V. J., Miele, J. A., & Siu, Y. T. (2019). Enactivism and ethnomethodological conversation analysis as tools for expanding Universal Design for Learning: The case of visually impaired mathematics students. *ZDM Mathematics Education, 51*(2), 291-303. https://doi.org/10.1007/s11858-018-0998-1

Akkan, Y. (2021). Mathematics teachers' understanding of the concept of mathematical fluency. *Turkish Journal of Mathematics Education*, *2*(2), 84-109. https://doi.org/10.16949/turkbilmat.323384

Alegre, F., Moliner, L., Maroto, A., & Lorenzo-Valentin, G. (2020). Academic achievement and peer tutoring in mathematics: A comparison between primary and secondary education. *Sage Open*, *10*(2).

Alrajeh, T. S., & Shindel, B. W. (2020). Student engagement and math teachers support. *Journal on Mathematics Education*, *11*(2), 167-180.

Althauser, K. L. (2018). The emphasis of inquiry instructional strategies: Impact on preservice teachers' mathematics efficacy. *Journal of Education and learning*, *7*(1), 53-70.

Ansari Ricci, L., Persiani, K., Williams, A. D., & Ribas, Y. (2021). Preservice general educators using co-teaching models in math and science classrooms of an urban teacher residency programme: Learning inclusive practices in teacher training. *International Journal of Inclusive Education*, *25*(4), 517-530. https://doi.org/10.1080/13603116.2018.1563643

Anthony, G., Hunter, J., & Hunter, R. (2019). Working towards equity in mathematics education: Is differentiation the answer? In G. Hine, S. Blackley, & A. Cooke (Eds.), *Mathematics education research: Impacting practice* (pp. 117-124). https://files.eric.ed.gov/fulltext/ED604500.pdf

Awofala, A. O., & Lawani, A. O. (2020). Increasing mathematics achievement of senior secondary school students through differentiated instruction. *Journal of Educational Sciences*, *4*(1). https://doi.org/10.31258/jes.4.1.p.1-19

Baker, A. T., & Cuevas, J. (2018). The importance of automaticity development in mathematics. *Georgia Educational Researcher*, *14*(2), 11-23. https://digitalcommons.georgiasouthern.edu/gerjournal/vol14/iss2/2?utm_source=digitalcommons.georgiasouthern.edu%2Fgerjournal%2Fvol14%2Fiss2%2F2&utm_medium=PDF&utm_campaign=PDFCoverPages

Basham, J. D., Blackorby, J., & Marino, M. T. (2020). Opportunity in crisis: The role of universal design for learning in educational redesign. *Learning Disabilities: A Contemporary Journal*, *18*(1), 71-91. https://files.eric.ed.gov/fulltext/EJ1264277.pdf

Behlol, M. G., Akbar, R. A., & Sehrish, H. (2018). Effectiveness of problem-solving methods in teaching mathematics at elementary level. *Bulletin of Education & Research*, *40*(1), 231-244. https://files.eric.ed.gov/fulltext/EJ1209742.pdf

Benson-O'Connor, C. D., McDaniel, C., & Carr, J. (2019). Bringing math to life: Provide students opportunities to connect their lives to math. *Network: An Online Journal for Teacher Research, 21*(2). https://doi.org/10.4148/2470-6353.1299

Berrett, A. N., & Carter, N. J. (2018). Imagine math facts improves multiplication fact fluency in third-grade students. *Journal of Behavioral Education*, *27*(2), 223-239. https://doi.org/10.1007/s10864-017-9288-1

Björklund, C., van den Heuvel-Panhuizen, M., & Kullberg, A. (2020). Research on early childhood mathematics teaching and learning. *ZDM- Mathematics Education*, *52*(4), 607-619. https://doi.org/10.1007/s11858-020-01177-3

Boon, R. T., Urton, K., Gruenke, M., & Rux, T. A. (2019). Mnemonic strategies in mathematics instruction for students with learning disabilities: A narrative review. *Learning Disabilities: A Multidisciplinary Journal*, *24*(2), 49-62. https://doi.org/10.18666/ldmj-2019-v24-i2-9901

Brigandi, C. B., Gilson, C. M., & Miller, M. (2019). Professional development and differentiated instruction in an elementary school pullout program: A gifted education case study. *Journal for the Education of the Gifted*, *42*(4), 362-395. https://doi.org/10.1177/0162353219874418

Cai, J., Chen, T., Li, X., Xu, R., Zhang, S., Hu, Y., Zhang, L., & Song, N. (2020). Exploring the impact of a problem-posing workshop on elementary school mathematics teachers' conceptions on problem posing and lesson design. *International Journal of Educational Research*, *102*, 101404. https://doi.org/10.1016/j.ijer.2019.02.004

Camfield, L., & Palmer-Jones, R. (2013). Improving the quality of development research: What could archiving qualitative data for reanalysis and revisiting research sites

contribute? *Progress in Development Studies, 13*(4), 323-338. http://doi.org/10.1177/1464993413490481

Chambers, D., & Coffey, A. (2019). Guidelines for designing middle-school transition using universal design for learning principles. *Improving Schools, 22*(1), 29-42. https://doi.org/10.1177/1365480218817984

Charalambous, C. Y., & Delaney, S. (2019). Mathematics teaching practices and practice-based pedagogies: A critical review of the literature since 2000. *International Handbook of Mathematics Teacher Education* (vol. 1, pp. 355-390). https://doi.org/10.1163/9789004418875_014

Charalambous, C. Y., Hill, H. C., Chin, M. J., & McGinn, D. (2020). Mathematical content knowledge and knowledge for teaching: Exploring their distinguishability and contribution to student learning. *Journal of Mathematics Teacher Education, 23*(6), 579-613. https://doi.org/10.1007/s10857-019-09443-2

Cho, J., Kim, S., & Lee, D. (2019). Prospective teachers' perception on the teaching sequence of multiplication and division of fractions and decimal numbers. *Journal of Elementary Mathematics Education in Korea, 23*(1), 1-17.

Corkin, D. M., Ekmekci, A., & Parr, R. (2018). The effects of the school-work environment on mathematics teachers' motivation for teaching: A self-determination theoretical perspective. *Australian Journal of Teacher Education, 43*(6), 50-66. http://dx.doi.org/10.14221/ajte.2018v43n6.4

Cottone, R. R. (2017). In defense of radical social constructivism. *Journal of Counseling & Development, 95*(4), 465–471. https://doi.org/10.1002/jcad.12161

Craig, S. L., Smith, S. J., & Frey, B. B. (2022). Professional development with universal design for learning: supporting teachers as learners to increase the implementation of UDL. *Professional Development in Education*, *48*(1), 22-37. https://doi.org/10.1080/19415257.2019.1685563

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage.

Doabler, C. T., Nelson, N. J., Kennedy, P. C., Stoolmiller, M., Fien, H., Clarke, B., Gearin, B., Smolkowski, K., & Baker, S. K. (2018). Investigating the longitudinal effects of a core mathematics program on evidence-based teaching practices in mathematics. *Learning Disability Quarterly*, *41*(3), 144-158. http://dx.doi.org/10.1177/0731948718756040

Drushlyak, M. G., Semenikhina, O. V., Proshkin, V. V., & Sapozhnykov, S. V. (2021, March). Training pre-service mathematics teacher to use mnemonic techniques. In *Journal of Physics: Conference Series* (Vol. 1840, No. 1, p. 12006). IOP Publishing. http://doi.org/10.1088/1742-6596/1840/1/012006

Dwijanto, I. H., & Istiandaru, A. (2018). Manipulatives and question series for elementary school mathematics teaching on solid geometry. *International Journal of Instruction*, *11*(3), 649-662. https://files.eric.ed.gov/fulltext/EJ1183443.pdf

Evmenova, A. (2018). Preparing teachers to use universal design for learning to support diverse learners. *Journal of Online Learning Research*, *4*(2), 147-171. https://www.learntechlib.org/primary/p/181969/

Farrokh, P., Vaezi, H., & Ghadimi, H. (2021). Visual mnemonic technique: An effective learning strategy. *GIST–Education and Learning Research Journal, 23,* 7-32. https://doi.org/10.26817/16925777.1042

Fitriani, A. D., Prabawanto, S., & Darhim, D. (2020). The mathematical content knowledge of elementary school pre-service teachers. In *Borderless Education as a Challenge in the 5.0 Society* (pp. 311-315). Routledge. https://doi.org/10.1201/9781003107279-58

Fries, L., Son, J. Y., Givvin, K. B., & Stigler, J. W. (2021). Practicing connections: A framework to guide instructional design for developing understanding in complex domains. *Educational Psychology Review*, *33*(2), 739-762. http://doi.org/10.1007/s10648-020-09561-x

García-Campos, M. D., Canabal, C., & Alba-Pastor, C. (2020). Executive functions in universal design for learning: Moving towards inclusive education. *International Journal of Inclusive Education*, *24*(6), 660-674. http://doi.org/10.1080/13603116.2018.1474955

Gentles, S. J., Charles, C., Ploeg, J., & McKibbon, K. (2015). Sampling in qualitative research: Insights from an overview of the methods literature. *The Qualitative Report, 20*(11), 1772-1789. https://nsuworks.nova.edu/tqr/vol20/iss11/5/

Georgia Department of Education. (2019a). *Glossary of CCRPI terms.* https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Accountability/Documents/Resdesigned%20CCRPI%20Support%20

Documents/2019%20Resources%20for%20Educators/Glossary%20of%20CCRPI%20Terms%208.2.19.pdf#search=glossary

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

Georgia Department of Education. (2020). *Teacher Keys Effectiveness System*. https://www.gadoe.org/School-Improvement/Teacher-and-Leader-Effectiveness/Pages/Teacher-Keys-Effectiveness-System.aspx

Ghofur, A., Masrukan, M., & Rochmad, R. (2022). Mathematical literacy ability in experiential learning with performance assessment based on self-efficacy. *Unnes Journal of Mathematics Education Research*, *11*(1), 94-101. http://journal.unnes.ac.id/sju/index.php/ujmer

Gibbs, A. S., Hinton, V. M., & Flores, M. M. (2018). A case study using CRA to teach students with disabilities to count using flexible numbers: Applying skip counting to multiplication. *Preventing School Failure: Alternative Education for Children and Youth*, *62*(1), 49-57. https://doi.org/10.1080/1045988X.2017.1342218

Glesne, C. (2011). *Becoming qualitative researchers: An introduction* (4th ed.). Pearson.

Guest, G., MacQueen, K. M., & Namey, E. E. (2011). *Applied thematic analysis.* SAGE Publications.

Gupta, A. (2008). Constructivism and peer collaboration in elementary mathematics education: The connection to epistemology. *Eurasia Journal of Mathematics,*

Science and Technology Education, *4*(4), 381-386. https://doi.org/10.12973/ejmste/75364

Hajovsky, D. B., Oyen, K. A., Chesnut, S. R., & Curtin, S. J. (2020). Teacher–student relationship quality and math achievement: The mediating role of teacher self-efficacy. *Psychology in the Schools*, *57*(1), 111-134. https://doi.org/10.1002/pits.22322

Hao, S. U. N., Ximin, C. U. I., Debao, Y. U. A. N., Jinbao, J. I. A. N. G., & Wenbin, S. U. N. (2020). Exploring and practicing of effective teaching methods for quantitative remote sensing courses. *Bulletin of Surveying and Mapping*, (7), 147. http://doi.org/10.13474/j.cnki.11-2246.2020.0233

Hardman, J., & Lilley, W. (2023). iLearn? Investigating dialogical interaction with tablets in mathematics lessons. *Technology, Pedagogy and Education*, *32*(3), 321-335. https://doi.org/10.1080/1475939X.2023.2193194

Hidayah, I., & Asikin, M. (2021). Quality management of mathematics manipulative products to support students' higher order thinking skills. *International Journal of Instruction*, *14*(1), 537-554. 4. https://doi.org/10.29333/iji.2021.14132a

Hima, L. R., Nusantara, T., Hidayanto, E., & Rahardjo, S. (2019). Changing in mathematical identity of elementary school students through group learning activities. *International Electronic Journal of Elementary Education*, *11*(5), 461-469. https://doi.org/10.26822/iejee.2019553342

Hyett, N., Kenny, A., & Dickson-Swift, V. (2014). Methodology or method? A critical review of qualitative case study reports. *International journal of qualitative*

studies on health and well-being, *9*(1), 23606. http://doi.org/10.3402/qhw.v9.23606

Hyslop-Margison, E. J., & Strobel, J. (2008). Constructivism and education: Misunderstandings and pedagogical implications. *Australian Journal of Teacher Education*, *43*(1), 72-86. http://dx.doi.org/10.1080/0887873070172894

Iglesias-Sarmiento, V., Alfonso, S., Conde, Á., Pérez, L., & Deaño, M. (2020). Mathematical difficulties vs. high achievement: An analysis of arithmetical cognition in elementary school. *Developmental Neuropsychology*, *45*(2), 49-65. https://doi.org/10.1080/87565641.2020.1726920

Indriayu, M. (2019). Effectiveness of experiential learning-based teaching material in mathematics. *International Journal of Evaluation and Research in Education*, *8*(1), 57-63. https://doi.org/10.11591/ijere.v8.i1.

Ishak, A. H. N., Osman, S., Wei, C. K., Kurniati, D., Ismail, N., & Nanna, A. (2021). Teaching strategies for mathematical problem-solving through the lens of secondary school teachers. *TEM Journal, 10*(2), 743-850. http://doi.org/10.18421/TEM102-31

Karnes, J., Barwasser, A., & Grünke, M. (2021). The effects of a math racetracks intervention on the single-digit multiplication facts fluency of four struggling elementary school students. *Insights into Learning Disabilities, 18*(1), 53-77. https://files.eric.ed.gov/fulltext/EJ1295254.pdf

Khan, S. N. (2014). Qualitative research method: Grounded theory. *International Journal of Business and Management, 9*(11), 224-233. http://dx.doi.org/10.5539/ijbm.v9n11p224

Kieran, L., & Anderson, C. (2019). Connecting universal design for learning with culturally responsive teaching. *Education and Urban Society*, *51*(9), 1202-1216. https://doi.org/10.1177/0013124518785012

Kusuma, J. W., Rochmad, R., Isnarto, I., & Hamidah, H. (2021). Constructivism from philosophy to mathematics learning. *International Journal of Economy, Education and Entrepreneurship*, *1*(2), 104–111. https://doi.org/10.53067/ije3.v1i2.16

Lacy, C. (2019). *Problem-solving versus solving problems from the ESL math teachers' point of view* (Thesis, Concordia University, St. Paul). https://digitalcommons.csp.edu/ cup_commons_grad_edd/411

Lambert, R., Imm, K., Schuck, R., Choi, S., & McNiff, A. (2021). "UDL is the what, design thinking is the how:" Designing for differentiation in mathematics. *Mathematics Teacher Education and Development, 23*(3), 54-77. https://files.eric.ed.gov/fulltext/EJ1321118.pdf

Lee, Y., Capraro, R. M., & Capraro, M. M. (2018). Mathematics teachers' subject matter knowledge and pedagogical content knowledge in problem posing. *International Electronic Journal of Mathematics Education*, *13*(2), 75-90. https://doi.org/10.12973/iejme/2698

Liggett, R. S. (2017). The impact of use of manipulatives on the math scores of grade 2 students. *Brock Education: A Journal of Educational Research and Practice, 26*(2), 87-101. https://doi.org/10.26522/brocked.v26i2.607

Lin, X., Peng, P., & Zeng, J. (2021). Understanding the relation between mathematics vocabulary and mathematics performance: A meta-analysis. *The Elementary School Journal, 121*(3), 504-540. https://doi.org/10.1086/712504

Lindeman, A. (2019). *Improving math fact fluency in elementary students with computer-assisted instruction: A quasi-experimental study* (Doctoral dissertation, Northcentral University). https://www.proquest.com/dissertations-theses/improving-math-fact-fluency-elementary-students/docview/2322186312/se-2

Lodico, M., Spaulding, D., & Voegtle, K. (2010). *Methods in educational research: From Theory to Practice.* Wiley.

Long, T., Zhao, G., Li, X., Zhao, R., Xie, K., & Duan, Y. (2020). Exploring Chinese in-service primary teachers' Technological Pedagogical Content Knowledge (TPACK) for the use of thinking tools. *Asia Pacific Journal of Education*, 1-21. https://doi.org/10.1080/02188791.2020.1812514

Macdonald, K., Milne, N., Orr, R., & Pope, R. (2020). Associations between motor proficiency and academic performance in mathematics and reading in year 1 school children: A cross-sectional study. *BMC pediatrics, 20*(1), 1-11. https://doi.org/10.1186/s12887-020-1967-8

Maghfirah, M., & Mahmudi, A. (2018). Number sense: The result of mathematical experience. *Journal of Physics: Conference Series*, 1097(1), 1. https://doi.org/10.1088/1742-6596/1097/1/012141

Malterud, K., Siersma, V. D., & Guassora, A. D. (2016). Sample size in qualitative interview studies: Guided by information power. *Qualitative Health Research*, *26*(13), 1753–1760. https://doi.org/10.1177/1049732315617444

Marshall, B., Cardon, P., Poddar, A., & Fontenot, R. (2013). Does sample size matter in qualitative research? A review of qualitative interviews in research. *Journal of Computer Information Systems, 54,* 11-22. http://www.iacis.org/jcis/jcis.php

Martin, C., Mraz, M., & Polly, D. (2022). Examining Elementary School Teachers' Perceptions of and Use of Formative Assessment in Mathematics. *International Electronic Journal of Elementary Education*, *14*(3), 417–425. https://www.iejee.com/index.php/IEJEE/article/view/1764

Mavidou, A., & Kakana, D. (2019). Differentiated instruction in practice: Curriculum adjustments in kindergarten. *Creative Education*, *10*(3), 535-554. https://doi: 10.4236/ce.2019.103039

Meiri, R., Levinson, O., & Horowitz-Kraus, T. (2019). Altered association between executive functions and reading and math fluency tasks in children with reading difficulties compared with typical readers. *Dyslexia, 25*(3), 267-283. https://doi.org/10.1002/dys.1624

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.

Merritt, E. G., Palacios, N., Banse, H., Rimm-Kaufman, S. E., & Leis, M. (2017). Teaching practices in grade 5 mathematics classrooms with high-achieving English learner students. *Journal of Educational Research*, *110*(1), 17-31. https://doi.org/10.1080/00220671.2015.1034352

Morano, S., Randolph, K., Markelz, A. M., & Church, N. (2020). Combining explicit strategy instruction and mastery practice to build arithmetic fact fluency. *TEACHING Exceptional Children*, *53*(1), 60-69. https://doi.org/10.1177/0040059920906455

Nazihovna, Y. G., & Ibrokhimjon kizi, A. S. (2022, June 5). *Mnemonics, information technologies and software methodology of teaching "English + mathematics+ informatics" (STEAM Education).* International Conference on Research in Humanities, Applied Sciences and Education, 444-450. https://conferencea.org/index.php/conferences/article/view/652/610

Newton, K. J., Leonard, J., Evans, B. R., & Eastburn, J. A. (2012). Preservice elementary teachers' mathematics content knowledge and teacher efficacy. *School Science and Mathematics, 112*(5), 289-299. https://doi.org/10.1111/j.1949-8594.2012.00145.x

Ni, L. B., & Hassan, N. A. B. (2019). The use of mnemonic and mathematical mnemonic method in improving historical understanding. *International Journal of Educational and Pedagogical Sciences, 13*(2), 93-97. https://www.researchgate.net/profile/Bih-Lee/publication/330873641_The_Use_of_Mnemonic_and_Mathematical_Mnemo

nic_Method_in_Improving_Historical_Understanding/links/5c5945ec92851c22a3aa7904/The-Use-of-Mnemonic-and-Mathematical-Mnemonic-Method-in-Improving-Historical-Understanding.pdf

Nieminen, J. H., & Pesonen, H. V. (2019). Taking universal design back to its roots: Perspectives on accessibility and identity in undergraduate mathematics. *Education Sciences, 10*(1), 12. https://doi.org/10.3390/educsci10010012

Nugroho, S. A., & Jailani, J. (2019). The effectiveness of concrete representational abstract approach (CRA) approach and problem solving approach on mathematical representation ability at elementary school. *KnE Social Sciences, 3*(17), 27-36. https://doi.org/10.18502/kss.v3i17.4620

Onwuegbuzie, A. J., & Collins, K. M. T. (2007). A typology of mixed methods sampling designs in social science research. *The Qualitative Report, 12*(2), 281-316. https://nsuworks.nova.edu/tqr/vol12/iss2/9

Organisation for Economic Co-operation and Development (OECD). (2018). *Programme for International Student Assessment (PISA) Results from PISA 2018, United States.* https://www.oecd.org/pisa/publications/PISA2018_CN_USA.pdf

Panthi, R. K., & Belbase, S. (2017). Teaching and learning issues in mathematics in the context of Nepal. In *Online Submission*. Online Submission. https://files.eric.ed.gov/fulltext/ED573754.pdf

Paul, J. M., Gray, S. A., Butterworth, B. L., & Reeve, R. A. (2018, June 7). Reading and math tests differentially predict number transcoding and number fact speed

longitudinally: A random intercept cross-lagged panel approach. *Journal of Educational Psychology*. http://dx.doi.org/10.1037/edu0000287

Pellegrini, M., Neitzel, A., Lake, C., & Slavin, R. (2021). Effective programs in elementary mathematics: A best-evidence synthesis. *AERA Open, 7*(1), 1-29. https://doi.org/10.1177/2332858420986211

Peng, P., & Lin, X. (2019). The relation between mathematics vocabulary and mathematics performance among fourth graders. *Learning and Individual differences, 69*, 11-21. https://doi.org/10.1016/j.lindif.2018.11.006

Polman, J., Hornstra, L., & Volman, M. (2021). The meaning of meaningful learning in mathematics in upper-primary education. *Learning Environments Research, 24*(3), 469-486. https://doi.org/10.1007/s10984-020-09337-8

Ponisciak, S. M., & Dallavis, J. W. (2022). Student performance on renaissance star assessments in catholic and public schools. *Religion & Education, 49*(2), 212-233. https://doi.org/10.1080/15507394.2022.2069453

Prast, E. J., Van de Weijer-Bergsma, E., Kroesbergen, E. H., & Van Luit, J. E. (2018). Differentiated instruction in primary mathematics: Effects of teacher professional development on student achievement. *Learning and Instruction, 54*, 22-34. https://doi.org/10.1016/j.learninstruc.2018.01.009

Purwadi, I., Sudiarta, I., & Suparta, I. N. (2019). The effect of concrete-pictorial-abstract strategy toward students' mathematical conceptual understanding and mathematical representation on fractions. *International Journal of Instruction, 12*(1), 1113-1126. https://doi.org/10.29333/iji.2019.12171a

Qu, S. Q., & Dumay, J. (2011). The qualitative research interview. *Qualitative Research in Accounting & Management*, *8*(3), 238-264. http://doi.org/10.1108/11766091111162070

Qushem, U. B., Christopoulos, A., & Laakso, M. J. (2022). Learning management system analytics on arithmetic fluency performance: A skill development case in K6 education. *Multimodal Technologies and Interaction*, *6*(8), 61. https://doi.org/10.3390/mti6080061

Reid, M., & Reid, S. (2017). Learning to be a math teacher: What knowledge is essential? *International Electronic Journal of Elementary Education*, *9*(4), 851-872. https://files.eric.ed.gov/fulltext/EJ1146686.pdf

Remillard, J. J., & Kim, O. O. (2017). Knowledge of curriculum-embedded mathematics: exploring a critical domain of teaching. *Educational Studies in Mathematics*, *96*(1), 65-81. http://dx.doi.org/10.1007/s10649-017-9757-4

Riegler, A., & Steffe, L. P. (2014). What is the teacher trying to teach students if they are all busy constructing their own private worlds? *Constructivist Foundations*, *9*(3), 297-301. https://constructivist.info/9/3/297.editorial

Rittle-Johnson, B. (2019). Iterative development of conceptual and procedural knowledge in mathematics learning and instruction. In J. Dunlosky & K. Rawson (Eds.), *The Cambridge handbook of cognition and education* (pp. 124-147). University Press. https://doi.org/10.1017/9781108235631.007

Samsuddin, A. F., & Retnawati, H. (2018). Mathematical representation: the roles, challenges and implication on instruction. *Journal of Physics: Conference Series, 1097*(1), 1. https://doi.org/10.1088/1742-6596/1097/1/012152

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

Stake, R. (2005). Qualitative case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (3rd ed., pp. 433-466). Sage.

Steiner, D. M. (2014). Learning, constructivist theories of. *Value Inquiry Book Series, 276*, 319–320.

Stoevenbelt, A. H., Flore, P. C., Schwabe, I., & Wicherts, J. M. (2022). The uniformity of stereotype threat: Analyzing the moderating effects of premeasured performance. *Intelligence, 93,* 101655. https://doi.org/10.1016/j.intell.2022.101655

Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., & Reynolds, T. (2003). Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: A review of literature. Journal for the Education of the Gifted, 27, 119–145. http://doi.org/10.1177/016235320302700203

Vallée, B., Magoutier, F., Voisin, D., & Montalan, B. (2020). Reducing the effects of the stereotype threat that girls perform less well than boys in mathematics: the

efficacy of a mixed debate in a real classroom situation. *Social Psychology of Education, 23*(5), 1327-1341. https://doi.org/10.1007/s11218-020-09583-x

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Vygotsky, L. S. (1987). *Collected works of L. S. Vygotsky, Vol. 1: Problems of General Psychology* (Norris Minick, Trans.). Springer.

Wang, W., Schmidt-Crawford, D., & Jin, Y. (2018). Preservice teachers' TPACK development: A review of literature. *Journal of Digital Learning in Teacher Education, 34*(4), 234-258. https://doi.org/10.1080/21532974.2018.1498039

Wang, Z., Shakeshaft, N., Schofield, K., & Malanchini, M. (2018). Anxiety is not enough to drive me away: A latent profile analysis on math anxiety and math motivation. *Plus ONE, 13*(2), 1-16. http://dx.doi.org/10.1371/journal.pone.0192072

Westine, C. D., Oyarzun, B., Ahlgrim-Delzell, L., Casto, A., Okraski, C., Park, G., Person, J., & Steele, L. (2019). Familiarity, current use, and interest in universal design for learning among online university instructors. *International Review of Research in Open and Distributed Learning*, *20*(5), 20-41. https://doi.org/10.19173/irrodl.v20i5.4258

Wood, T., Cobb, P., & Yackel, E. (2012). Reflections on learning and teaching mathematics in elementary school. In *Constructivism in education* (pp. 419-440). Routledge. https://doi.org/10.4324/9780203052600-28

Yan, Y. (2020). Improving learning effectiveness-some aspects shouldn't be ignored in mathematics teaching. *American Journal of Educational Research and Reviews*, *5*, 74-74. https://doi.org/10.28933/ajerr-2020-07-1505

Appendix A: The Project

Instructional Practices Teachers Use to Improve Elementary School Students' Mathematics Achievement

3_Day Professional Development Outline

Overview

This professional development project is developed to be a source to help teachers implement effective mathematics instructional practices to improve elementary school students' mathematics achievement. The professional learning sessions will be provided during the 3-day professional development training, which was developed from data collected and analyzed from a case study. The professional development training is designed for teachers to create lesson plans using effective mathematics strategies to strengthen students' understanding of core mathematics standards in Grades 3 through 5. The professional development sessions will allow teachers to collaborate with their peers to create lesson plans with the mathematics instructional strategies derived from the study.

Target Audience

The target audience for this project study is elementary school teachers with at least 3 years of teaching experience in mathematics for Grades 3 through 5.

Professional Development Schedule

Professional development sessions will be held for a 3-day professional development divided amongst three quarters. The professional development will be held during the 2023-2024 school year. One professional development day will be committed

at the beginning of the first, second, and third quarters to address the units being covered during the quarter.

Professional Development Goals

1. Provide teachers with opportunities to expand classroom strategies to implement mathematics instructional strategies effectively.
2. Teachers will collaborate to create lesson plans using the concrete representational abstract (CRA) model, universal design for learning (UDL) approach, differentiation, experiential learning, mnemonics, and mathematics fluency.
3. Teachers will use the state standards, district curriculum map, and district-approved lesson plan template when designing lesson plans using effective mathematics instructional strategies derived from this study.

Professional Development Objectives

After the 3-day professional development, participants can incorporate effective research-based strategies into mathematics instruction.

Outcomes of the Professional Development

1. Teachers will learn mathematics research-based instructional strategies to incorporate into daily instruction to increase students' mathematics academic achievement.
2. Teachers will learn how to ensure students are prepared for state assessments.

Professional Development Day 1: Exploring Effective Mathematics Instructional Strategies with an Emphasis on Numbers and Base Ten

Required Materials

- Professional Development Binder: Day 1 Handouts

  (Georgia Standards of Excellence and Articles)
- Highlighters
- Anchor Charts
- Markers
- Laptop

Day 1: Exploring Effective Mathematics Instructional Strategies with an Emphasis on Numbers and Base Ten		
Time	**Session**	**Session Overview**
7:45 am-8:15 am	Ice Breaker and Welcome	Participants will participate in a toss-a-name game. The teacher participants will think of an adjective that describes their feelings about teaching mathematics, followed by their name. A soft object will be tossed around, and each person will have to say the adjective and the name stated by the person(s) before them. The first person will start the game and lead with an adjective and their name. (Slide 8) The facilitator will welcome the participants to the professional development session and review the agenda and goals. The participants will join the Google Classroom presented by the facilitator. This Google Classroom will be a place to store documents easily accessible for participants. (Slide 9)
8:15 am-9:45 am	How to implement the CRA model and	During this session, the facilitator will inform the participants about planning the UDL approach and the effectiveness of the CRA model. (Slides 10-11)

	UDL approach into daily mathematics lesson plans?	Articles: 1. Callahan, L. (2022). *Educators' perceptions of the universal design for learning framework in support of economically disadvantaged third and fourth grade students* [Doctoral dissertation, University of New England]. Digital UNE. https://dune.une.edu/theses/426 Handout: The Universal Design for Learning Guidelines. https://education.ky.gov/educational/diff/Documents/New%20Guidelines.pdf 2.Nugroho, S. A., & Jailani, J. (2019). The effectiveness of concrete representational abstract approach (CRA) approach and problem-solving approach on mathematical representation ability at elementary school. *KnE Social Sciences, 3*(17), 27-36. https://doi.org/10.18502/kss.v3i17.4620
9:45am-10:00am	Break	Participants will take a break to stretch and to get a light snack. (Slide 12)
10:00 am-11:30 am	How to implement experiential learning and mnemonics in mathematics lessons?	The facilitator will present the participants with a video of experiential learning being implemented in the classroom. The participants will complete a quizziz (an interactive game that can be played whole group or individually) to review what has been discussed on experiential learning. Quizziz Code: 158152 (Slides 13-15) The participants will break into groups to discuss an experiential learning activity they can use in their grade level's numbers and base ten unit. They will be given their grade level standards to help guide the activity created. Experiential Learning Video: https://study.com/academy/lesson/experiential-teaching-strategies-for-mathematics-concepts.html The facilitator will present the participants with a video on mnemonics and how they can be implemented in a lesson. Mnemonics Learning Video:

		https://study.com/learn/lesson/mathematics-mnemonics-examples-use.html
11:30 am-12:30 pm	Lunch	Participants will break for lunch. (Slide 16)
12:30 pm-1:00 pm	Mathematics Fluency	The facilitator will discuss mathematics fluency and how to build mathematics fluency. Each participant will register for a free class(es) on xtramath.org. The participants will use the XtraMath program in their classrooms. (Slide 17)
1:00 pm-3:00 pm	Plan and Create to Execute	The facilitator will provide participants with a lesson plan format using the themes from this participation. The participants will choose a standard from Numbers and Base Ten to create a lesson using the themes. The participants will be given standards, anchor charts, and markers to create materials to return to their classrooms immediately. (Slide 18)
3:00 pm-3:15 pm	Wrap-Up/ Next Steps Evaluation Form	The facilitator will provide an online link for participants to complete the evaluation form. (Slide 19)

Professional Development Day 2: Exploring Effective Mathematics Instructional Strategies with an Emphasis on Operations and Algebraic Thinking

Required Materials

- Professional Development Binder: Day 2 Handouts

  (Georgia Standards of Excellence and Articles)
- Highlighters
- Anchor Charts
- Markers
- Laptop

Day 2: Exploring Effective Mathematics Instructional Strategies with an Emphasis on Operations and Algebraic Thinking		
Time	**Session**	**Session Overview**
7:45 am-8:05 am	Ice Breaker and Welcome	Participants will participate in a toss-a-name game. The teacher participants will think of an adjective that describes their feelings about applying effective strategies to their daily lesson plans since the first professional development session, followed by their names. A soft object will be tossed around, and each person will have to say the adjective and the name stated by the person(s) before them. The first person will start the game and lead with an adjective and their name. (Slide 27) The facilitator will welcome the participants to the professional development session and review the agenda and goals.
8:05am-8:15am	Feelings?	The facilitator will ask the participants to share their feelings on applying the mathematics instructional strategies since the first session. (Slide 28)
8:15 am-9:45 am	Using the CRA Model When Teaching	During this session, the facilitator will present the participants with a hard copy of grade-level state activities and allow them to go to https://www.georgiastandards.org/Georgia-Standards/pages/mathematics.aspx to view state activities. The teachers will break into groups to review the state activities and

	Operations and Algebraic Thinking	highlight which activities show examples of the CRA model being used. (Slide 29) Articles: Day, L., & Hurrell, D. (2018). *Process over product: It's more than an equation*—Mathematical Association of Victoria Annual Conference. https://researchonline.nd.edu.au/cgi/viewcontent.cgi?article=1123&context=edu_conference Handout: Concrete-Representational-Abstract: Instructional Sequence for Mathematics https://www.pattan.net/getmedia/9059e5f0-7edc-4391-8c8e-ebaf8c3c95d6/CRA_Methods0117
9:45am-10:00 am	Break	Participants will take a break to stretch and to get a light snack. (Slide 30)
10:00 am-11:30 am	Experiential Learning and Using Mnemonics with Operations and Algebraic Thinking	The facilitator will show the participants a video on students using experiential learning and mnemonics. The group will discuss the pros and cons of the video. (Slide 31) ***Video:*** The Big Picture of "Teaching the New Way" in the Ron Clark Academy [Video]**.** https://www.facebook.com/RonClarkAcademy/videos/rca-mathematics-song/10154657689053599/ The facilitator will bring the participants back to discuss the pros and cons. The facilitator will instruct the participants to choose a standard from the operations and algebraic thinking unit to create a mnemonic.
11:30 am-12:30 pm	Lunch	Participants will break for lunch. (Slide 32)
12:30 pm-	Mathematics Fluency	The facilitator will ask the participants to share data from their classes. The facilitator will want to know how often students use XtraMath weekly. (Slide 33)

1:00 pm		
1:00 pm- 3:00 pm	Plan and Create to Execute	The facilitator will provide participants with a lesson plan format using the themes from this participation. The participants will choose a standard from Operations and Algebraic Thinking to create a lesson using the themes. The participants will be given standards, anchor charts, and markers to create materials to immediately take back to their classrooms. (Slide 34)
3:00 pm- 3:15 pm	Wrap Up/ Next Steps Evaluation Form	The facilitator will provide an online link for participants to complete the evaluation form. (Slide 35)

Professional Development Day 3: Exploring Effective Mathematics Instructional Strategies with an Emphasis on Numbers and Base Ten-Fractions

Required Materials

- Professional Development Binder: Day 3 Handouts

  (Georgia Standards of Excellence and Articles)
- Highlighters
- Anchor Charts
- Markers
- Laptop

Day 3: Exploring Effective Mathematics Instructional Strategies with an Emphasis on Numbers and Base Ten-Fractions		
Time	**Session**	**Session Overview**
7:45 am-8:15 am	Ice Breaker and Welcome	Participants will participate in a toss-a-name game. The teacher participants will think of an adjective that describes their feelings about how they feel teaching mathematics after this professional development, followed by their names. A soft object will be tossed around, and each person will have to say the adjective and the name stated by the person(s) before them. The first person will start the game and lead with an adjective and their name. (Slide 43) The facilitator will welcome the participants to the professional development session and review the agenda and goals. (Slide 44)
8:15 am-9:45 am	Using the CRA Model When Teaching Numbers and	During this session, the facilitator will provide an overview of the CRA instructional model. The facilitator will provide an article for students to review on building an understanding of fraction division with the CRA instructional model.

	Base Ten Fractions	(Slides 45-46) Articles: 1. Disney, A., Eisenreich, H., Fisher, K., Lorden, A., Willis, T., & High, S. J. (2022). *I can't remember which fraction to keep or flip: Building understanding of fraction division with the CRA instructional model*. https://www.gctm.org/page-1709595 The facilitator will show the participants the video "Using the CRA approach to teach fractions." Video: *Using the CRA approach to teach fractions* [Video]. YouTube. https://www.youtube.com/watch?v=GLZ92IuDWSM The participants will view: How to teach mathematics effectively using the concrete representational abstract model. Shelley Gray. https://shelleygrayteaching.com/concrete-representational-abstract-model/ to view various CRA models used in mathematics.
9:45am-10:00am	Break	Participants will take a break to stretch and get a light snack. (Slide 47)
10:00 am-11:30 am	How to implement experiential learning and mnemonics in mathematics lessons?	The facilitator will present the participants with a video of implementing mnemonics in the classroom. The participants will complete a quizziz to review what has been discussed on mnemonics. Quizziz Code: 715410 (Slides 48-49) The participants will break into groups to discuss an experiential learning activity they can use in their grade level's numbers and base ten units. They will be given their grade level standards to help guide the activity created. *This Order of Operations Mnemonic is Better Than PEMDAS Rule!* [Video]. YouTube. https://www.youtube.com/watch?v=GJIey1WPcsQ

		The facilitator will present the participants with a video on using mnemonics when solving fractions. Mnemonics Learning Video: https://www.youtube.com/watch?v=GJIey1WPcsQ
11:30 am-12:30 pm	Lunch	Participants will break for lunch. (Slide 50)
12:30 pm-1:00 pm	Mathematics Fluency	The facilitator will ask the participants to share data from their classes. The facilitator will want to know how often students use XtraMath weekly. (Slide 51)
1:00 pm-3:00 pm	Plan and Create to Execute	The facilitator will provide participants with a lesson plan format using the themes from this participation. The participants will choose a standard from Numbers and Base Ten-Fractions to create a lesson using the themes. The participants will be given standards, anchor charts, and markers to create materials to immediately take back to their classrooms. (Slide 52)
3:00 pm-3:15 pm	Wrap-Up/ Next Steps Evaluation Form	The facilitator will provide an online link for participants to complete the evaluation form. (Slide 53)

Evaluation Form

1. How was today's professional development beneficial?

2. Based on today's professional development, how can you immediately return to your classroom and apply one or mathematics instructional strategies in your daily instruction?

3. Which instructional strategy(s) did you find most effective with today's mathematics unit and why?

4. Which instructional strategy(s) did you find ineffective with today's mathematics unit and why?

5. What suggestions do you have to help strengthen the professional development?

Appendix B: Interview Questions

Interview performed by: Kwanza Atkinson
Teacher Interviewee: _____
Teacher Interviewee Position: _____
Date of Interview: _____
Interview Location: _____
Interview Start Time: _____
Interview End Time: _____
Interview Location: _____
Interview Start Time: _____
Interview End Time: _____

1. What current district-approved mathematics strategies are you implementing in your lessons? (RQ1)

2. What current mathematics strategies that you are currently using do you find to be most effective for Grades 3-5 students? (RQ2)

3. Tell me about a mathematics lesson that you found to be most successful with students. (RQ2)

4. What about the lesson did you think helped it to be successful? (RQ2)

5. Was there anything about the lesson you might change? (RQ2)

6. Tell me about a mathematics lesson that did not go as well as you hoped it would. (RQ2)

7. What do you think might improve the lesson, or what would you do differently the next time you teach the lesson? (RQ2)

8. How can your school district help to support your needs to improve student achievement in mathematics? (RQ2)

9. What have I not asked you that you need to share with me?

Appendix C: Lesson Plan Protocol

Date:

Teacher ID:

Lesson Plan 1/Lesson Plan 2 (circle):

Content/Concept Taught (Write in):

Approach/Strategy	**Number of occurrences in lesson plan**	**Notes** (Did the teachers name the approach/strategy or provide detail in using the approach/strategy?).
UDL approach		
CRA model		
Differentiation		
Experiential learning		
Mnemonics		
Math fluency		

Appendix D: Codes

Code 1: Abundance of resources
Code 2: Collaboration
Code 3: CRA model
Code 4: Flexibility
Code 5: Hands-on activities
Code 6: Mathematics competency
Code 7: Notetaking
Code 8: Peer tutoring
Code 9: Student journals
Code 10: Student seating
Code 11: Summarizing strategies
Code 12: Support visits
Code 13: Teacher journal
Code 14: Teaching with manipulatives
Code 15: Time management
Code 16: Types of learners
Code 17: Visible resources
Code 18: Visuals
Code 19: Vocabulary
Code 20: Workshops
Code 21: Academic achievement levels
Code 22: Differentiation
Code 23: Factors for student performance
Code 24: Increase math scores
Code 25: Lack of resources
Code 26: Learning through experiences
Code 27: Low-achieving students
Code 28: Math facts repetitiveness
Code 29: Mnemonics
Code 30: Multiplication fluency
Code 31: Preparation for state assessments
Code 32: Professional development
Code 33: Real-life connections
Code 34: Standard algorithm
Code 35: Test readiness
Code 36: Training

Appendix E: Hand Codes and Examples

Code	Participant	Example
Hands-on Activities	Participant 4	Hands-on and visuals are important strategies to implement in math lessons. Students can have something that they can see, something that they can touch.
Collaboration	Participant 3	By using peer collaboration, students can collaborate with their peers to fill in the missing gaps of what they are misunderstanding.
Academic achievement levels	Participant 8	I was able to differentiate the lesson based on all students' needs and derive my lesson from those accommodations, student learning differences.
Learning through experiences	Participant 3	Manipulatives allows students to explore learning through an active experience.
Lack of resources	Participant 2	Having more support that they could give their teachers to be more successful. We need more training on how to strengthen district-approved strategies.

Appendix F: NVivo Codes and Examples

Code	Participant	Example
Teaching with manipulatives	Participant 6	I find it most effective to allow students to explore concepts with the use of manipulatives and visual representations.
Visible resources	Participant 2	Students who have the biggest struggles are able to turn towards my chart paper to view the anchor chart on the standard.
Factors for student performance	Participant 6	…the use of consistent tools and visual representations contributed to the success of the lesson.
Real-life connections	Participant 5	Rather than focus on my students' abilities to compute using measurement units, I will be sure to have my students explore measurement concepts with concrete, relevant, real-world applications.
Low-achieving students	Participant 8	The CRA model is a current district approved mathematics strategy that I find to be effective. The hands-on approach is beneficial for students, especially low performing students.

Appendix G: Codes and Categories

Codes	Categories
Code 1: Abundance of resources	CRA model
Code 3: CRA model	
Code 5: Hands-on activities	
Code 8: Peer tutoring	
Code 14: Teaching with manipulatives	
Code 17: Visible resources	
Code 18: Visuals	
Code 26: Learning through experiences	
Code 31: Preparation for state assessments	
Code 32: Professional development	
Code 33: Real-life connections	
Code 1: Abundance of resources	UDL approach
Code 2: Collaboration	
Code 4: Flexibility	
Code 5: Hands-on activities	
Code 8: Peer tutoring	
Code 9: Student journals	
Code 10: Student seating	
Code 14: Teaching with manipulatives	
Code 16: Types of learners	
Code 17: Visible resources	
Code 18: Visuals	
Code 22: Differentiation	
Code 26: Learning through experiences	
Code 32: Professional development	
Code 33: Real-life connections	
Code 21: Academic achievement levels	Differentiation
Code 22: Differentiation	
Code 23: Factors for student performance	
Code 26: Learning through experiences	
Code 27: Low-achieving students	
Code 30: Multiplication fluency	
Code 31: Preparation for state assessments	
Code 32: Professional development	
Code 33: Real-life connections	
Code 34: Standard algorithm	
Code 35: Test readiness	

Code 26: Learning through experiences	Experiential learning
Code 27: Low-achieving students	
Code 32: Professional development	
Code 33: Real-life connections	
Code 16: Types of learners	Mnemonics
Code 28: Math facts repetitiveness	
Code 29: Mnemonics	
Code 32: Professional development	
Code 34: Standard algorithm	
Code 35: Test readiness	
Code 23: Factors for student performance	Math fluency
Code 27: Low-achieving students	
Code 28: Math facts repetitiveness	
Code 30: Multiplication fluency	
Code 31: Preparation for state assessments	
Code 35: Test readiness	

Appendix H: Hand and NVivo Categories and Examples

Category	Participant	Example
CRA	Participant 5	The CRA model definitely provides the necessary steps to help guide students to become learners who explore more than one way to solve mathematical concepts.
UDL	Participant 1	The UDL framework allows teachers to help those students in need in a small group setting…
Differentiation	Participant 8	… students may be strategically placed in homogeneous groups and later in the term heterogeneous groups… allows me to help more students at one time.
Experiential learning	Participant 4	I found that when I incorporated games that were relatable to the students, they drew connections to the mathematics concepts being taught to their daily lives.
Mnemonics	Participant 2	Using mnemonics to reach all learners is a clever way that would hold more memory in day-to-day use.
Mathematics fluency	Participant 8	Mathematics fluency needs to be introduced and revisited in each elementary grade level to assure mathematics facts are being retained from grade to grade.

Appendix I: Themes

Category	Theme
CRA model and UDL approach	Grade 3-5 mathematics teachers used the CRA model and UDL approach to teach elementary students
Differentiation, experiential learning, mnemonics, and mathematics fluency	Grade 3-5 mathematics teachers used differentiation, experiential learning, mnemonics, and mathematics fluency to teach elementary students.