Teacher Perspectives of Small-Group Mathematics Instruction: A Qualitative Study

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Abstract

Nationally, a large percentage of students have a phobia concerning mathematics, due in part to a lack of understanding. At the same time, student scores on state-administered mathematics tests have plateaued. Some of these students may become teachers and instruct a new generation of students in much the same manner. Research has outlined the need to differentiate instruction within a small-group setting, but a gap remains in the literature concerning why teachers make the pedagogical choice to teach mathematics using a whole-group methodology. The Vygotskian constructivist theory of third space framed the study. The purpose of the qualitative case study was to explore the rationale for mathematics teachers' pedagogical choices specific to group size in the local setting. A judgment sampling of 13 third- through fifth-grade mathematics teachers across a local school district was determined. To understand teacher perspective, data collection consisted of an open-ended questionnaire, semi-structured interview, and a document review of lesson plans. Data revealed some teachers consider time constraints, expertise, and classroom management as hindrances to teaching mathematics in small-group settings, while other teachers believe small groupings to be unnecessary.

Keywords: *small group mathematics, teacher perspective, pedagogy, time constraints, third space*

Dedication

I dedicate this dissertation to my family. I cannot express the warmth, kindness, and patience you have shown during this process. I have benefited from my wife, Lucia’s unyielding support and knowledge that I would one day complete this portion of my journey. The unceasing love and understanding I would one day achieve this goal has been unwavering. I also benefitted from my sons Joshua's and Nathaniel’s frankness over the length of time taken to reach this stage. Their unique way of getting to the essence of the matter helped me continue along this path. They have always helped me want to be a better person. And, to my mother-in-law Elisa, who saw this as an incredible opportunity. Your passing came much too soon, but your love for me continues. I feel honored and blessed to have had such an amazing support system. Thank you.

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Chapter 1: Introduction

Every day, teachers make upwards of 1,500 educational decisions, such as how a lesson based on content or audience might be taught (Goldberg & Houser, 2017). Teachers are faced with a myriad of items that factor into pedagogical decisions, including the diversity of students, the goal of the lesson, and alignment to state testing (Tolley, 2019). As part of preparation courses for preservice elementary teachers, teachers are taught a way to differentiate instruction known as the *guided model* or *workshop model* (Yenmez & Özpinar, 2017). Instead of a long, often 45-minute, whole-group lecture block, teachers shorten lessons to no more than 10–15 minutes and use the additional time to make adjustments to smaller groups of students (Benders & Craft, 2016; Fernando & Marikar, 2017; Fountas & Pinnell, 1996; Shaw & Hurst, 2012).

In reviews of comprehensive instruction, the National Center for Education Statistics (2010) reported 86% of elementary teachers utilized small-group instruction at least once during each instructional week. Additionally, the same research report indicated specific program increases in student scores by 9 percentile points when small groupings of students were used in treatments such as tutoring or remediation. The small-group instruction model serves as a standard framework by which many teachers run classrooms (Benders & Craft, 2016). Research suggests similar structures can be used successfully in all content areas, including mathematics (Benders & Craft, 2016; Blazar, 2015; Boaler, 2016; Sharp et al., 2019). Research by Swanson et al. (2013) and Benders and Craft (2016) found small-group instruction improved student understanding of mathematics.

Despite promising research in the area of small-group mathematics instruction, teachers often opt for whole-group instruction (Benders & Craft, 2016). Rather than adapting instruction to meet individual student needs and learning styles, some teachers choose to deliver content to the whole class in the same manner (Malacapay, 2019). In school districts such as the local setting, teacher professional development was designed to improve teacher understanding of small-group instruction. Yet, regardless of the attempts to increase the use of small groups as a pedagogical strategy by district-level personnel, district leadership indicated teachers in the local setting tend to choose whole-group instruction as a means of disseminating information. Although research lists the benefits of small-group instruction, a gap in the literature exists concerning teacher perspectives of pedagogical choices in terms of small-group mathematics instruction (Sharp et al., 2019).

The chapter addresses the problem of teachers' pedagogical choices involving group size and differentiation in a local school district. The purpose and significance of the study are discussed. Research questions and the conceptual framework are addressed. Finally, terms impacting understanding of the research are defined, and scope and limitations are reviewed.

Background of the Problem

Teachers' understanding of how students learn and how to match students' needs affects the ability to differentiate instruction and is an essential aspect of quality instruction (Gupta, 2015; Tomlinson, 2015). Differentiated instruction allows students to filter new learning through existing knowledge, or schema, improving and deepening understanding (Mishra, 2015). As teachers differentiate instruction based on student learning style, previous knowledge, and any learning difficulties, differentiation requires teachers to adjust teaching and content to align to student need, placing requirements on teachers (Nedellec, 2015; Tomlinson, 2015).

Teachers make targeted adjustments and improvements to instruction practices when students are arranged in small groups (Krahenbuhl, 2016). Having smaller groups of students aids teachers in the ability to scaffold questioning, enabling student metacognition of material, and provides access to content and connection to learning (Davoudi & Sadeghi, 2015; Ewing et al., 2019). Literature indicates small-group mathematics instruction is influential to student learning (Sharp et al., 2019).

Statement of the Problem

The problem was many elementary-level teachers in a local school district choose to teach mathematics in whole groups with little or no differentiation. The local district was a growing public school district in South Central Texas, employing several thousand staff to teach just over 20,000 students from diverse backgrounds and cultures. Despite increasing research revealing the benefits of small-group mathematics instruction and pedagogical strategies allowing for differentiation of content, context, and process, as well as continuing professional development in the area of small-group instruction, teachers in the local school district continue to use whole-group math instruction. In a recent district gathering of approximately 600 elementary school teachers, less than 10% indicated the utilization of small-group instruction for mathematics. Additionally, data for the district from 2017 to 2019 showed student progress as measured by state-mandated testing was stagnant and average scores declined (Texas Education Agency, 2019).

Although research indicates the advantages and limitations associated with small-group mathematics instruction, little literature was available as to the rationale teachers use when deciding between whole-group and small-group instruction (Reed et al., 2015; Sharp et al., 2019). The study sought to learn more about the decisions teachers were making concerning group size in the local setting. Understanding teacher rationale could enhance professional development sessions, improve pedagogical practices, and ultimately increase student learning.

Purpose of the Study

The purpose of the qualitative case study was to explore the rationale for mathematics teachers' pedagogical choices specific to group size in the local setting. Although the literature indicates small-group instruction is an excellent way to provide differentiated instruction across core content areas (Lynch et al., 2018), many teachers in the local setting used a whole-group approach with little or no differentiation. The study explored local school district elementary school math teachers' perspectives of small-group math instruction. Findings may be reported to the board of trustees, including the assistant superintendent of curriculum and instruction.

The case study theory approach was used to gain an understanding of a complex issue (Creswell, 2015). A qualitative approach allowed for the exploration of teacher perspectives and rationale when making pedagogical choices. Judgment sampling of 13 mathematics teachers in Grades 3–5 allowed for a broad range of participants from among the district's 20 campuses. An electronic questionnaire and an online, semi-structured interview permitted for the coding and examination of themes to deepen the understanding of teacher perspectives as to instructing mathematics. A document review of teacher lesson plans provided an added source of information, allowing for triangulation of data.

Significance of the Study

Findings from the study will lead to the identification of insights concerning pedagogical choices made by teachers. Based on state testing data, student mastery of mathematical concepts had plateaued (Texas Education Agency, 2019). Despite professional development in the area of mathematics instruction, including formal sessions and onsite coaching, overall student passing rates had not improved. Where the problem of stagnating achievement in the local district lies was unknown, making the exploration of the perspectives of the mathematics teachers in the local setting related to small-group differentiated instruction essential. Such insights may lead to improved professional development both in formal settings and in onsite coaching, advancing teacher practice and improving student understanding.

Research Questions

The research explored the rationale for teachers' pedagogical choices when instructing math. Perspectives on the benefits and challenges associated with teaching mathematics in small groups were explored. Specifically, the purpose of the research was to answer the following questions:

Research Question 1: What are teachers' rationale for choosing whole-group mathematics instruction?

Research Question 2: What are the perceived benefits of whole-group and small-group math instruction?

Research Question 3: What are the perceived challenges of whole-group and small-group math instruction?

Research Question 4: What are the teachers' perspectives of the features of small-group mathematics instruction?

Conceptual Framework

Vygotskian third space theory refers to the area of compromise between individuals as mutual understanding occurs, and is an essential component of the broader social constructivist theory (Gupta, 2015). A third space can occur as discussion over new content between individuals occurs, coming to a mutual understanding (Bruner, 1986; Vygotsky, 2017). The theory helps with understanding how new information is learned and provides a perspective about how new knowledge is influenced by a group (Vedeler, 2015). Understanding social constructivism aids teachers in making choices involving instructional practices, leading to differentiation of content, process, and product within a small-group setting (Hang et al., 2017).

Social constructivist theory explains student learning as an active process whereby students interact with new material rather than being passive recipients (Learning Theories, 2018). New learning is attached to previously held information, making knowledge unique to each individual as the third space is created to make meaning of the newer content. Constructivist classrooms are often characterized by small-group instruction and student discussion. Small groups help teachers differentiate instruction to meet the needs of a wide variety of students. Discussion among students helps the students make sense of new information and eliminate or correct previously held misconceptions (Vygotsky, 1978). A social constructivist view accounts for the zone of proximal development (ZPD), the distance between what a student can accomplish with adult help and what can be completed with peer interaction and/or no outside help. Constructivists consider the ZPD as the sweet spot for learning and bridges content that is too easy with frustratingly difficult material.

While literature indicates increased student gains in core instructional areas in general and mathematics in particular, little research has examined teacher perspectives and practices (Sharp et al., 2019). Teachers make pedagogical decisions about how to deliver content to students. Yet, as discussed by principals of the local school district, many teachers in the local setting continue to opt for whole-group math instruction despite research and substantial professional development.

Definitions of Terms

Confusion and misinterpretation can occur as terminology does not carry a static, predetermined set of definitions. Clarity and understanding of specific terms used within the context of the research are essential. As such, the following definitions were used as a standard for the literature and research associated with the research project. The definitions played a central role in how the research presented in the literature review was interpreted. Understanding the environment in which students are learning is paramount to understanding the nature and role differentiation could play in student learning. Additionally, two words were defined to provide a framework for differentiation: *accommodation* and *modification* (Benders & Craft, 2016).

Accommodations. Accommodations are adaptations that are made to the general curriculum but do not fundamentally change learning goals or objectives or the level of content (Tomlinson, 2015).

Departmentalization. Students receive core subject instruction from multiple teachers. Typically, departmentalization occurs when students receive reading, mathematics, science, and social studies instruction from different teachers (Taylor-Buckner, 2014).

Differentiated instruction. Differentiated instruction refers to accommodating instruction to meet the needs of students. Differentiation occurs either by content, process, product, or learning environment (Lynch et al., 2018; Malacapay, 2019).

Modifications. Modifications are changes to content, either level or complexity, that change grade-level expectations, goals, or rigor (Tomlinson, 2015).

Scaffolding. To move students toward a learning goal, teachers sometimes break an objective into smaller parts. The breaking of instruction into smaller parts is known as scaffolding (Fountas & Pinnell, 1996).

Self-Contained Students. Self-contained students receive core subject instruction from a single teacher. Self-contained students could still receive instruction, such as music, art, or physical education, from a specialized teacher, but the core subjects of reading, writing, mathematics, science, and social studies are taught by one teacher (Taylor-Buckner, 2014).

***Small-Group Instruction*.** In small-group instructions, students learn in small groups rather than in whole groups. Small-group instruction can follow whole-group instruction to reinforce or reteach specific standards or concepts, providing a smaller student-teacher ratio. Small groups of four to six students allow teachers to tailor instruction to align closely with the specific needs of each student (Fountas & Pinnell, 1996).

***Student-Centered Instruction*.** Student-centered instruction is a pedagogical practice whereby students play a central part in learning (Nedellec, 2015). Rather than focusing on the teacher, student-centered classrooms often utilize group work.

***Teacher-Centered Instruction*.** Teacher-centered instruction is a pedagogical practice whereby the classroom focus is on the teacher (Nedellec, 2015).

***Whole-Group Instruction*.** In whole-group instruction, students receive instruction as a large group, often through direct instruction (Fountas & Pinnell, 1996). Whole-group instruction regularly utilizes teacher-led instruction in the form of a lecture and a common curriculum, such as textbooks or supplemental materials, with a minimum of differentiation in content, process, or assessment.

Assumptions

Given the state testing data and feedback from the area educational resource center, the local district was assumed to be typical of school districts in the region. The participants in the study were assumed to be forthright and honest in answering the questionnaire and semi-structured interview questions and providing lesson plans. Due to the nature of the study, the assumptions were necessary. Participation in the study was voluntary, with participants understanding the findings would be published. Maintaining research participant anonymity in the local setting was a priority. The belief was the participants would be agreeable to the results being part of the public domain. The results of the study may not apply to all districts in all regions of the United States.

Scope and Delimitations

The research focused on one public school district in South Central Texas. The medium-sized district had approximately 22,000 students and a few thousand teachers. The sample of participants comprised 13 third- through fifth-grade mathematics teachers. The unique nature of elementary mathematics teachers reporting using whole groups to teach mathematics despite several years of professional development on the use of small-group instruction prompted the research. The need for an in-depth understanding of teacher rationale and perspectives necessitated the use of a relatively small sampling of teachers from within the district. The scope of the study limits its generalizability to other districts. The study comprised third- through fifth-grade mathematics teachers employed in the 2019–2020 school year who would be returning for the next school year. A longer period was not chosen due to time limitations related to data collection.

To address limitations and not impact the outcome of the research, participants ranged from multiple grade levels and nine of the 20 schools in the district. Further, teacher assignments varied, including self-contained, partnered, and fully departmentalized. Data collected in the study comprised all teaching assignments to gain a wider understanding of the research problem. The judgment sampling allowed the study to examine trends including location, grade-level assignment, and years of service while allowing for stratification and important trends (Creswell, 2015; Maul, 2018).

Acknowledgment of subjectivity and preconceived notions of the small-group instructional model and the district was made. To protect against potential biases, a full disclosure of researcher employment, history, and connection to the local setting is provided in Chapter 3. The disclosure aided in the removal of potential biases as data were coded and interpreted.

Limitations

The limitations of the study were the sample, time constraints, and means of data collection. While the judgment sample provided insights into teacher perspectives, the nature of the sampling procedure presented potential bias (Creswell, 2015). The study was limited to a single district in South Central Texas. The judgment sample included teachers from nine schools in three grade levels, but the sample was limited to mathematics teachers in grades three through five.

Data collection utilized time constraints out of regard for the participants. Additionally, data collection tools were limited to a questionnaire, semi-structured online interviews, and a document review of teacher lesson plans, in part due to changes brought about by the COVID-19 pandemic. Classroom observations may have allowed for a greater understanding of data. Inclusion of researcher experiences and bracketing of biases enhanced objectivity, improving reliability and validity.

Chapter Summary

Chapter 1 summarized the problems associated with a local school district. A flattening of mathematics scores on state testing prompted the district to examine pedagogical practices. Despite the district determining small-group instruction would provide needed differentiation of content and enhance student performance, many teachers in the district continue to use whole-group instruction as the primary means of delivering mathematical content. A gap was identified in research regarding teacher perspectives of hindrances associated with small-group differentiated instruction. The framework for the study was a qualitative case study design used to generate a theory and explore and understand a central phenomenon (Creswell, 2015). The purpose and significance of the study were addressed expressing the importance small-group instruction plays in the differentiation of content. Additionally, the purpose and significance were related to the research questions. The conceptual framework and key terms were provided. Assumptions, scope, and limitations were addressed.

The study sought to use findings to understand the trends within the local setting, as well as, on a larger scale. Transitioning mathematics instruction to small groups, such as with the workshop model, should improve student understanding of content, improve student mastery of skills demonstrated with state testing, and reduce anxiety surrounding mathematics. Improvement in student understanding should lead to the improvement of state testing scores.

Chapter 2 explores literature in greater depth and frames the conceptual framework of Vygotskian third space and the role social constructivism plays in small-group mathematics instruction. Conceptual understandings of constructivist views are explained and related to pedagogical practices. Connections between constructivist theories, differentiated instruction in general, and practices specific to mathematics are made. The benefits and limitations of utilizing the workshop model in a mathematics classroom are outlined, and the gap in the literature is explored.

Chapter 2: Literature Review

In many public school districts, elementary mathematics teachers are not using small-group instruction (Lambert, 2015; Voss & Rickards, 2016). The purpose of the qualitative case study was to explore the rationale for mathematics teachers' pedagogical choices specific to group size in the local setting. Small-group instruction as a means of differentiation is a crucial element of constructivist philosophy and is influential in education (Krahenbuhl, 2016). Since 2016, teachers in the local school district were provided various professional development opportunities on the topic of small-group instruction, including traditional sessions, professional learning community support, and individualized coaching, even though over half the teachers in the United States have received no such training (Young et al., 2019). The problem was, despite the focus on small-group mathematics professional development, many teachers in the local setting continue to teach using whole-group strategies, limiting the potential of differentiated instruction and microteaching.

The literature review contains the theory upon which the study was based and research on the topic broken into sections. Terms and definitions as applied to the research are included in the first section. The second section explores general theories surrounding small-group instruction and learning theory. The third section reviews research about differentiated approaches to teaching in general, while the fourth section examines research specific to differentiation in mathematics classrooms. Benefits and potential issues pertaining to differentiated mathematics instruction are addressed in the fifth section. The final section includes conclusions and summarizes the literature review.

Literature Search Strategy

Information for the topic of small-group differentiated instruction was uncovered through online databases, including ERIC, Internet searches, and personal experiences. ERIC searches were limited to peer-reviewed literature published between 2015 and 2020. Search terms originally included *small group mathematics* and *differentiated mathematics instruction* but provided limited results. The search was expanded to incorporate *differentiated instruction*, *pedagogy and mathematics*, and *workshop model*. Key terms were gleaned from articles to increase the parameters of the search.

Once a sufficient number of research articles were obtained, citations within the selections were used to expand the search parameters. Key terms were noted and used to further the search both in ERIC and through the Internet. Priority was placed on finding keywords, including *scaffolding*, *peer*, *differentiation*, *pedagogy*, *instructional decisions*, and *student performance*. The term *student performance* emerged from the literature as a means to quantify student improvement and was used as a comparative measure of whole-group instruction compared to small-group instruction.

A review of the literature associated with small-group differentiated mathematics instruction found a limited number of terms. Initial search terms were obtained through previous interactions with literature, graduate classes, and classroom experience. The search terms had to be flexible to obtain a sizable amount of information since the number of research articles in the field of small-group mathematics instruction was small. The terms *guided mathematics* and *mathematics workshop* yielded a few peer-reviewed papers and led to additional search parameters such as *workshop approach* and *mathematics teacher perspectives*. Each paper was reviewed, and potential new terms were used to further the search.

Conceptual Framework

The study used the social constructivist theory of third space as a framework (Bruner, 1986; Krantz, 2016; Vygotsky, 1978, 2017). The term *third space* describes the area of compromise created when two individuals come to an understanding between two views (Gupta, 2015). Rather than thinking of learning as extending from the dissemination of ideas from the teacher or the memorization of content from the student, third space focuses on the gray area created between student and teacher or between student and student as dialogue occurs (Bruner, 1986). The theory of third space allows for an understanding of the cultural and social identities of learners and differences in learning perceptions (Krantz, 2016).

Tomlinson (2015) identified differentiated instruction as an essential component of teaching regardless of content. Taken in the constructivist framework of Vygotskian theory of a third space, research indicates small-group mathematics instruction as a strategy to improve student understanding (Sharp et al., 2019). Third space emerged from Vygotskian theory as the social interactions among learners explain the uniqueness of each learner (Krantz, 2016). As described in the theory, each learner is considered a hybrid as learning is constructed and shaped through communal activities, with the culture of the space contributing to individual learning (Bruner, 1986). The theory provided an understanding that new knowledge does not rest solely in a learner's mind but is distributed within a group (Vedeler, 2015).

Vygotsky's (1978) theory relied on what is known as the ZPD. The ZPD, or construction zone, is a space in which new meaning is created (Vygotsky, 1978). Teaching within a student's zone allows the teacher to instruct at the optimal level of difficulty as the zone lies between a level of frustration where content is too difficult and a level of independence where the learner does not require teacher support as the material is relatively easy (Guseva & Solomonovich, 2017). A teacher, acting as the knowledgeable other, asks questions and utilizes assessment data to determine the zone for each student (Vygotsky, 1978). Danish et al. (2017) found the progression of questioning by teachers and responding by students was more involved when scaffolded. Scaffolded instruction occurs as the teacher and the learner form shared understandings within the third space (Ashley, 2016). The ability to scaffold questioning facilitates student metacognition (Davoudi & Sadeghi, 2015). In addition to small-group instruction allowing for teacher differentiation of content and questioning, a secondary area involves what Vygotsky (2017) referred to as *social constructivism* or *sociocultural learning theory*. The process of social constructivism helps explain how students construct meaning in a social context and the importance of dialogue between teacher and student or student and student in actively learning new content (Badie, 2016; Skidmore & Murakami, 2016; Stinnett & Oregon, 2018).

The construction of new knowledge is the building of new meanings or refinement of existing meanings through social discursive activity (Mishra, 2015). Social constructivism translates into student dialogue in pedagogical practices (Bozkurt, 2017). Rather than the dissemination of knowledge from a lecture format, the social aspect of constructivist thought deals with learners interacting with the teacher or other learners (Mishra, 2015). The dialogue is used as a tool to enhance learning for students (Bozkurt, 2017). Whether viewed through Vygotsky's or Bakhtin's lens, the social aspect of learning is an essential component of effective learning (Mishra, 2015).

Social constructivism is applied within the framework of pedagogical practice (Hang et al., 2017). Specifically, social constructivism is about the dialogue that occurs as a learner gains understanding and connects new knowledge to older knowledge through a lens of schema, or experience (Bozkurt, 2017; Vygotsky, 2017). Although broader implications are associated with social constructivism, the social constructivist philosophy, as described within the literature review, is confined to a pedagogical practice contrasted against a lecture style of teaching, a monologue versus dialogue approach to teaching (Fleury & Garrison, 2014).

Sometimes referred to as *radical constructivism*, constructivism relating to pedagogical practice deals with two main principles: (a) knowledge is gained through an active process rather than a passive one, and (b) cognition is adaptive and organized based on experiences (Bozkurt, 2017; Vygotsky, 1978). In the process of connecting new information, learners connect to older information based on schema (Vygotsky, 2017). Since the learning is filtered through the lenses of both dialogue and previous experiences outside the learning environment, the social aspect of learning is a critical component (Bozkurt, 2017; Gupta, 2015). Understanding learners filter new information based on experiences and mold the information through peer interactions forces teachers to examine pedagogical practices and take dialogue into account (Kazak et al., 2015).

Mathematics classrooms have historically been a transmission model whereby the teacher disseminates information such as discrete skills to the class (Fernando & Marikar, 2017). The traditional model often incorporates a guided portion whereby the teacher instructs the whole class, provides a gradual release whereby the students practice the skill being learned and provides an independent practice during which students spend time working on problems (Benders & Craft, 2016). In the traditional model, little attention is paid to learners as individuals (Fernando & Marikar, 2017). Considering mathematics learning through the lens of Vygotskian space, a different pedagogical model should be examined (Thompson et al., 2016). By contrast, constructivist thought ensures learners interact with one another in groups to understand the material and connect stimulus to previous experiences (Hang et al., 2017). The social aspect of learning becomes an essential component of gaining new knowledge in general and particularly applies to mathematics instruction (Bozkurt, 2017). As with other content areas, mathematics teachers should consider student dialogue (Kazak et al., 2015).

Research Literature Review

The research study examined the rationale for pedagogical choices made by mathematics teachers. Teachers are often faced with a dilemma: reaching students in a culturally relevant way while remaining within mandated parameters such as scope and sequence timelines and state standards (Leonard & Evans, 2018). Though many variations of pedagogy have been studied, two standard methodologies include whole-group and small-group instruction (Jayanthi et al., 2017). Even though both pedagogical choices have merits and limitations, research indicates small-group instruction in elementary mathematics classrooms allows students to internalize content (Benders & Craft, 2016; Garrett & Hong, 2016).

An examination of the connection between the role differentiated instruction plays in both curriculum design and pedagogy should occur to understand the function of small-group differentiated instruction in the classroom (Ismajli & Imami-Morina, 2018). Differentiated instruction refers to the creation of curriculum and instruction while ensuring students are engaged using different modalities and compete against individual knowledge bases rather than each other (Baker & Harter, 2015; Tomlinson, 2015). The practice of differentiated instruction is not new, nor does differentiation look the same from room-to-room or school-to-school; nonetheless, differentiation has specific characteristics setting the practice apart from more traditional direct-teach models (Baker & Harter, 2015). Teachers ought to take responsibility for learning student learning styles and then adapting instruction to meet individual student needs (Malacapay, 2019).

Differentiated instruction refers to a teacher’s ability to adapt instruction to meet the needs of individual students and often comprises responses to what students know and matching an appropriate pedagogy (Ismajli & Imami-Morina, 2018; Malacapay, 2019). Often, teachers differentiate instruction based on students' learning speeds, learning styles, and any learning difficulties, requiring teachers to be flexible in pedagogical approaches (Tomlinson, 2015). Teachers consider student knowledge, preferences, and abilities to organize instruction (Ismajli & Imami-Morina, 2018). Differentiation requires teachers to adjust teaching and content to align with student needs, placing requirements on teachers (Ismajli & Imami-Morina, 2018). As a rule, differentiation occurs in content, process, product, and environment (Ashley, 2016; Beasley & Beck, 2017).

Two broad terms for differentiation as applied to the classroom are *accommodation* and *modification* (Morningstar et al., 2015). For the literature review, accommodation is an adaptation of instruction provided by the teacher, whereas modification is the change of curriculum, often in the form of reduced cognitive demands (Morningstar et al., 2015). Discussion in the literature reviewed involving differentiation was more closely related to accommodation than to modification as the information concerning differentiation concerned adapting content, process, product, and environment to meet the needs of students to access and understand the material (Tomlinson, 2015). The changing of grade-level expectations, or modification, was outside the scope of the literature review (Morningstar et al., 2015).

Content

Broadly defined, *content* in the context of differentiation refers to the knowledge, concepts, and skills learned by students (Beasley & Beck, 2017). Differentiating content means adjusting delivery methods, including video, lectures, readings, and audio (Tomlinson, 2015). Much has been written about the differentiation of content, including flipped classrooms, workshop models, and student choice boards (Baker & Harter, 2015). Each differentiation technique allows students to move through the curriculum either in a unique pathway or in a timeline more suited to individualized learning (Ngo, 2016). Student choice, for example, allows students to choose a unique sequence to complete learning tasks, although all students have the same learning goals (Baker & Harter, 2015). The level of complexity at which each student grasps the material may be different (Tomlinson, 2015).

As the curriculum is designed and instructional practices are reviewed for a purpose, educators should consider Bloom's taxonomy (Manouchehri et al., 2016). Benjamin Bloom, a cognitive psychologist who studied how people learn, believed six levels of learning exist, ranging from memorization to the ability to understand and solve problems (Irvine, 2017). These levels move from lower levels of cognition to higher levels and include knowledge, application, comprehension, analysis, evaluation, and synthesis (Manouchehri et al., 2016). Traditional curriculum and instruction focus on the lower levels of Bloom's taxonomy, mainly knowledge and application (Fernando & Marikar, 2017). For students to gain critical thinking skills, curriculum and instruction should be designed, constructed, and delivered in a manner that takes into consideration the upper levels of Bloom's taxonomy and in a way in which each student receives differentiated instruction specific to the student's individual needs (Rahman & Manaf, 2017). Differentiation of content helps move students through the continuum of Bloom's taxonomy from the lower levels of knowledge and application to the higher levels of evaluation and synthesis (Tomlinson, 2015).

Process

In terms of differentiation, the accommodating *process* refers to a teacher providing differing levels of support, lower entry points, and student choice about how learning is expressed (Rahman & Manaf, 2017). Examples of process differentiation include centers/stations, time, various materials, and consideration of students' multiple intelligences and learning styles, all designed to aid a student in making sense of information (Ngo, 2016). As Tomlinson (2015) indicated, effective process differentiation involves providing multiple learning opportunities ranging from simplistic to complex and from guided to open-ended, independent tasks, and providing time to contemplate new information. Differentiating processes can include varying questioning; adjusting presentations; adjusting teaching pace; and providing alternative methods, problem-based tasks, student contracts, and independent student projects, as well as time to reflect activities such as think–pair–share and partner talk (Turner & Solis, 2017).

Product

In the realm of differentiation, *product* refers to what students create to verify learning, known as an *artifact* (Turner & Solis, 2017). Product differentiation occurs when students are allowed different outcomes for the same task and often involves various tasks (Tomlinson, 2015). Although product differentiation could be as simple as providing alternative assignments, the practice could include student contracts, choice boards, negotiation, student-proposed products, and moving students toward synthesis and analysis rather than recall (Rahman & Manaf, 2017). Product differentiation has been shown to increase student interest and improve the learning fit, thereby improving standardized test performance (Tomlinson, 2015).

Environment

By differentiating the environment, teachers change the look and atmosphere of the classroom, provide a safe and positive environment for learning, allow for individual work preferences, and manage the learning space (Turner & Solis, 2017). In the classroom, a teacher incorporates flexible grouping, student choice, varied ecologies, and a wide range of guided to independent learning opportunities (Manuel & Freiman, 2017). The myriad possibilities available to students contribute to a safe learning environment and help establish student needs, readiness, and interest (Tomlinson, 2015).

Curriculum and Instruction

The National Council of Teachers of Mathematics (NCTM, 2014) recommends number and operations, geometry, measurement, and algebra as focal points for mathematics instruction. States such as Texas adopted standards to mirror those found in the recommendation (Center on Standards, Alignment, Instruction, and Learning, 2018). Teachers should balance the learning standards with conceptual understanding, computation and procedural fluency, and problem-solving (Ashley, 2016). Such views mirror the state standards of Texas as multiple student expectations explicitly identify aspects of student-centered instruction (Texas Education Agency, 2020).

As no specific universal taxonomy is prescribed, teachers often utilize instructional pedagogies based on either belief or experience (Siswono et al., 2019). Based on standards and beliefs, teachers tend to instruct students on problem-solving techniques and how to become better problem solvers (Siswono et al., 2019). The views of teachers to move students beyond just rote memorization or procedural knowledge toward being problem solvers illustrate the importance of a balanced approach to mathematics instruction (Ashley, 2016). As a result, some research has examined teacher use of alternative pedagogies that allow for differentiation of content and student readiness (Newton, 2016; Sharp et al., 2019).

Curriculum materials play a role in potential pedagogical choices (Barjesteh et al., 2015). Instructional materials become part of a triadic relationship with students and teachers as teachers analyze materials (Miyazaki, 2019). As instructional materials can be viewed as an extension of a teacher’s spoken lesson, the design of a curriculum becomes influential to student learning (Miyazaki, 2019; Rahimi et al., 2015). Certain curricula lend themselves toward more dialectic inquiry, and no preprepared curriculum can meet the needs of the classroom exactly, providing credence to the notion teachers should be able to adapt the curriculum to meet the needs of students (Rahimi et al., 2015).

Differentiated Instruction in the Classroom

As Tomlinson (2015) stated, trademarks of differentiated classrooms include rooms in which the teachers provide specific ways for each individual to learn as deeply as possible and as quickly as possible, without assuming one student's road map for learning is identical to anyone else's (Rahman & Manaf, 2017). Differentiation means teachers would need to use a range of instructional strategies to meet the needs of individual learners rather than attempting to fit learners into similar pedagogies and curricula (Manuel & Freiman, 2017). Enough emphasis cannot be placed on the difference between the two pedagogical strategies. With differentiation, the teacher adapts instruction to meet individual student needs, whereas by placing students into predetermined curricula, students are the ones expected to adapt (Tomlinson, 2015).

Differentiation is a technique whereby teachers can adapt learning to meet individual student needs rather than assuming students can adapt to the delivered content in a one-size-fits-all situation (Doubet & Hockett, 2018; Tomlinson, 2015). Students can be grouped by individual readiness to receive content based on pre-lesson assessments to determine student proximity to lesson access (Dack et al., 2019). The students are then given unique opportunities to learn as compared to other students with different content readiness levels in the same classroom or within the same lesson (Tomlinson, 2015).

The argument does not say whole-group instruction should not take place; students should be exposed to specific standards of education imposed by state or federal regulations, and large-group instruction is efficient (Irvine, 2017). Large-group instruction does not necessarily refer to teacher-led instruction (Jayanthi et al., 2017). Rather, students can be taught from similar standards in small groups with peer interaction and with proper curriculum design and pedagogical practices, meaning students receive similar instruction regardless of group size (Cardimona, 2018). Using the broader definition of whole-group instruction allows for differentiation in instruction, even with a mandated curriculum (Irvine, 2017). By contrast, differentiated instruction is thought of as flexible small-group or individualized instruction in which the teacher targets specific, remediated skills or allows students to explore and extend topics addressed in class (Turner & Solis, 2017). As Shepherd and Acosta-Tello (2015) acknowledged, excellent teachers use a wide variety of approaches based on the objective.

An outsider entering a room in which differentiated instruction is occurring is likely to see short minilessons in whole groups and small groups in which students are interacting on a variety of tasks (Sharp et al., 2019; Tomlinson, 2015). In addition, a teacher is likely engaged with a small group or an individual student working on a skill related to the tasks being completed by other students in the class (Cardimona, 2018; Thompson et al., 2016). The picture is contrasted by one in which students are sitting in rows, gaining knowledge only as dispensed by the teacher at the front of the room (Fernando & Marikar, 2017). Besides the appearance, the two classrooms differ significantly, as in the whole-group instruction classroom, the teacher provides content through a single transmission, whereas the small-group instruction classroom provides an opportunity for the teacher to deliver and explain the material in multiple ways and using various means for each small group (Tomlinson, 2015). The teacher has the opportunity to provide multiple transmissions as a means to differentiate small-group lessons (Sharp et al., 2019; Tomlinson, 2015).

Literature Concerning Differentiated Instruction

A common problem facing education is the ability to come to terms with teaching diverse populations while ensuring quality education (Turner & Solis, 2017). When curriculum design is proper and in harmony with good instructional practices, depth of knowledge rather than breadth of instruction can occur (Jayanthi et al., 2017). Students gain critical thinking skills suited to individuals rather than lessons designed to teach the class as a whole (Dack et al., 2019; Tomlinson, 2015). Students solve authentic problems with unique techniques, not just rote memorization answers found on multiple-choice assessments (Baker & Harter, 2015). Curriculum designers can ensure learners are presented with authentic problems to elicit original learning (Barber et al., 2015; Wormeli, 2018). The difference is significant as, for students to problem-solve effectively, students should have an in-depth grasp of the material (Sforza et al., 2016). Mills et al. (2019) described approaches being used in many schools that do not promote critical thinking, enduring understanding, or transfer of knowledge. The role of the curriculum and pedagogy is to guarantee greater depth in the material, resulting in meaningful discourse (Tomlinson, 2015). Irwanto et al. (2019) stated at the heart of critical inquiry is the willingness and ability to participate in a dialogue. When students can engage in meaningful discourse, the marriage of the curriculum and pedagogical practices has achieved the desired results (Tomlinson, 2015).

Curriculum and instruction should be designed in such a way as to improve the chances of transfer of knowledge from one subject to another and one situation to another as students can often complete low-level tasks but struggle with higher-order work, which requires transfer (Sforza et al., 2016). One way to ensure students contemplate problem-solving is to assign problems to solve (Wu & An, 2016). In much the same way a sports coach allows players opportunities to participate in games even before mastery of the basic skills, teachers can allow for curriculum design and pedagogical practices affording students opportunities to problem-solve at a conceptual level, even before mastery of some traditionally prerequisite skills (Wu & An, 2016).

A more concrete example would be to give students opportunities to solve problems whose answers are found easily by multiplication before the teaching of the multiplication algorithm (Boaler, 2016). Students, working in teams, use alternative methods such as repeated addition for solving multiplication problems or use visual aids (Root et al., 2019). The process forces learners to rely on schema to make connections to previous learning (Boaler, 2016). By definition, *schema* is the process whereby people make connections to prior knowledge or experiences (Duncan & Redwine, 2019). By activating schema in such a manner, students begin to transfer what is known about addition and repeated addition to what is learned about multiplication, and in the process are more engaged with the content being presented (Boaler, 2016).

Students should make connections with the world, just like the adults around them. In reading, for example, students should make text-to-text, text-to-self, and text-to-world connections (Ciecierski & Bintz, 2016). Student connections to previously taught material allow the teacher to assess the students' comprehension (Reid & Reid, 2017). Students making connections with the text are more likely to obtain greater depth and understanding (Paesani, 2016). According to Bempeni and Vamvakoussi (2015), understanding is about more than just recall; rather than learning skills in isolation, students learn and transfer relevant life skills across content areas as well as across standards within the same content areas (Barber et al., 2015).

As a conceptual framework, differentiated instruction relies on teacher skills (Nedellec, 2015). Proper implementation hinges on teacher experience and, to some extent, the number of years teaching (Dack et al., 2019; Moosa & Shareefa, 2019). Teaching experience, as well as educational qualification, add to a teacher's knowledge and sense of efficacy, adding to the ability to adjust the content, process, product, and environment (Moosa & Shareefa, 2019; Tomlinson, 2015). An additional factor affecting differentiation is educational leadership, as a teacher's perspective of principal support plays a role in the teacher's implementation of frameworks such as differentiated instruction (Bogen et al., 2019).

A teacher's knowledge of both content and pedagogy plays a role in the consistent implementation of differentiated strategies (Dack et al., 2019; Reid & Reid, 2017). According to Nedellec (2015), a teacher's knowledge of content pedagogy directly affects the regular implementation of differentiation strategies. Through the lens of content-specific differentiation, a teacher could understand differentiation within a reading classroom, for example, but miss the nuances associated with differentiation specific to a mathematics classroom (Reid & Reid, 2017). A teacher's ability to provide differentiated instruction in any given content requires, in part, a teacher's understanding of the specific area of instruction (Nedellec, 2015).

Literature Specific to Differentiated Mathematics Instruction

When students in mathematics classrooms struggle to succeed despite hard work, teachers often find the students are overly dependent on memorization and algorithms (Benson-O'Connor et al., 2019). Teachers should realize learning through understanding is an approach to mathematics the students can be encouraged to use from an early age (Vedeler, 2015). Helping children to develop mathematical fluency and flexibility can reignite interest in and enjoyment of mathematics as a creative and pleasurable activity (Manuel & Freiman, 2017). More than teaching the algorithm, mathematics instruction must include conceptual understanding (Benson-

O'Connor et al., 2019). Many students spend large amounts of time attempting to learn traditional computational procedures that can be completed on a calculator (Bozkurt, 2017). Moreover, while certain aspects of the reading classroom have been employed in mathematics classrooms, such as the use of journaling, much mathematics instruction tends to be didactic and large-group (Lambert, 2015; Voss & Rickards, 2016).

Without a doubt, mathematics teachers should be aware of issues concerning the teaching and learning of mathematics, such as teacher questioning, providing access, and connecting learning (Ewing et al., 2019; Lee & Lee, 2017). Although differentiation of reading and writing is often done through guided and workshop models, students in mathematics classrooms are often presumed to work at the same level (Benson-O'Connor et al., 2019). Research by Stein et al. (2017) and Ewing et al. (2019) described the issues concerning the improvement of teaching mathematics that should be addressed are instructors' lack of knowledge, explicit attention to concepts, and students' opportunity to struggle. The described deficiencies are consistent with a more guided approach discussed at the 1993 draft of the NCTM assessment standards, the updated draft from 2014, as well as state standards for teaching mathematics found in the local setting (Texas Education Agency, 2020).

Teachers and preservice teachers should see schools and society as interconnected, according to Craig and Marshall (2019). Craig and Marshall found teaching could not be reduced to a specific prescription, which might lead to enhanced student performance; a more constructivist manner of teaching, such as problem-based learning, could be utilized. As the framework of constructivism is predicated on the belief individuals construct new meaning in different ways based on prior experiences and through social interactions, how students access new information is critical (McPhail, 2016). The teacher's role in the design is to determine methods of learning that are best suited to individual student needs (Nedellec, 2015). A differentiated approach suggests the core of the curriculum focuses on the whys and hows of implementing particular features of teaching (Tomlinson, 2015). To say students should be taught to execute and apply procedures or to say students should be presented with challenging and conceptually rich problems is not enough (Reid & Reid, 2017). Instead, understanding the importance of these features and when and how the elements can be implemented to achieve specific individual learning goals is when differentiated instruction flourishes (Tomlinson, 2015).

In terms of beliefs, Lambert (2015) concluded pressures to have students perform well on standardized tests and college entrance exams force teachers to abandon philosophies about contemporary instruction in favor of more traditional instructional practices. As such, the teacher combines strong beliefs in specific pedagogies with reflective practices (Youmans et al., 2018). In addition, the Lambert study characterized the two typologies researched as *contemporary constructivist/discussion* and *traditional/procedural*. While the teachers surveyed in the study began with discussion-based pedagogies, the practice was abandoned as the state test approached, illustrating that teacher beliefs were not consistent with pedagogy (Lambert, 2015). Other districts report changing dialectic instruction practices based on potential standardized test scores in favor of worksheet-driven, whole-group methods (Simpson, 2015). Ironically, the change led to the stagnation of student scores rather than an increase (Simpson, 2015).

Differentiated approaches often employ peer tutoring and interaction (Biju, 2019). Social interaction is believed to promote higher-order thinking skills (Voss & Rickards, 2016). Hwang et al. (2018) found increases in peer interaction led to higher rates of problem-solving. The research of Belcher et al. (2015) indicated students made significant gains in thinking strategies while interacting with peers, perhaps as a result of filling existing gaps of understanding. As an added benefit, students indicated enjoying the socialization brought about during peer interactions (Hwang et al., 2018). Differentiated pedagogies might be considered successful in specific subpopulations as well (Altintas & Ozdemir, 2015). In studies concerning at-risk populations, defined as students in greater danger of dropping out prior to graduation, students used word problems with similar structures and transferred skills to other types of mathematics problems (Kong & Swanson, 2019). Students exposed to differentiated, schema-based instruction made significant gains (Reed et al., 2015).

Altintas and Ozdemir (2015) identified differentiation and enrichment of audience, student needs and interest, and content objectives as necessary for the successful implementation of the curriculum. Gender was an important factor when considering differentiation needs (Lau et al., 2018). Social persuasion, such as found in small-group student interaction when completing mathematics problems, is a strong predictor of student self-efficacy and allows students the third space needed to adjust learning within schema (Dack et al., 2019; Lau et al., 2018).

Benefits of Differentiated Mathematics Instruction

A school district's philosophy drives the instruction in the many classrooms within the district (Lambert, 2015). The philosophy defines how teachers handle the myriad decisions made daily, both academically and personally, including specific pedagogical decisions (Simpson, 2015; Youmans et al., 2018). District policies, driven by the district's philosophy, determine when and to what extent teachers offer students help, as well as the opportunity to learn a lesson or concept in a guided and protected environment (Wilt, 2016). The district in which educators teach influences individual teacher philosophy (Mathis, 2016). Wilt (2016) emphasized the personal philosophy of a teacher is critical in the approach to education. The position validates the importance of an educator to develop a personal philosophy driving their pedagogy (Mathis, 2016). The permutation of progressivism (whatever works) and social efficiency theory (authentic learning within a curriculum) should be found within a district (O'Connor & Lessing, 2015). These characteristics best define a constructivist, differentiated outlook concerning education (Webber & Miller, 2016).

Some researchers wonder whether a curriculum designed around specific tasks in isolation would be better suited to standardized testing measures, although research does not support the notion (Simpson, 2015; Tomlinson, 2015). Few researchers doubt, however, that students can excel in authentic assessments when designed by the classroom teacher to meet the particular needs of students (Kaider et al., 2017). Designing and teaching curriculum in differentiated ways enhances student achievement as measured by standardized tests (Wormeli, 2018). According to Wormeli (2018), students do well on standardized assessments if the material is known well and instruction is differentiated in a manner in which students learn best. Türkben (2019) found students' thoughts and emotions were transferred to the learning in interactive classroom environments, confirming the supposition of interactive teaching as a viable pedagogical practice, and Simpson (2015) found student increases in dialogue concerning content led to higher standardized test scores.

Increases in student duress are associated with increased difficulties in learning (Russo & Hopkins, 2017). A positive differentiated classroom and a well-planned curriculum can help ensure depth in student learning (Donaldson, 2019). As Roffey (2017) found, individuals' needs are driven by safety, respect, and self-esteem, and once these needs are met, students are better able to explore higher levels of thought. Further, a positive student attitude toward content leads to a stronger intention to perform (Mutohir et al., 2018). Differentiated classrooms help foster learning environments in which students are safe as learning is specific to an individual or small group rather than a class (Donaldson, 2019).

Tomlinson (2015) stated differentiated instruction is an essential component of teaching regardless of content. The sentiment was echoed by Lynch et al. (2018), who studied how mathematics teachers differentiated based on content, process, and product. Teachers facilitated productive struggle for students, ensuring the desired level of rigor based on the findings of one seventh-grade mathematics teacher (Lynch et al., 2018). Lynch et al.'s study depicted three below-level students, each with a diagnosis of learning disabilities, and a teacher providing an opening mathematics problem. Whole-group problems were designed to challenge all students; then, scaffolded supports were designed with specific students in mind, allowing all students to gain entry to the problem yet providing an opportunity for productive struggle (Lynch et al., 2018). Multiple entry points into solving problems help students engage in vocabulary-dense mathematical problems and allows for productive struggle with the ZPD (Ewing et al., 2019).

Similar scaffolding techniques were depicted in Ankrum et al.'s (2014) case study, in which an exemplary teacher provided verbal scaffolding supports in a kindergarten classroom. A teacher assumes the role of the more knowledgeable other, guiding students through processes that are challenging to complete without support (Vygotsky, 2017). In Ankrum et al.'s study, the teacher met with small groups of students as warranted by student struggles; frontloading potential areas of difficulties and providing verbal cues led to students reaching understanding. The process of asking probing questions requires a skill not necessarily found in novice teachers (Lu & Rongxiao, 2016).

As the creation of a differentiated learning environment and probing questions are not inherently easy for many teachers, some university teacher preparation programs incorporate differentiated learning theory into the curriculum (Gilliam et al., 2018; Temli Durmus, 2016). Yenmez and Özpinar (2017) researched preservice programs, including differentiated mathematics instruction, and found the 49 participants had the perception of knowledge and ability to differentiate in a classroom as the training received incorporated both theory and practice. The researchers concluded more effective differentiated instruction could occur when preservice teachers are trained at the university level (Yenmez & Özpinar, 2017).

Teachers need knowledge of the content being taught as well as the ability to communicate the knowledge clearly and efficiently (Ewing et al., 2019; Lee & Lee, 2017). Known as *pedagogical language knowledge*, teachers understand where students are, what skills students possess, and students' previous knowledge (Ollerhead, 2018). The nature of these variables in any given classroom is wide-ranging, making small-group differentiation an essential element of classroom instruction (Tomlinson, 2015). Further, Choi and Walters (2018) found student discourse in small groups improved student performance. Similarly, Reid and Reid (2017) found discourse in the form of teachable moments, especially concerning concepts and models, increased a teacher's influence on students learning mathematics.

Small-group instruction is often the preferred method for remediation of students (Thompson et al., 2016). Benders and Craft (2016) examined first-grade reteach of a mathematics concept of 11 students and found flexible small-group instruction improved student mastery from 25% to 90%. Additionally, small-group intervention may be used as a means to reduce student anxiety about math (Ruff & Boes, 2014). Ruff and Boes (2014) studied the influence of counseling small groups of students who displayed anxiety toward math. The researchers found 84% of students had an improvement in necessary mathematics computation tests after having received counseling services specific to mathematics anxiety (Ruff & Boes, 2014). Further, Choi and Walters (2018) found students who were involved in small-group discussions concerning problem-solving were significantly more likely to score proficient or advanced on state testing than students who were not involved in such discussions.

Spoken activities play a role in student performance (Chou & Lin, 2015). Baiduri (2017) found student performance improved when students had opportunities to discuss problems in small groups, even when the facilitator of the group was a peer, aligning to Vygotsky's (1978) theory concerning social negotiation. The study data indicated performance also increased for the peer tutor (Baiduri, 2017). Discussion leads to students making connections between concepts and procedures, deepening student learning (Reid & Reid, 2017).

Small-group differentiation is a method used for classroom remediation as well (Thompson et al., 2016). Payant and Reagan (2018) found completion rates for student tasks increased when students were given time to interact with one another, and the teacher was free to facilitate small groups, improving both perseverance and skills. Additionally, research from Ruff and Boes (2014) indicated small-group instruction reduced student anxiety about mathematics, improving student performance. In both cases, students were observed to participate more, and tenacity increased with the implementation of a small-group differentiated approach (Payant & Reagan, 2018; Ruff & Boes, 2014).

Mathematics is often associated with emotions of fear and anxiety (Zamora-Lobato et al., 2019). Mathematical competence, reasoning formulation, and using procedures and mathematical facts are correlated with a student’s level of anxiety toward mathematics (Ruff & Boes, 2014; Zamora-Lobato et al., 2019). Mathematics anxiety is a response to situations involving and developing from personal, intellectual, and environmental factors from the past (Sanders et al., 2019). The utilization of small groups and peer-to-peer interactions has been shown to lessen anxiety (Ruff & Boes, 2014).

Mathematics Workshop

The NCTM (2014) recommends eight research-based teaching practices for mathematics, including establishing mathematics goals to focus learning. Additional recommendations include implementing tasks that promote reasoning and problem solving, using and connecting mathematical representations, and supporting productive struggle in learning mathematics (NCTM, 2014). Recommendations also include facilitating meaningful mathematical discourse, posing purposeful questions, building procedural fluency from conceptual understanding, and eliciting and using evidence of student thinking (NCTM, 2014). Daily lesson practices are contrasted by traditional delivery methods, which may hinder how a student learns mathematics (Hattie et al., 2017). Shifting from whole-group to small-group differentiated instruction allows teachers to deliver thorough, student-centered, focused lessons (Hattie et al., 2017; Newton, 2016).

In practice, differentiating content for each student is a shift from the teacher-centered model often employed (Sharp et al., 2019). The push for the success of all students warrants a systemic change in how instruction is delivered (Bogen et al., 2019). With difficulties in differentiating content and process of a class full of students, some mathematics teachers have adapted the workshop model found in reading classes to manage the various levels of student mathematics readiness (Benders & Craft, 2016; Blazar, 2015; Sharp et al., 2019). The resultant model is referred to as a *mathematics workshop*, with the small-group differentiation occurring during a guided mathematics portion of the content block (Newton, 2016).

Mathematics workshop is a student-centered instructional model in which teachers can differentiate instruction for various-sized groups of students (Newton, 2016; Sharp et al., 2019).

The mathematics workshop is a social–constructivist model as students complete tasks in a small interactive group (Vygotsky, 1978). Mathematics workshop incorporates several components within the mathematics instructional block, including an opening or warm-up, a minilesson, guided mathematics time, and a closing (Newton, 2016). Each element of the workshop model aids the teacher in the ability to instruct a small, differentiated group (Sharp et al., 2019).

Regardless of content, student warm-up activities are a component of the lesson cycle and have the ability to set the tone for the lesson (Barney & Leavitt, 2019). Warm-ups include a myriad of content and activities ranging from previously taught content to fact fluency checks but have a common purpose of stimulating mathematical thinking (Sharp et al., 2019). Rather than a traditional 45-minute lesson cycle, short minilessons are designed to teach students only the most essential portion of new content with explicit instruction (Sharp et al., 2019). Minilessons are brief but focused direct-teach lessons designed to instruct students on a specific skill or concept (Newton, 2016). During the bulk of a mathematics block time, known as *guided mathematics*, some students are working independently of the teacher while the teacher pulls groups of students for targeted, guided lessons (Newton, 2016). Small groups are dynamic, meaning the group members can change depending on need, and teachers can differentiate content and process (Benders & Craft, 2016; Blazar, 2015; Sharp et al., 2019). The final component of the workshop model involves closing the lesson, allowing students time to share and reflect on current understanding (Sharp et al., 2019).

Some research suggests the use of constructivism has limitations (Muller et al., 2018). McPhail (2016) found teacher misconceptions concerning play and the lack of integration of interrelated theories required a reexamination of constructivism. Further, McPhail concluded constructivist theory was reconceptualized from psychology for educational purposes; as such, the complex nature of student learning in the classroom was not adequately addressed using constructivist views or may be difficult to maintain (Muller et al., 2018). Despite potential limitations, researchers such as Temli Durmus (2016) studying the nuances of constructivist theory indicated the value in small-group instruction, and research by Benders and Craft (2016) and Garrett and Hong (2016) found small-group instruction in elementary mathematics classrooms allows for internalization of content.

While the literature indicates teachers use small-group differentiated instruction, less literature exists as to the reasons many teachers continue to opt for whole-group instruction (Reid & Reid, 2017). Murray et al. (2017) and Reid and Reid (2017) found mathematics teacher pedagogical decisions were related to mathematics content knowledge. Ruff and Boes (2014) found institutional and instructional changes needing to be made by already-overwhelmed teachers contributed to the status quo. The added pressures associated with standardized testing performance can contribute to a teacher’s decision to teach with traditional memorization tactics (Lambert, 2015; Voss & Rickards, 2016).

Gap in Literature

While research concerning the role of differentiated instruction and the manifestation of constructivist philosophy as applied to the learning in classrooms is plentiful, less literature exists on how constructivist philosophies change mathematics instruction, although research results indicate small-group mathematics instruction positively influences student learning (Reed et al., 2015). While much literature was available regarding constructivism as explained by Vygotsky (1978, 2017) and Bruner (1986), a great deal of the research was devoted to psychology. A subset of the literature was dedicated to social constructivism and the role of constructivism in the classroom (Bozkurt, 2017). The notion of third space and the applicability to the relationship of individual learning were prevalent in the literature, and the effects were evident (Bruner, 1986; Krantz, 2016; Vygotsky, 1978, 2017).

In terms of content, research on small-group reading was prevalent (Ciecierski & Bintz, 2016; Jarosz & Kutay, 2017; Tomlinson, 2015). Search terms such as *guided reading* and *readers workshop* provided substantial literature, including the literature comparing whole-group and small-group instruction and the impact on student performance. Leaders in the field of teaching reading, such as Fountas and Pinnell, and Tomlinson, are ubiquitous and used with the instruction of preservice teachers at universities (Jarosz & Kutay, 2017). Although research on the effects of small-group reading was widespread, the same cannot be said for research on small-group mathematics (Sharp et al., 2019).

Less literature was available concerning small-group mathematics and the treatment of mathematics as a language, although literature supporting using similar instructional strategies for both was available (Handford & Leithwood, 2019; Sharp et al., 2019). To provide perspective, the initial ERIC search for *small group reading* provided 47 articles, with *guided reading* adding another 55 peer-reviewed articles. *Small group mathematics* returned just three articles and *guided mathematics* only five. While some research, such as Sharp et al.'s (2019), has been completed in the area, much of the published work fell outside the date range for the literature review. As outlined in the literature search strategy section of the chapter, much effort was needed to find information specific to the influence of small-group mathematics.

Often, mathematics teachers employ traditional transmission methods as was experienced when the teachers were students (Fernando & Marikar, 2017). Less available research exists concerning the rationale surrounding teacher decisions between traditional transmission of content and small-group constructivist modes of delivery (Ashley, 2016; Sharp et al., 2019). The research study filled a gap in the literature by exploring why some teachers opt for pedagogical practices other than small-group instruction. The literature review provided links between constructivist philosophy and Vygotskian third space (Bruner, 1986; Vygotsky, 1978, 2017) to small-group differentiation (Tomlinson, 2015) and small-group mathematics (Nedellec, 2015; Sharp et al., 2019).

Two pairs of authors, Choi and Walters (2018) and Benders and Craft (2016) researched the impact small-group mathematics instruction had on student achievement, and Sharp et al. (2019) explored the implementation of a mathematics workshop model. No literature was found specific to teacher perspectives concerning the selection of small-group instruction as a mathematics strategy or the decision a teacher might make to teach a skill in whole groups versus small groups, although research of how often teachers utilize instructional pedagogies based on either belief or experience was completed by Siswono et al. (2019). Extrapolating the conclusions of Siswono et al. to a larger population was problematic as the sample size was small.

The available research had a common thread indicating positive outcomes when small-group differentiated instruction was employed in the classroom (Amponsah et al., 2018; Benders & Craft, 2016; Craig & Marshall, 2019; Thompson et al., 2016). Information in the literature linked small groups and a teacher’s ability to differentiate instruction (Amponsah et al., 2018). Further, Vygotskian (2017) third space provided a lens through which to view why social constructivism, as experienced in small groups, is successful. The use of small groups when new content is presented was supported by the literature, including in the study of mathematics, reducing mathematics anxiety, remediation of content, and delivery of new information, as well as a worthwhile practice when remediating instruction (Payant & Reagan, 2018; Ruff & Boes, 2014; Thompson et al., 2016). Small-group mathematics instruction is a viable pedagogical strategy as a means to differentiate instruction to meet individual student needs (Benders & Craft, 2016; Choi & Walters, 2018; Reed et al., 2015).

Chapter Summary

The purpose of the literature review was to provide a better understanding of various aspects related to small-group instruction and the influence small group instruction has on student performance (Craig & Marshall, 2019). An examination of the theory of differentiated instruction and Vygotskian third space in the context of mathematics instruction was conducted and organized (Gupta, 2015; Vygotsky, 2017). Reviewing the theory in the broad context of learning helped make sense of the scope of the theory and potential applications (Jitka et al., 2018). The theory of third space applies to various educational settings, including mathematics classrooms, and helped explain the need for small-group differentiated instruction, supporting the problem statement (Amponsah et al., 2018). Literature provided evidence as to the importance of teaching within students' ZPD as well as improving student understanding (Vygotsky, 2017). Small-group differentiation has been linked to higher student performance, longer student retention of material, and internalization of content (Benders & Craft, 2016; Garrett & Hong, 2016; Tomlinson, 2015).

The literature provided background concerning the complexities surrounding Vygotsky's (2017) third space theory and the application to classroom instruction. Third space was defined as the area of compromise between individuals as mutual understanding occurs (Gupta, 2015). A third space can occur as dialogue over new content between students or between student and teacher occurs, coming to a mutual understanding (Bruner, 1986). The theory offered a framework allowing for awareness about how new knowledge does not rest solely with a learner but within a group as well (Vedeler, 2015). Understanding social constructivism fell within teacher choices concerning pedagogical practice (Hang et al., 2017).

Teachers should have a comprehensive understanding of how students learn and how to best suit students' needs (Gupta, 2015). The ability to differentiate instruction is a necessary component of quality instruction (Tomlinson, 2015). Differentiated instruction permits students to filter new learning through existing schema, allowing for the sensemaking of content and gaining a deeper understanding (Mishra, 2015). Teachers differentiate instruction based on students' learning speeds, learning styles, and any learning difficulties, requiring teachers to be flexible in pedagogical approaches (Tomlinson, 2015). Student knowledge, preferences, and abilities to organize instruction are considerations as teachers determine how to differentiate content, process, product, and environment (Ashley, 2016; Beasley & Beck, 2017). Differentiation requires teachers to adjust teaching and content to align with student needs, placing requirements on teachers (Nedellec, 2015).

The connection between differentiation and small-group instruction was made (Sharp et al., 2019; Vygotsky, 1978, 2017). Placing students in small groupings helps teachers make targeted adjustments and improvements to teaching (Krahenbuhl, 2016). Having small groups of students aids teachers in the ability to scaffold questioning, which enables student metacognition of material (Davoudi & Sadeghi, 2015). Research results showed small-group mathematics instruction has a positive influence on student learning (Reed et al., 2015; Sharp et al., 2019).

Chapter 3 discusses the qualitative case study, identifying teacher perspectives of whole-group and small-group experiences. Research rationale, methodology, questions, and procedures are presented, as is the target population. The role of the researcher and potential biases are established, as are the ethical considerations and proper protocols, including data preparation, data analysis, and reliability and validity.

Chapter 3: Methodology

The methodology chapter comprises multiple sections. First, the design of the methodology and the rationale are examined. The research questions are restated, and matters involving the population are discussed. Next, the study's data collection instruments are presented, as are the reliability and validity of the data. The study's procedures are described, and the steps for data analysis are outlined. A summary concludes the chapter.

Research Design and Rationale

A qualitative study was selected because of the need to identify teacher perspectives of whole-group and small-group experiences. A case study was preferred as the approach allows for the investigation of a phenomenon in depth and within a real-life context (Creswell, 2015; Yin, 2014). The case study approach was preferable over other designs such as an ethnography as the data collection period of three weeks for the case study aligned with the time constraints needed to complete the study. The qualitative research approach provided for an examination of a complex problem to answer the rationale for pedagogical choices when teaching mathematics. Fifteen third- through fifth-grade mathematics teachers in a local school district consented to participate in the study. However, recruitment of participants at the beginning of a school year in which the COVID-19 pandemic occurred meant many potential respondents would decline the invitation to participate thus creating a recruitment constraint. Teachers responded to a questionnaire regarding community, differentiation, and pedagogical decisions toward mathematics instruction. Participants completed semi-structured online interviews and submitted mathematics lesson plans for lessons taught during the previous school year. The purposeful, judgment sampling contained intermediate-level mathematics teachers from elementary campuses within a single district. Judgment sampling allowed the study to examine trends, including location, grade-level assignment, and years of service, while allowing for stratification (Maul, 2018). Additionally, a document review of teacher lesson plans allowed for triangulation of data. The research examined teacher perspectives of experiences and practices in teaching mathematics. The following questions guided the study:

Research Question 1: What are teachers' rationale for choosing whole-group mathematics instruction?

Research Question 2: What are the perceived benefits of whole-group and small-group math instruction?

Research Question 3: What are the perceived challenges of whole-group and small-group math instruction?

Research Question 4: What are the teachers' perspectives of the features of small-group mathematics instruction?

Chapter 3 outlines the research design and rationale for the study. The role of the researcher, procedures, reliability and validity, and ethical procedures are explained. In addition, Chapter 3 explains time and resource constraints associated with the study design and defines the data analysis used for the study.

Role of the Researcher

The qualitative study explored why teachers choose whole-group mathematics instruction rather than utilize the small-group pedagogies being learned as part of district professional development. In qualitative research, the role of the researcher is to attempt to access the thoughts and feelings of participants (Sutton & Austin, 2015). Patton (2014) stated the disclosure of biases held by qualitative researchers mitigates impact. As such, I addressed personal biases associated with the topic rather than ignoring the biases.

The researcher, a district mathematics specialist, has worked in the district under study for 20 years. The researcher worked as an instructional coach at the campus level for 4 years and as a curriculum specialist and coach at the district level for 3 years. The experiences provided the researcher with myriad understandings and were the basis and impetus for advocating for small-group mathematics instruction. No personal relationships existed between the researcher and participants, although each participant would have attended professional development presented by the researcher, had a classroom observation completed by the researcher, or both, as the researcher was employed in the same district as the participants. No known conflict of interest existed.

As part of the reflective practice, data and potential biases were recorded in a reflexive field journal along with the document review data. The journal was kept electronically and used throughout the study. By bracketing biases, acknowledgment of personal experiences, such as the experience, role, and passion of district personnel, assists readers in understanding the filters through which the research data passed.

The role of the researcher was as an observer (Creswell, 2015). Recognition of previous experiences as an elementary school teacher and as an employee in the same district as the study participants were made. Participation in the study was voluntary. Prior professional relationships with participants may not have weakened the reliability of data and validity of conclusions but may have added a layer of understanding. Procedures and protocols for qualitative research, as outlined by the National Institutes of Health (2018), were followed.

Research Procedures

This section provides a detailed account of the measures of the study. The population, sample selection, and instrumentation are described and justified. Additionally, participant risk and consent are addressed.

Population and Sample Selection

Judgment sampling allowed for the gathering of school district data not possible with random sampling criteria. The population used in the study was accessible as the researcher and participants were employees of the same district and could be easily stratified. All participants were mathematics teachers in Grades 3–5 in the same Texas school district. The district employed approximately 255 third- through fifth-grade teachers, approximately 195 of whom taught mathematics. The sample size of 13 was large enough to allow for diversity of participants but small enough to allow for in-depth analysis of the questionnaire, semi-structured interview, and document data (Morse, 2000), allowing the research questions to be answered (Maul, 2018).

The participants were selected based on subject taught, grade level taught, and participant willingness to share practices related to small-group mathematics instruction. Procedures for identifying participants began with the availability and willingness of elementary mathematics teachers in Grades 3–5. As a district-level mathematics specialist, a professional relationship with many mathematics teachers in the district existed, as well as knowledge of professional development and classroom expectations as set by the district. A strength of the approach was the personal knowledge of the district and district mathematics teachers. Knowledge of participants and an ongoing professional relationship helped answer why and how participants felt and acted (Sutton & Austin, 2015).

Some of the benefits associated with the method of participant selection were racial and gender diversity of the group, a wide range of teaching experiences, the willingness of participants to share experiences, the ease of data collection, and the speed of data collection. The risk of a participant being removed from the study was low, as all met the criteria and had a working relationship with the researcher. No participants were removed from or left the study.

Each participant signed a consent form before participating in the study. All participating teachers worked in one Texas school district as elementary mathematics teacher, although some taught only mathematics, while some were self-contained and taught all content areas. Once the research proposal was approved by the Institutional Review Board (IRB), participants received an email invitation to the study that explained the study, purpose, and potential benefits and consequences. Additionally, the email contained the consent form. Upon return of the signed consent, each participant received a second email containing the questionnaire link, a calendar request for an interview, and a request to submit lesson plans.

Instrumentation

The purpose of the qualitative case study was to explore the rationale for mathematics teachers' pedagogical choices specific to group size in the local setting. As the intention of the study was specific and focused, an expert questionnaire (see Appendix A) previously used in research by Sharp et al. (2019) was selected. Sharp et al. employed a design to triangulate data from the questionnaire, ensuring the validity of the tool. Sharp et al. tailored the questionnaire to address a balance of teacher understanding of small-group mathematics instruction in a public school district in the southern United States during the 2016–2017 school year. The district had been providing professional development for mathematics teachers on the implementation of a mathematics workshop model since 2014. As the purpose and circumstances in the Sharp et al. study were similar to those in the present study, the open-ended section of the questionnaire was chosen.

Permission was obtained from the developers to use the questionnaire in whole or in part. Clarification of and permission to use the entirety of the open-ended questions of the questionnaire without modification is included in Appendix B, and the questionnaire is included in Appendix A. As the only modification of the questionnaire was the deletion of the quantitative portion of the instrument, no additional subject matter experts were required. The semi-structured interview questions were based on research by Ashley (2016) concerning the mathematics workshop and are included in Appendix C. Permission to use the protocol is included in Appendix H.

Data Collection

Qualitative research relies on multiple sources of data to gather evidence as a means of triangulation (Creswell, 2015). For triangulation in the study, an expert questionnaire, semi-structured interviews, and analysis of documents occurred. The data obtained were collected and analyzed based on the questions within the parameters of the research of teacher perspectives of small- and large-group mathematics instruction.

The expert questionnaire allowed for teachers' open-ended responses. Data were triangulated through online, semi-structured interviews and a document review of teacher lesson plans. As the study explored an issue in a single school district, judgment sampling was used. Information about the mathematics staff in the district was known, thereby allowing the focus to be on specific criteria of grade level, content taught, and interest in small-group instruction. Once the IRB approved the survey, interview, and document protocols, participants received a recruitment email (see Appendix D) and an email containing consent (see Appendix E), and an explanation of the study. The returned forms will be kept for 5 years. Notes will be held in an electronic field journal with a focus on classroom pedagogy during mathematics lessons.

Questionnaire

The expert questionnaire was completed online through Google Forms to ensure district login credentials. No one outside the study had access to the password-protected results. Data obtained from the questionnaire were used to help mold the semi-structured interview.

Semi-structured Interview

Interviews were held through phone conferences and video conferencing, with the choice being determined by the participant. Questions and responses were recorded with both platforms and maintained on a password-protected computer. Sessions lasted no more than 30 minutes, following the interview protocol. The open-ended nature of the semi-structured interviews provided the ability to ask follow-up questions to clarify respondent answers. The interview protocol was modified to shift focus on certain areas or exclude questions where response data were unproductive.

Interview participants were asked about perspectives related to mathematics pedagogy, including large-group and small-group instruction, as well as personal practices. Each interview began with three introductory questions followed by questions driven by the research questions. Answers to questions specific to instructional group size were restated to participants to ensure accuracy of understanding. After the interviews, recordings were transcribed using Studio Transcribe and verified for accuracy. Member checking was utilized to confirm accuracy and completeness.

Document Review

Participants were asked to submit lesson plans from the 2019–2020 school year through Google Drive. Lesson plans were used to explore collaboration with questionnaire and interview results and whether a pattern exists as to when or if small-group instruction was employed. As with all data obtained in the study, the documents reviewed were obtained and held electronically on a password-protected computer. Additionally, all names were removed from the documents. In the teacher lesson plans, all student names were removed. Pseudonyms were assigned to participant names and aligned to the questionnaire, lesson plans, and interviews.

Data Storage

Protection of the data obtained in the study was essential. All data were obtained electronically, as were the notes and coding. Each portion of the data was maintained on a password-protected computer, and each file was encrypted and protected by a password to provide an additional layer of security. As encryption and password protection is a viable option in the Microsoft Windows environment, backup of data on an external hard drive followed the same protocols to ensure the safety and security of the data.

Data were evaluated and compared for themes. The questionnaire and interview, administered electronically, were stored in a password-protected file. Coding and synonyms were employed to ensure anonymity. Data were aggregated and disaggregated using coding. Any identifying marks obtained through the data collection were removed. Creswell (2015) suggested storing the data in a locked device for 5 years and then destroying the data to prevent misuse.

Data Preparation

Responses obtained through the questionnaire, interview, and lesson plans were coded to ensure participant anonymity, with the key remaining under password protection. Respondents' names and any identifying information were removed. A key for the coding was kept in a separate encrypted folder accessible only to the researcher. Coding remained consistent throughout the study. Once coded, data were clustered to examine themes (Creswell, 2015). The same coding format was used with interviews and documents.

The questionnaire, interview data, lesson plans, coding, and document review were stored electronically. The password-protected files were accessible only to the researcher. To further ensure anonymity, pseudonyms are used in the data analysis section of the study. Any identifying marks in the surveys, interviews, and documents were removed before being reported in the study.

Data Analysis

The data were collected and analyzed based on the questions as to teacher perspectives of small- and large-group mathematics instruction. The qualitative study allowed for a broad look at a single district (Maul, 2018; Sutton & Austin, 2015). The survey data combined with the interview and document data met the criteria to answer the research questions. A complete and in-depth analysis of the data to determine key emerging themes was completed.

Questionnaire data were coded based on a general process outlined by Creswell (2015). The first step of the process was to get a sense of the data by reading through each transcript carefully and jotting down what was noticed. The next step was to begin examining interviews for underlying meanings. The coding of the documents included identifying text segments and phrases. Code words were examined for redundancy. Once an initial set of codes was established, the interview transcripts were examined to identify five to seven themes. Along with open coding, subcategory properties were explored to provide details. Additionally, each property was dimensionalized to examine potential extremes. Data obtained through the questionnaire were compared to the data gained during the interview and document review.

Questionnaire responses were separated into potential groups based on responses. Data from interviews and documents were examined within those groups to determine alignment. The converging of data from multiple sources strengthened the findings of the research. Both emerging themes and any lack of themes were analyzed (Ryan & Bernard, 2003). As the study explored teachers’ rationale for mathematical pedagogical practices, the case study approach focused on how the participants constructed an understanding of a mathematics workshop and the associated pedagogical choices each teacher made. The case study approach utilized iterative steps outlined by Guetterman (2015), including a judgment sample; data collection; and initial, intermediate, and advanced coding in a concurrent and constant comparative manner. With each iteration, memoing to record thoughts and feelings related to the data was employed. Initial assumptions were developed based on the survey results, but revisions to coding occurred as expected as the process was repeated in both the interviews and the document reviews.

Reliability and Validity

To establish credibility, experiences, decisions, and interpretations were included. Member checking by participants increased data analysis credibility, as did the triangulation of data from multiple sources and multiple groups. Credibility was established through the use of member checks, both during the interview process and at the conclusion of the study. During each interview, the participant's information and important responses were restated to ensure accuracy. Findings obtained during the study will be shared through the publication of the research and possibly through a professional presentation for district administration. Member checks improved the accuracy and interpretation of the data (Creswell, 2015).

Transferability was established by outlining criteria as to the participants, the process for collecting data, and iterations of data coding. Replication of the study under similar circumstances might allow for the generalization of findings. Nonetheless, as Yüksel and Yildirim (2015) explained, qualitative research findings are not easily generalizable to other cases.

The reliability of the qualitative study was enhanced by bracketing potential biases. Accounting for personal perceptions and the potential effect on the study allowed for the contemplation of biases (Varpio et al., 2017). Experiences and personal beliefs that could bias the findings of the study were identified. Personal perceptions are discussed in greater detail in the ethical procedures section.

Participants taught third through fifth grade and were garnered from different schools within the district. Further, teacher assignments varied, including self-contained, partnered, and fully departmentalized. Data collected in the study comprised many groups to gain a full understanding of the research problem.

Ethical Procedures

According to the U.S. Department of Health and Human Services (2019), ethics in research involves respect, kindness, and fairness of participants. IRB approval and informed consent were obtained before the collection of any data. The study adhered to the stated procedures. Further, research was not conducted on vulnerable populations, such as students, and instead focused on teacher rationale and experiences. Voluntary participation and ensuring anonymity, as well as coding and security measures, were part of the protocol to ensure the ethical treatment of participants. As teachers were employed in the school district where the study was conducted, participants were not pressured to participate in the study or answer questions with which participants felt uncomfortable.

Potential bias was addressed and recorded in the electronic field journal. The bracketing and disclosure of possible predispositions countered any potential biases. Limiting potential bias was critical as the district mathematics specialist was the sole researcher in the study. Even though the researcher and participants were employed in the same district, no one involved was in a supervisory position within the school district. The purpose was to collect data to conduct the research and not evaluate the participants. Pseudonyms were utilized to protect teachers’ identities. During the interview, the interviewer followed the proposed question stems. By using a specific set of open-ended questionnaire questions and interview stems, personal opinions and preconceived notions were set aside to focus specifically on the expressed thoughts of the participants. Data will be maintained in the password-protected computer within an encrypted, password-protected file and will be purged after the recommended 5 years (Creswell, 2015).

Chapter Summary

The chapter detailed the study's methodology and practices. The case study design and methodology were warranted, and the judgment sampling was justified. The purpose and limitations of the study were addressed. Roles and potential biases were established. Ethical considerations and proper protocols were provided. Procedures, including sample size, instrumentation, data collection, data storage, and data preparation were delineated. Multiple sources of data, the segregation of data by theme, and credibility were outlined. Chapter 4 explains the results of the study, including data collection, deviations, analysis, and results from the three data collection tools.

Chapter 4: Research Findings and Data Analysis Results

The purpose of the qualitative case study was to explore the rationale for mathematics teachers' pedagogical choices specific to group size in the local setting. Data collected regarding teachers' self-reported pedagogical practices are presented in the chapter. Data were gathered through an online questionnaire containing open-ended questions. The open-ended responses supplied comprehensive data as to teacher rationale. The second source of data was semi-structured interviews. Teachers were asked open-ended questions regarding small-group and large-group instruction in mathematics classes. The third source of data involved a document review of lesson plans from the 2019–2020 school year. Findings were compiled from responses gathered from all three instruments to answer the following research questions:

Research Question 1: What are teachers' rationale for choosing whole-group mathematics instruction?

Research Question 2: What are the perceived benefits of whole-group and small-group math instruction?

Research Question 3: What are the perceived challenges of whole-group and small-group math instruction?

Research Question 4: What are the teachers' perspectives of the features of small-group mathematics instruction?

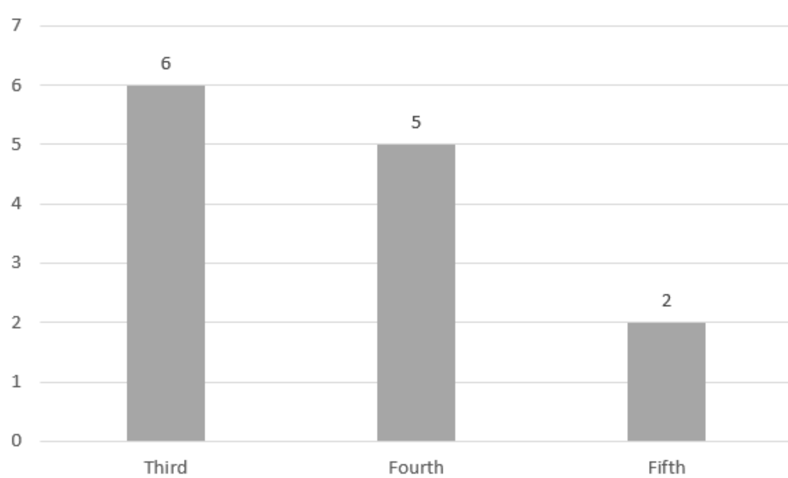
The problem in the local setting was many elementary-level teachers chose to teach mathematics in a large group with little or no differentiation, which may have contributed to stagnating scores on state tests. Data collection tools were selected to acquire information and insights regarding teachers' pedagogical choices specific to group size in one public school district. Data obtained in the study are presented, and reliability and validity are discussed.

Data Collection

Data for the study were collected using three instruments: an online questionnaire, a review of lesson plans, and semi-structured interviews of participants. The research involved 13 mathematics teachers in Grades 3, 4, and 5 in a single school district. The breakdown by grade level taught is presented in Figure 1. Of the 20 elementary campuses in the district, nine were represented with at least one participant. Teaching experience for the teachers ranged from 3 to 23 years, with an average of 13 years teaching and an average of just over 7 years at the current campus.

Figure 1

Number of Teacher Participants by Grade Level Taught



After receiving permission from the school district (see Appendix F) and IRB approval, an invitation to participate in the study was emailed to teachers in September 2020 through the district email system. To be eligible for the study, teachers must have taught mathematics in Grades 3–5 during the 2019–2020 school year. The email explained the purpose of the study and the potential benefits and consequences. Additionally, the email contained the consent form, which was signed electronically by each participant through a fill-and-sign option of the Adobe DC program and submitted through school district email. Signatures were verified via a tracking history associated with the program. Once consent was obtained, a reply email was sent that included a hyperlink to an electronic questionnaire, a hyperlink to an electronic calendar to schedule the semi-structured interview, and a discussion about submitting mathematics lesson plans. All data from the three instruments were collected during a 3-week window from late September 2020 to mid-October 2020.

Deviations From the Data Collection Plan

Although a total of 15 teachers consented to the study, two teachers did not participate once the data collection window was opened. One teacher had a family emergency that kept the teacher from participating, while the second teacher failed to respond to the emailed reminders. Ultimately, neither of the two teachers participated in any of the data collection. The instruments used for data collection remained the same as described in Chapter 3. Each of the 13 participants submitted lesson plans and participated in the interview within the 3 weeks allotted by the study. Twelve participants completed the questionnaire. Studio was used to transcribe the semi-structured interviews as the accuracy rate was comparable to similar programs and Studio was readily available.

Data Collection Using the Questionnaire Instrument

The electronic questionnaire was created as an adaptation of an expert questionnaire created by Sharp et al. (2019). The original questions are included in Appendix A and permission to use the applicable portion of the questionnaire is included in Appendix B. Respondents completed 10 short-answer questions, which allowed for coding of responses. As was indicated in the directions, respondents were not required to complete any questionnaire item with which the respondent felt uncomfortable or chose not to answer.

Teachers were directed to respond in the context of the 2019–2020 school year to ensure answers reflected pre-pandemic instruction. The questionnaire was built within Google Forms to allow participants to answer on a computer or a personal device such as a smartphone. Additionally, as the school district utilizes Google, teachers were required to log in to gain access to the questionnaire. The link was readily available only to those who had shared access to the form, and respondents were unable to see responses from other participants, ensuring confidentiality.

Twelve participants completed all items of the questionnaire, although the questionnaire was available to all 15 potential participants and was open for 3 weeks. A reminder email as to the closing of the instrument was sent at the end of Week 1 and again at the end of Week 2 (see Appendix G). Analysis of the results began after data were collected.

Data Collection Using the Semi-structured Interview

The semi-structured interview questions were adapted from research by Ashley (2016) concerning mathematics workshop and are included in Appendix C. Though the choice to participate in the interview process by phone was given, none of the participants chose a phone conference. Instead, all participants chose video conferencing through Zoom as accounts were readily available to all teachers in the district. Each interview was conducted individually to ensure confidentiality. Permission to record each interview was obtained, and recordings were housed on a password-protected computer. Although the proposal assumed the interviews would take no longer than 30 minutes, two interviews lasted over 35 minutes; the extra time was attributed to the complexity of answers and follow-up/clarifying questions.

Interviews consisted of four overarching sections of introductory questions, differentiation, small-group mathematics instruction, and mathematics workshop. Each participant was asked the same core set of question stems to keep uniformity, although certain questions required follow-up or clarity depending on the participant's response. In one case, for example, the respondent indicated mathematics workshop was not used. The following questions, all relating to mathematics workshop, were adapted to have the respondent speculate about the model in other classrooms. The potential for modifying the interview protocol was anticipated and discussed in the proposal.

Handwritten notes were taken during the interviews. The notes were used along with the recordings to ensure the accuracy of the transcripts. In addition, the notes provided for initial reactions to potential coding. For example, when asked about what differentiation means, "response to student gaps" was a common answer and created the basis for early coding.

At the end of each session, the interview was transcribed using Studio as the accuracy rate was comparable to similar programs and Studio was readily available. Each transcript was verified for accuracy by proofreading the transcript and comparing it to written notes taken during the interview. Interview responses specific to instructional group sizes were verified with each participant to ensure accuracy and resonance. Notes and transcripts were stored on a password-protected device. Once the interview process was complete, the coding of responses began.

Data Collection Using the Document Review

As a means of triangulation of data, teachers submitted three to five mathematics lesson plans. Directions were given to submit lesson plans reflecting face-to-face instruction. In the case of the school district in the study, most face-to-face instruction occurred pre-pandemic; consequently, lesson plans from the 2019–2020 school year were requested. Teachers either emailed lesson plans as attachments or shared links through Google Drive. In both cases, the plans were downloaded and placed in a folder on a password-protected device. Teacher names were removed from the documents to ensure participant confidentiality. As with the other instruments, lesson plans were examined and coded for themes, which were compared to those found in the other instruments.

Data Analysis and Results

A qualitative method was used for data analysis, which included collecting data, analyzing the data to develop themes, and recording the data. After reviewing the responses from the questionnaire and the semi-structured interviews, data were deconstructed for understanding. Common keywords and ideas were compared to teacher lesson plans. Codes based on relationships were categorized and considered as possible themes. Themes from all three sources were studied as a whole for recurrence and uniqueness within a given data collection instrument through the use of search functions in Studio and Microsoft Word. Occurrences of keywords from the coding were noted.

Twelve third- through fifth-grade teachers from a single local district completed the questionnaire. The questionnaire contained 10 open-ended questions, which allowed for coding. The questionnaire was created on a Google Form platform. Open-ended responses were collected from the spreadsheet and coded for themes. Tables were used to present the data collected. Visual representations such as figures were derived from exporting data from both Google Sheets and Microsoft Excel.

Semi-structured interviews were completed. Transcripts were created and verified to ensure accuracy. Participant answers were coded and examined for themes. Coding occurred as an iterative process. The first step involved browsing through each transcript and making notes.

A second, line-by-line read allowed for redundant words and phrases to be discerned. As salient themes emerged, each was compared to the context of the study and its relationship to the research questions. The cyclical process allowed for the grouping of codes as categories. Categories were developed and a hierarchy was explored. The relationship to each theme and category was translated into graphical representations.

As a means of triangulation, a document review of teacher lesson plans was conducted. Plans were searched for themes and keywords associated with both small- and large-group instruction. Lesson plans were compared to responses from teacher interviews and questionnaires to test for consistency. Data obtained in the document review are represented as a narrative in the chapter.

The qualitative case study explored the rationale for mathematics teachers' pedagogical choices specific to group size in the local setting. The choice of a case study approach allowed for the exploration of the rationale and perspectives of teachers when making choices regarding group size. The selection of a qualitative study established a comprehensive approach to understanding the nuances associated with teacher pedagogical choice of student groupings and potentially provided insight into stagnating student scores on state testing.

The use of each data collection instrument was intended to address various aspects of each research question to understand teacher rationale and perceived benefits and challenges associated with pedagogical strategies during mathematics instruction. Research Question 1 concerning teacher rationale, for example, was addressed through data collected from questionnaire items concerning the facilitation of a community of learners, choices of activities, and differentiation. Research Question 2, about perceived benefits of whole-group and small-group instruction, as well as Research Question 3, addressing perceived challenges of whole-group and small-group instruction, were addressed in the interview by asking the research questions as written. The use of aspects of each data collection instrument as it was used to understand each research question is shown in Table 1.

Table 1

Aspects of Data Collection Instruments for Research Questions

Research question	Questionnaire	Interview questions	Document review
Research Question 1: What are teachers' rationale for choosing whole-group mathematics instruction?	• Facilitating a community of learners • Choice of activities • Differentiation	• Planning for instructional diversity • The need for differentiation	• Activities • Differentiation • Planning
Research Question 2: What are the perceived benefits of whole-group and small-group math instruction?	• Coaching students • Lesson cycle	• Benefits of whole-group instruction • Benefits of small-group instruction	Evidence of: • Lesson cycle • Group size
Research Question 3: What are the perceived challenges of whole-group and small-group math instruction?	• Response to student need	• Challenges of whole-group instruction • Challenges of small-group instruction	Evidence of: • Lesson cycle • Group size

Research question	Questionnaire	Interview questions	Document review
Research Question 4: What are the perspectives of teachers about the features of small-group mathematics instruction?	• Lesson cycle • Direct-teach • Closure • Reteach	• Classroom environment • Mathematics workshop	Evidence of: • Direct-teach • Closure • Reteach

As noted previously, 15 teachers agreed to participate in the study. Ultimately, the number of teachers participating in the data collection portion of the study was 13. The grade-level distribution of participants who completed the questionnaire was presented in Figure 1.

The questionnaire contained 10 short-answer responses to a variety of questions involving a community of learners, facilitating, differentiation, and the role of the teacher. Keywords and phrases within responses were coded and examined for themes. Interview questions involved perceived benefits and challenges associated with group sizes and the features of the mathematics workshop. Data are presented as follows with items grouped into subsections by research question where appropriate.

Teacher Rationale

Research Question 1 concerned the rationale for choosing whole-group mathematics instruction. To address the research question, participants responded to several questionnaire items and interview questions. Teachers were asked two questionnaire items concerning learning communities in the classroom. Table 2 depicts codes and themes concerning learning communities taken from the responses to the two items.

Table 2

Emergent Themes in Responses to Community of Learners

Questionnaire item	Codes	Theme
Describe the importance of having a community of learners in your classroom.	• Important • Holds students accountable • Responsible • Encourage • Essential • Chance to be a leader • Learn from each other/help • Family atmosphere • Teach to learn • Students feel safe	Creates a nurturing learning environment
How do you facilitate a community of learners during math instruction?	• One-on-one • Randomness • Students defend answers/accountable talk/conversations/sharing • Variety • Partnerships • Independent workers • Building confidence • Modeling	Conversations between teacher and student and student and student

The first questionnaire item asked about the importance of having a community of learners in the classroom, while the second questionnaire item asked about facilitating during mathematics instruction. Responses revolved around themes of importance, safety, and collaboration. Codes included family, safety, and conversations, with the overarching themes involving the nurturing learning environment and classroom conversations.

Participants were asked how student learning activities were chosen. Responses included knowledge gained from student checks and informal assessments, student work samples, and more formal assessment data based on mock assessments aligned to state testing standards. Although student needs and engagement were mentioned in the short responses on the questionnaire, such responses were in the minority. Recurring responses to the questionnaire item regarding guiding teachers to select student activities to ensure student success included previous student work. Response codes and themes for what guided teachers to select learning activities are presented in Table 3, with the theme of the answers revolving around student performance.

Table 3

Emergent Themes in Responses to Student Activities

Questionnaire item	Codes	Theme
What guides your choice of student activities?	• Student understanding • Student needs • Previous work • Data • State standards • Student engagement	Student performance

Differentiation was addressed in Item 4 of the questionnaire. Teachers specifically mentioned (a) creating work that is more challenging and requires students in the talented and gifted (TAG) program to check in with the teacher less often, and (b) the implementation of documented and required accommodations for special education (SPED) students.

Participant 1 discussed regularly “scrapping” small-group instruction to teach the whole group based on the perception of lesson success. Codes associated with the item are shown in Table 4. The general theme of accommodating student need permeated the codes.

Table 4

Emergent Themes in Responses to Differentiation

Questionnaire item	Codes	Theme
How do you differentiate for students?	• Decrease student check-ins • Accommodations • Challenging work • Still working on it • Small groups	Accommodate student need and provide enrichment

Teachers responded to a questionnaire item about how students were coached. Of note were codes of repetition of problems and algorithms, whole-group instruction, and questioning techniques. Only one emergent theme, small groups of students, deviated from the answers being entirely about whole-group instruction. Participant 13 discussed creating a challenging research project for TAG students to allow for the remediation of all other students in class. Participants 3 and 6 had similar responses to coaching; Participant 3 noted the need for "repetition, repetition, repetition," while Participant 6 stated, "Practice, practice, practice." The theme concerning coaching was about directing student work (see Table 5).

Two items about the closure of lessons were included in the questionnaire. The first item asked about the value of closure, and the second item asked about how the closure was conducted. Seven teachers mentioned the use of exit tickets as a means of closing lessons, underscoring a theme of checking for understanding.

Table 5

Emergent Themes in Responses to Coaching

Questionnaire item	Codes	Theme
How do you coach your students?	• Repetitions • Probing questions • Remind students how mathematicians work • Small groups • Direct teaching to a large group • Work with students • Feedback	Directing work

Participant 2 indicated, “Closure is a way to gauge the students’ understanding of the topic,” emphasizing if students “get it.” Other codes included student reflections and share-outs. Three of the responses indicated closing activities were unnecessary or were not used, with Participant 6 not using “any type of closure activity unless . . . being evaluated.” Themes of checking for understanding and utilization of student products are presented in Table 6.

Table 6

Emergent Themes in Responses to Closure

Questionnaire item	Codes	Theme
What do you see as valuable with the use of closure?	• Not important • Exit tickets • Student recognition • Check for understanding • Transition • Students show what they know	Check for understanding

Questionnaire item	Codes	Theme
What are specific ways that you conduct closure?	• Do not use • Exit tickets • Student reflections • Share-outs	Student product

When asked what mathematics workshop meant, teachers' responses included a framework and a management system, and a means of incorporating small-group instruction. When asked about the process of determining student group placement, seven of the 12 teachers discussed basing groups on a low–medium–high system of dividing the total class enrollment by the number of desired groups. Only three of the teachers mentioned keeping groups small enough to maintain focus or using data to support design making. Codes and themes associated with how teachers perceived mathematics workshop are displayed in Table 7.

Table 7

Emergent Themes in Responses to the Meaning of Math Workshop

Questionnaire item	Codes	Theme
What does a math workshop mean to you?	• Management system for behaviors • Mini-lesson • Small groups • Active engagement • Guided framework • Skill building	Framework for mini-lessons and small groups

Benefits and Challenges of Group Sizes

Research Questions 2 and 3 asked about the perceived benefits and challenges associated with whole-group and small-group math instruction. One distinct theme could be seen in Item 8 regarding the role of the teacher during student work time (see Table 8). One set of codes included guide and facilitator. Such responses accounted for five of the 12 responses, with Participant 4 stating, “My role during work time is as a facilitator. I like to give the students time to work on their own and teach them it’s okay to struggle.” A second, distinct code included keywords concerning checking on and monitoring students and accounted for one out of every four responses. Participant 2 answered the primary role was to “monitor the students, make sure they are on task.”

Table 8

Emergent Themes in Responses to Teacher Role

Questionnaire item	Codes	Theme
What is your role as the teacher during work time?	• Moving about the room checking on students • Facilitator • Guided support • Monitor	• Facilitator • Monitor

Table 9 represents responses to Item 9 on the questionnaire about problems assigned to students. When asked how many problems were assigned to students during work time, two main themes appeared. While nine of the 12 participants included “10” in the response, three participants included 10 as the upper end of the range and six included 10 as the lowest end of the range. Two respondents indicated the number of assigned problems was contingent on factors such as complexity.

Table 9

Emergent Themes in Responses to Number of Problems Assigned

Questionnaire item	Codes	Theme
On average, how many problems are students given to work during work time?	• 10–20 • 4–5, no more than 10 • 10 • Dependent	Approximately 10

The final questionnaire item concerned participant responses to student needs during work time. Three distinct codes arose: student-initiated, adult-initiated, and miscellaneous. Table 10 identifies emergent codes from a variety of responses.

Table 10

Emergent Themes in Responses to Responding to Student Needs

Questionnaire item	Codes	Theme
How do you respond to students' needs during work time?	Teacher-initiated: • Checking in constantly • Reteaching • Pull students to the table Student-initiated: • Protocols • Help only if a student is stuck Other/miscellaneous: • Scaffolding • Someone else helps • Students work until I can get to them • Won't give an answer	Monitor/adjust

Several responses involved not giving students answers or allowing other students or adults in the room to help. Of the responses, five indicated a teacher-initiated theme such as reteaching of pulled students and seven included either peer support or help from a co-teacher in the room. Participant 2 stated the importance of not giving students answers, while Participant 3 mentioned helping students if “students are seen struggling and I am available.”

During the interview, participants were asked about differentiation, planning for an academically diverse group of students, and the use of assessments and data. Participant 5 stated differentiation included giving students “whatever they need to be successful,” while Participant 4 indicated differentiation meant “meeting the needs of various levels of students.” Such responses were countered by replies such as “on the fly” and “I don’t.”

While being asked about differentiation, Participant 12 admitted only “certain kids” require differentiation; specific tactics were often based on time, either to “accelerate or decelerate” the speed by which students received instruction; and lessons tended to be on the same academic level. Participant 3 replied differentiation occurs based on student performance but is often part of a whole-group strategy. An example provided was how the use of a 4-digit number in a problem could be changed to a 2-digit number as a scaffolding technique to get the point of the lesson across. Table 11 indicates codes and themes associated with differentiation, diversity, and the use of assessments and data.

Table 11

Emergent Themes in Responses to Differentiation and Diversity

Questionnaire item	Codes	Theme
What does differentiated instruction mean to you?	• Respond to student needs/adjusting • Give kids whatever is needed to be successful • Same lesson, different level • Individualization • Questioning	Adjusting to student
How do you plan math instruction for academically diverse learners?	• Backward planning • Plan for the middle • Accelerate/decelerate/scaffold • Look at data • Manipulatives • Don't • On the fly • Ability group	Monitor/adjust
How do you use math assessment data?	• Weekly tests • Reduce assignments • Pre-/posttests • Already know student gaps • Quick-check to tutor	Tests

The document review of submitted lesson plans indicated some differentiation as related to required programs such as TAG and SPED, although none indicated differentiation of mathematics for most students. Indicators for various accommodations included oral administration and extra time (see Table 12). More nuanced differentiation, such as the use of manipulatives or inclusion in small-group instruction, was not present.

Table 12

Emergent Themes in Responses to Differentiation

Lesson plans component	Codes	Theme
Differentiation	• Program (talented & gifted, special education; reduced assignment, oral administration, extra time, small group) • Extension	Accommodations

Explicit mention of differentiation was only seen in two sets of lesson plans. In one case, all words indicated students in special programs such as TAG or SPED and listed required accommodations. In the second case, mention was made of extension activities for early finishers of work. No other documents submitted by participants indicated differentiation or remediation in any capacity.

Themes regarding a cluster of interview questions involving mathematics workshops are presented in Table 13. Participant 13 discussed not utilizing the workshop model in favor of “doing it my own way”; Participants 2, 6, and 7 echoed the sentiment. Participant 6 stated being able to “see students struggle in whole group,” whereas having students at stations, “which I don’t do at all,” might “keep that from happening.” Participant 2 described the importance of students solving “real-world problems and not just textbook work,” but the workshop involved students “doing a lot of stuff.” Participant 7 believed the mathematics workshop to be too distracting and thus does “something different.”

Table 13

Emergent Themes in Responses to Benefits and Challenges

Interview question	Codes	Theme
What are the benefits of whole-group math instruction?	• Get information out/efficient/scope • Group discussions/shared point of view/togetherness • Management • Modeling	Efficiency
What are the benefits of small-group math instruction?	• Personal • Most change • Comfortable • Feedback/conversation/peer interaction • Attentiveness • Reteach	Effective
What are the challenges of whole-group math instruction?	• Can't get to every kid • Management • Behavior/boredom/engagement/attention • Student confidence/understanding • Guesswork	Time and class management
What are the challenges of small-group math instruction?	• Exhausting/excessive planning • Behavior • Not original work • Time/getting to students	Time and class management
What are the impediments, to you or other teachers, to implementing small-group instruction?	• Class/behavior/time management • "Old-school" is not a growth mindset • Teacher preparedness/planning • Teacher understanding/comfort with math	Management/ preparedness

Themes for the coding with the interview question cluster involved the efficiency and effectiveness of instruction, as well as behavior, class, and time management. Specific to impediments was the time necessary to plan and carry out small-group instruction. Teachers prioritized planning for behavior over planning for small-group instruction.

Perspectives of Small-Group Instruction Features

Concerning features about small-group mathematics instruction asked in Research Question 4, teachers were asked to describe the classroom environment and structure. Respondents indicated the use of student stations as a means of rotating students. Although the rationale for the use of the stations varied, responses involved opening up the classroom and the movement of students.

Responses to the general environment ranged from open and entertaining to more structured. When asked about how group sizes were determined, responses ranged from dividing the total number of classroom students by the number of desired groups to ability grouping based on low, medium, and high levels of student success. One respondent commented about reading the temperature of the class, indicating the fluidity of groupings rather than a predetermined plan. Codes and themes associated with the classroom environment, structure, and how group size is determined are displayed in Table 14.

Table 14

Emergent Themes in Responses to Classroom Environment and Structure

Interview question	Codes	Theme
Please describe how your classroom environment is set up during math lessons.	• Rotations/stations/open/movement • Entertaining/open • Teacher modeling/structure/ organized • Low, medium, high • Safe/respectful	Rotating groups
How/why do you choose group size during mathematics instruction?	• Just divide • Temperature read • Need/low, medium, high • Small enough to focus	Predetermined levels

Commonly used words and phrases for the opening portion of lessons as written in lesson plans were “hooks,” “warm-up,” and “the Problem of the Day.” Other commonly used keywords were “formatted questions based on state testing and presented to the class.” Codes and themes associated with the structure are displayed in Table 15.

Modeling and direct teaching were common themes in the lesson area of the plans, as were objectives and directions. Some lesson plans contained descriptions of small-group work and contained indications of stations and journaling activities. Most lesson plans included some sort of closing activity, often exit tickets.

Table 15

Emergent Themes in Responses to Structure

Interview question	Codes	Theme
Opening/introduction	• Hook • Warm-up/seed • Question • State of Texas Assessment of Academic Readiness • Problem of the Day	Problem of the Day
Lesson/mini-lesson	• Modeling • Practice • Objective • Activity • Direct-teach/PowerPoint/directions	Modeled instruction
Closing	• Exit ticket	Closing

Participant 4 combined the terms “direct teaching” and “mini-lesson” in the submitted documents and used “framing the lesson” in place of “hook” or “warm-up,” whereas Participant 6 did not include any mention of small groups or mini-lessons. The only mention of warm-up was in referring to a specific product. Similarities existed with the documents received from Participant 1. No mention of small groups or minilessons was included in the documents, and while a column header was included for the introduction/hook, no activity or plan was mentioned. Codes were organized into themes for each component area of the lesson plan (see Table 16).

Table 16

Emergent Themes in Document Review of Lesson Plans

Lesson plans component	Codes	Theme
Guided/workshop	• Stations • Partner work • Independent/textbook/practice • Journal • Interactive • Discuss • Small group	Work stations/groups
Differentiation	• Program (talented & gifted, special education; reduced assignment, oral administration, extra time, small group) • Extension	Accommodations

Reliability and Validity

The triangulation of three data sources was used to ensure the reliability and validity of the research. Data were collected from questionnaires, semi-structured interviews, and a document review of lesson plans. Once keywords were identified and grouped into potential themes, examination of the same keywords in other data sources occurred. Multiple sources of data aid in understanding multiple perspectives and contemplating biases (Creswell, 2015; Varpio et al., 2017). The study explored teachers' rationale for and perceptions related to small-group instruction. Although participants worked at nine schools across the district and ranged in teaching experience from 3 to 23 years, the results cannot be assumed to apply to other districts. Replication of the study under similar circumstances could yield similar results, but the size of the study limits generalization (Yüksel & Yildirim, 2015). Familiarity with participants allowed for specific follow-up and clarifying questions during interviews that may not have otherwise been possible. To establish credibility, participant responses were restated to ensure accuracy and provide a feedback technique for member checks. Potential issues regarding bias were bracketed by journaling and disclosure. Experiences and personal beliefs were shared in the ethical procedures section.

The judgment sampling of mathematics teachers in Grades 3–5 allowed for a wide range of participants both in terms of campus placement and years of teaching experience. All participants received a letter stating the study objectives and the ability of the participants to opt-out of any question or submission, which were also included in the consent form. Some participants skipped some questionnaire items, but no interview questions were skipped, nor did any participant appear to omit portions of lesson plans. Protocols and coding remained in place to ensure participant anonymity. Credibility was enhanced by member checking and through the triangulation of data.

Chapter Summary

The findings of the qualitative case study were presented in Chapter 4. Consent was obtained from participants after IRB approval and before any data were collected. Data were obtained through a questionnaire available to participants on the Google Form platform through the district portal. Semi-structured interviews were scheduled through a Goggle Calendar, linked to the district portal, and carried out through Zoom telecommunication software. Lesson plans were obtained through district email and shared through the Google Drive platform. Document reviews of the teachers’ mathematics lesson plans, semi-structured interviews, and responses to questionnaire items were coded and examined for themes.

Transcripts of interviews were checked for accuracy and compared to notes. Coding of open responses, interview transcripts, and lesson plans were completed separately, then compared for themes and similarities. Data were grouped by research question and represented in tables displaying codes and themes.

Chapter 5 provides details of the findings and interpretations of the data. Discussions grouped by the research question, along with examples of teacher comments, are pooled. Reflection of the data instruments and clarifications as to the use of the instruments is shared. Conclusions, limitations, recommendations, and implications for leadership are addressed.

Chapter 5: Discussion and Conclusion

The purpose of the case study was to explore the rationale for mathematics teachers' pedagogical choices specific to group size in the local setting. While research indicates the impact small-group instruction can have on student performance, higher-order thinking skills, and improved attitudes toward mathematics (Hwang et al., 2018; Lynch et al., 2018; Voss & Rickards, 2016), many teachers in the local setting choose either limited or no small-group instruction for mathematics. As Lambert (2015) and Simpson (2015) found, teachers often abandon various pedagogical strategies as state testing nears in favor of largely whole-group instruction over formatted material. The problem in the local school district was many mathematics teachers tend to teach using little differentiated small-group instruction regardless of the time of year or proximity to state testing.

The research explored the rationale for teachers' pedagogical choices when instructing math. Perspectives on the benefits and challenges associated with teaching mathematics in a small group were explored. The research focused on answering questions concerning teachers' rationale for choosing whole-group mathematics instruction, perceived benefits of whole-group and small-group math instruction, perceived challenges of whole-group and small-group math instruction, and teachers' perspectives of the features of small-group mathematics instruction. The research strategy was based on a case study design used to understand a central phenomenon (Creswell, 2015). Thirteen teachers participated in the study, and three data sources were employed: a questionnaire, a semi-structured interview, and a document review of lesson plans. The questionnaire focused on the community of learners and the differentiation of instruction. Semi-structured interviews covered the differentiation of instruction, the workshop model, and perceived benefits and challenges with group sizes. The document review included lesson plans from the previous school year. Responses from the questionnaire, interviews, and lesson plans were coded and examined for themes.

Findings, Interpretations, Conclusions

The findings through data analysis were based on the conceptual framework of Vygotsky's (2017) third space and how social constructivist views are related to pedagogical practice. Constructivist views assist teachers in making pedagogical choices leading to differentiation of content, process, and product within a small-group setting (Hang et al., 2017). Based on the analysis and findings of this research, teachers had a rationale for both the use and nonuse of small-group differentiated instruction in a mathematics setting. Discrepancies between emergent themes in the data obtained from the three data collection tools indicate potential issues in how each teacher defined small-group differentiation and the workshop model, as well as perspectives concerning the amount of time devoted to a small group.

Research Question 1

The first research question asked, What are teachers' rationale for choosing whole-group mathematics instruction? To answer the question, specific items were included in the questionnaire and semi-structured interview. Respondents were asked how and why group sizes were chosen, the benefits and challenges associated with various group sizes, and potential impediments to implementation. Items supporting the research question included how to differentiate instruction, the role of the teacher, and responding to student need.

Several participants indicated the benefit of whole-group instruction is the efficiency of getting out large amounts of information in a limited time. Concerned with covering the scope of state-mandated standards, teachers indicated whole-group instruction is a means of delivering content efficiently and on time. For all teachers participating in the study, lessons were delivered to the whole group, with a similar rationale of efficiency and management. What differed was how long teachers remained in the whole group before moving into smaller groups for differentiation of content and what was being taught in small groups. Evidence a mini-lesson, a short, targeted lesson designed to increase schema, was employed as a time management technique to physically see small groups of students, as described by Sharp et al. (2019) and Tomlinson (2015), were limited.

Many teachers perceived group size as being a choice in the preferred delivery method, with part of the rationale being classroom management and student behavior management. As such, some teachers believed small-group instruction was unnecessary, opting instead to differentiate for students during independent work time with a brief reteach of the content when the students returned to their desks for continued independent practice. Although the framework for whole-group instruction and remediation might be efficient, the inability for students to interact with the teacher and other students in discourse limits third space, thereby restricting the ability of students to adjust new learning with schema (Dack et al., 2019; Lau et al., 2018).

The whole-group delivery method allows for an overarching view of content understanding and individual view to determine which students grasp the content. Differentiation occurred as adjustments were made in lesson delivery in the whole group. In the whole-group instruction classrooms, no independent work was assigned to any students until all students met a certain understanding during the guided portion of the lesson.

Teachers chose whole-group instruction as a means of ensuring student productivity. Lessons were designed with the average learner in mind, and alteration of the lesson occurred during the whole-group lesson based on checks of student understanding, such as students showing a thumbs-up to indicate understanding or a thumbs-down to indicate confusion. For many of the teachers, specific differentiation of content did not occur except for accommodations based on student need as indicated in SPED or TAG paperwork. In whole-group instruction classrooms, teachers perceived whole-group instruction to provide benefits outweighing other forms of delivery, in contrast to Lambert (2015) and the philosophy of the school district, which tends to define instructional practices. The teachers' rationale was, as long as the teacher was entertaining enough to maintain student engagement, altering content or process for students was unnecessary, except for students identified in special programs. The students in the TAG program were given independent projects and extension activities selected from choice sticks. Upon completing the work, presumably ahead of other students, each TAG student chose a stick at random to work on a long-term project.

All teachers indicated whole-group delivery of content, with the only variance being how long the instruction remained in the whole group. One-third of the teachers indicated using the whole group during the entire mathematics block or limiting small-group instruction to special circumstances. Two-thirds of the respondents stated using the whole group in the delivery of content and devoting at least some time during the week to small, differentiated groups.

Whole-group instruction is problematic in the context of Vygotskian third space as the basic tenet of the conceptual framework is the occurrence of a mutual understanding between a learner and the teacher or between learners (Bruner, 1986; Vygotsky, 2017). Didactic instruction precludes discussion in favor of the dissemination of content. Only two teachers shared the use of student interactions during whole-group instruction, meaning few, if any, instructional adjustments were made during lessons. Further, the limited use of classroom discussions meant students had fewer opportunities to find a compromise in the third space between what was known and what was being taught. The lack of social interaction would explain the limited individualized construction of meaning (Badie, 2016; Skidmore & Murakami, 2016), as evidenced by the stagnation of state testing results (Texas Education Agency, 2019).

Research Question 2

As a means of understanding why teachers make the pedagogical decision of group size, Research Question 2 asked, What are the perceived benefits of whole-group and small-group math instruction? Twelve respondents answered the question during the interview. Codes included management, efficiency, and togetherness, all relating to a theme of efficiency.

Each teacher interviewed referred to some type of management when discussing whole-group instruction, although the type and effectiveness differed. Half the teachers mentioned behavior management in discussing group size, although some teachers mentioned behavior management as a positive for whole-group instruction, while other teachers mentioned it as a negative for small-group instruction. Several teachers mentioned control of classroom and behavior management as a benefit of whole-group instruction but also cited group norms and modeling as the rationale. Classroom control, especially control over rules-based conception, aligns with the research of Ayebo and Assuah (2017).

Most respondents indicated the ability to disseminate large amounts of information efficiently was a benefit to whole-group instruction, aligning with Cardimona (2018) and Irvine (2017). Didactic instruction was not the only means of delivery discussed by the teachers during the interviews. Modeling problems, algorithms, and thinking during whole-group instruction, a variation described by Irvine and Jayanthi et al. (2017), was mentioned. Whole-group discussions were specified as taking place during the whole-group time, indicating much more than just teacher talk during whole-group delivery.

For teachers indicating the use of small-group instruction, the ability to give and apply feedback in a small group was important for struggling students. The importance of immediate feedback and getting to know students played a part in teacher selection of small groups for small-group instruction. Each code related to an overall theme of the effectiveness of small-group instruction.

While respondents listed benefits to both whole-group and small-group instruction, the participants agreed whole-group instruction was an efficient means of presenting large amounts of content in a relatively short time. Whole-group instruction was seen as a way to ensure the message remained consistent for all students. Small-group instruction, by contrast, was a time to engage in conversation, provide feedback, and reteach misunderstood concepts, lending to the notion each learner is unique (Bruner, 1986).

Participants discussed the need to differentiate instruction in a small group. Such beliefs were consistent with constructivist philosophies and the ability of a teacher to provide a space in which learners can construct meaning. The participants' descriptions concerning small-group learning mirrored the active learning characterized by Tomlinson (2015) and Sharp et al. (2019). The small groupings of students described by the teachers were consistent with the conceptual framework of third space as a means to improve student understanding (Sharp et al., 2019). The use of small groups helped teachers facilitate the scaffolding of questioning and improve student responses (Danish et al., 2017). Potential problems arose as the small groups were primarily described as being used after the delivery of new content, and specifically for students needing remediation. As Vedeler (2015) described, a third space explains how new information is learned, yet the use of a third space was relegated to remediation rather than initial instruction of new content.

Research Question 3

Respondents were able to clearly define the perceived benefits and challenges associated with group size. Research Question 3—What are the perceived challenges of whole-group and small-group math instruction?—dealt with the negative aspects of the whole-group and small-group instruction strategies. Emergent themes included challenges in planning and student engagement.

The participants stated the feeling small groups could be a challenge due to student personalities or behavior. Most often referring to group work away from the teacher, respondents indicated behavior impeding implementing small-group instruction. All teachers in the study reported either excessive planning or the inability to find the time to get to students as being challenges. Further, students doing work other than assigned work, or not working at all, were concerns the teachers had while students were in small groups. While the response was the only statement concerned with the originality of student work, half the teachers discussed creating stations for students in such a manner that group work was expected. Further, it is worth noting not all teachers perceived the same meaning to the question, as some addressed small groups of students out in the classroom away from the teacher, while other teachers considered only the group of students at the teacher table for instruction.

Whole-group instruction was also seen to have challenges. Management of bored students and trying to reach every student were noted. Reasons for student boredom included teacher delivery and teaching something students already knew. Having to be entertaining when teaching was mentioned as another possible reason for student boredom. Formatively assessing student understanding was also perceived to be more difficult in whole-group lessons.

All interviewees cited challenges with whole-group and small-group instruction, although the reasons were different for each. Some teachers perceived time and behavior management as personal challenges, while other teachers perceived time and behavior management as personal strengths. The most notable challenges for small-group instruction, as indicated by the respondents, were the exhausting nature of planning and implementation and time getting to all students.

Benefits and challenges were consistent with the literature. One participant described the use of small-group instruction as a way to allow students to internalize content (Benders & Craft, 2016). All participants described the efficiency of whole-group instruction as a benefit, aligning with Irvine (2017). A variation on whole-group and small-group instruction was also discussed whereby students would utilize independent work time by proving proficiency with the teacher before progressing to assigned work. Such variations describe the active engagement of students and are consistent with those described by Jayanthi et al. (2017), although the model limits student-to-student interaction. The restriction of student interaction minimizes Vygotskian third space, thereby limiting the individualization of content understanding (Bruner, 1986; Gupta, 2015; Vygotsky, 2017). Although differentiation was described as a benefit of small-group instruction and was mentioned by all participants, most teachers described limiting student interactions during the delivery of new content, a juxtaposition from Badie (2016).

Research Question 4

The final question, Research Question 4—What were the perspectives of teachers about the features of small-group mathematics instruction?—contained a variety of responses. When asked about small-group instruction, mathematics workshop, and guided mathematics, teachers offered various visions. Ten teachers mentioned either center, stations, or rotations when discussing small-group instruction. Such answers point to teachers’ notion that small-group instruction is what was occurring in the room. Some evidence for the notion was found in the item concerning perceived impediments of small-group instruction requiring excessive planning. Although two-thirds of the teachers in the study utilized small-group instruction at some point during a typical school day as a means of remediation, as described by Thompson et al. (2016), half of the teachers pulled only the lowest-performing group, allowing other students to work either individually or in small, collaborative groups independent of the teacher.

Many teachers felt small-group instruction was unnecessary provided a teacher had good classroom management, which is counter to the conceptual framework of third space to ensure mutual understanding of content and with limited misconceptions (Bruner, 1986; Vygotsky, 2017). For this subgroup of teachers, of importance was control in the classroom, both in terms of behavior management and the message. Several teachers used a different framework whereby students were given class time to complete work. During the time, students were required to show the teacher the work to see if a reteach was necessary. The pedagogical strategy, in the minds of the teachers, eliminated the need to differentiate in small groups and had the added benefit of better classroom management. The strategy is counter to the basic tenets of third space (Gupta, 2015).

Additionally, themes emerged from the research that indicated small groups were determined by a variety of factors, including either simply dividing the total number of students in the class by the desired number of groups or creating groups deemed low, medium, and high. Arbitrarily assigning group members is counter to the idea of differentiation of instruction through the three avenues of process, product, and content (Hang et al., 2017). In most cases, teachers mentioned groups being fairly constant; usually, lower-performing students remain relatively low and consequently remain in the same group, as described by Amponsah et al.

(2018) and Reed et al. (2015). Only one teacher discussed the fluid nature of grouping small clusters of students based on the skill at hand.

Participants described small-group instruction in physical terms such as classroom organization and arrangement rather than features associated with teaching a small group. No discussion about using small groupings to improve student thinking, as outlined by Sharp et al. (2019), took place. Further, no participant alluded to the use of third space or constructivist tactics as a description of the features of small-group instruction. Even considering the model as a framework (Benders & Craft, 2016), teachers failed to mention the use of the small group to improve student understanding.

Limitations

The greatest limitation was the size of the study. While 15 participants consented to the study, only 12 individuals ultimately completed all three components of data collection. With a response rate of 80%, the number of respondents was adequate for this study (Nix et al., 2019). An email invitation was sent to a total of 33 potential participants. Ultimately, 15 individuals signed the consent to participate, with 13 completing the interview and submitting lesson plans and 12 participants completing the questionnaire. The smaller sample size means less representation of the overall population and less opportunity to extrapolate results to a larger group. The study was conducted over 3 weeks at the opening of the school year. Added to the situation was the need for teachers to be trained in a new learning management system in preparation for online learning being implemented at the start of the 2020–2021 school year due to COVID-19 pandemic protocols. Even though the number of participants in the study was adequate for the case study approach, the results cannot be assumed to be true in other school districts.

Recommendations

The following recommendations are based on questionnaire responses, interview responses, the document review of lesson plans, and themes based on coding gathered from the data analysis. Ideas for improvement include improved professional development in the area of conceptual understandings of the subject of mathematics, classroom management to include behavior and time management, and lesson planning.

The first strategy is to make a change in the professional learning of teachers in the district. Professional learning in the local setting often takes the form of traditional lecture-type events stacked early in the year, and usually contains content concerning new programs. Based on the responses of the participants in the study, teacher understanding and comfort level with mathematics impeded teacher implementation of a framework such as mathematics workshop in respective classes. A shift toward professional learning that includes nuances about how and why certain concepts are taught at the elementary level and suggestions on various ways to teach concepts in a foundational, concrete way would aid in teacher understanding of the material and pedagogy.

Management was another area addressed in the study. In the interviews, teachers discussed classroom management as being a critical hurdle in the implementation of small-group instruction. Student behavior, time management techniques, and relinquishing classroom control were seen as impediments to moving away from whole-group instruction to small groupings of students. The second strategy, professional learning to include model lesson demonstrations in the classroom, would assist teachers in seeing how a workshop framework functions in the classroom.

Assistance with efficient planning is the third strategy. Many respondents in the study either perceived the amount of work it takes to plan small-group instruction as excessive or had experienced the difficulties firsthand. Sessions on lesson planning, including how to plan within a workshop model and how and what to plan for students during work time but not with a teacher, would help alleviate concerns over excessive time given to planning.

While all three strategies are important recommendations, several respondents either alluded to or specifically mentioned control in the classroom. Classroom control stems from teacher beliefs concerning the monitoring of rule following and the need to maintain order (Ayebo & Assuah, 2017). While training in the area of classroom control is recommended, a paradigm shift for teachers who believe control is lost when students are not with the teacher would be difficult.

Based on the analysis within the study and the review of the literature, recommendations are made for further study. First, a larger sample size would improve the ability to generalize findings to other settings. Another study would have the ability to confirm findings from the present study. Additionally, conducting a similar study in the same setting after the implementation of the recommendations would allow for an understanding of the effectiveness of the professional development being offered. Furthermore, in light of the revelation that classroom control might be a part of what keeps teachers from using small-group instruction, a study to examine teacher philosophy concerning monitoring student rule-following and classroom control should be explored.

Implications for Leadership

The results of the study should be of benefit for instructional coaches and leaders in elementary schools as a way to understand teacher rationale in making certain pedagogical decisions, such as group size and whether to implement a framework such as a workshop model.

Based on the results of the study, impediments to the implementation of small-group differentiated instruction include lack of in-depth knowledge of the subject, necessity for classroom management, and the effort required to plan within the framework. As the teachers had been provided training on the implementation of and rationale for the model itself, the impediments were hurdles large enough to keep many teachers from utilizing the model.

School leaders should focus on professional learning specific to the concepts underpinning the understanding of elementary mathematics. Providing professional learning about determining prime numbers, for example, is much different than understanding how to find a prime number and then how to use a prime number to manipulate a fraction. Learning why numbers behave in a particular manner and helping students understand the nuances of number theory help explain the why behind why algorithms work.

Other areas for professional learning include both classroom management beyond just student compliance and efficient ways in which to plan for small-group instruction. The two learning opportunities have implications beyond the mathematics classroom and have the potential to influence instruction in other subject areas such as reading. As the mathematics workshop model was originally adapted from a reading model, connections between the two subjects can be made. Leaders should consider making a comprehensive professional learning plan that includes content, planning, and management. Such professional learning at a campus level could easily integrate with formal sessions offered at the district level to create a continuum of learning that is both consistent and applicable.

Conclusion

As a mathematics educator, conducting the study brought about a greater and more nuanced understanding of teacher perceptions of and rationale for pedagogical choices made when teaching mathematics. Based on the study, teachers weigh various aspects of how best to teach and how the choices impact teacher time and classroom management. The choice to teach a lesson in a specific manner goes beyond just what is most efficient or even what is best for students. Teachers assess the amount of personal time and expertise needed to create and implement a successful lesson. Moreover, teachers examine personal perceptions about a given model and compare the perceptions to individual beliefs and experiences. In the case of group-size choice and the workshop model for mathematics instruction, teachers examined the perceptions of time and behavior management and compared the attributes to previous experiences. Teacher perceptions about control entered into the rationale for how to teach mathematics. More than simply weighing a pedagogical practice as being effective or not, teacher schema and perceptions played a role in choosing how to teach mathematics. Data presented in the study can provide opportunities for insight into an extremely complex and critical area.

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Appendix A

Google Form Math Workshop Approach Questions

1. Describe the importance of having a community of learners in your classroom.

2. How do you facilitate a community of learners during math instruction?

3. What guides your choice of student activities?

4. How do you differentiate for students?

5. How do you coach your students?

6. What do you see as valuable with the use of closure?

7. What are specific ways that you conduct closure?

8. What is your role as the teacher during work time?

9. On average, how many problems are students given to work during work time?

10. How do you respond to students' needs during work time?

Appendix B

Permission to Use Questionnaire

[researcher name]

|

Mon 11/9/2020, 11:04 AM

WARNING: This email originated from outside of [district name]. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Yes, this is fine.

[researcher name]
[contact information]

Good Morning,

I hope this email finds you well. I wanted to be clear about the request in that I am interested in using the open-ended response portion of the tool. May I utilize just a part of your questionnaire?

Gary West
[contact information]
-

Good morning!

[researcher name]is no longer at [university name], but [researcher name] and I both received your message. We see no problem with you using the survey as part of your data collection.

Both of us are very anxious to see your research!

[researcher name]
[contact information]

West, Gary

|

Tue 2/11, 12:45 PM

Good Afternoon [researchers' name],

My name is Gary West and I am a math specialist for [district name] just outside of [city name]. I ran across your article concerning the implementation of math workshop. In the appendix is the questionnaire used for your research. I am in the process of submitting my proposal for my doctoral research on teacher perceptions regarding math workshop and the impediments to implementation. I am seeking permission to utilize the survey as one tool in my data collection.

I look forward to hearing from you,

Gary West
[contact information]
-

Appendix C

Semi-structured Teacher Interview Protocol

In this interview, we will discuss your experiences with math instruction and math workshop.

Do I have your permission to record this interview?

Introductory and warm-up questions:

1. How are you today?
2. How long have you been teaching?
3. How long have you been teaching at your current school?

I will now ask you some questions regarding differentiation of instruction.

4. What does differentiated instruction mean to you?
5. How do you plan math instruction for academically diverse learners?
6. Please describe a lesson that you have implemented within your classroom comprised of academically diverse learners.
7. How do you use math assessment data?
8. Please describe how your classroom environment is set up during math lessons?

I am now going to shift to some questions regarding small group instruction.

9. What does math workshop mean to you?
10. How/why do you choose group size during mathematics instruction?
11. What are the benefits of whole-group and small-group math instruction?
12. What are the challenges of whole-group and small-group math instruction?
13. How you plan math lessons?
14. How do you think math workshop impacts students’ math achievement?

15. How do you think the math workshop model affects your ability to differentiate instruction for a range of learners’ skills and interests?

16. Is there anything else you would like to discuss in terms of your experience with math instruction?

Thank you for your participation in our interview today. If you have any questions or concerns after our meeting today, please feel free to contact me by email: [contact information].

Appendix D

Recruitment Email

Subject Line: Research Study with Gary West

Dear Teacher,

I hope you are doing well!

I am currently conducting a study for my doctoral thesis and am seeking research participants.

I am conducting research to increase my understanding of how mathematics is taught in elementary as well as teacher perspectives of math instruction. The purpose of this study is to explore how and why teachers opt for whole group and small group instruction.

I'm writing to see if you would consider participating in this study. If you choose to participate, you will be asked to complete a brief questionnaire, complete a short interview, and submit a sample of math lesson plans. The interview will be recorded and will take place at a time and place most convenient to you. Your confidentiality will be maintained at all times; I will assign each participant a code and all interviews and documents will be referenced using only this code.

I am seeking twenty-five elementary teachers who have taught math in grades three through five. I am asking that interested participants please email me at -. If you are selected to participate, I will follow up with you to discuss in greater depth the study, ask you to sign an informed consent form, and schedule a time for our interview. You may withdraw from the study at any time. If you have any questions or concerns regarding my study, please contact me at -.

Thank you for considering to participate in this study.

Gary West

Appendix E

Consent Letter

Please Read this consent form carefully and ask as many questions as you like before you decide whether or not you want to participate in this research study. You are free to ask questions at any time before, during, or after your participation in this research.

Project Information

Project title: Small Group Mathematics Instruction: Teacher Perspectives

Researcher: Gary West

Contact information: [contact information]

-

Introduction

I am Gary West, specialist for [district name]. I am conducting research to increase my understanding of how mathematics is taught in elementary as well as teacher perspectives of math instruction. I will give you some information about the project and invite you to be part of this research. Before you decide, you can talk to anyone you feel comfortable with about the research. If you have questions, you can ask them.

Purpose of the Research

The research is a qualitative study specific to whole-group and small-group math instruction. As a math teacher, you are in an ideal position to provide valuable first-hand information from your own perspective. Data will be collected through a brief questionnaire, a semi-structured interview of less than half an hour, and a sampling of your math lesson plans from this last school year.

Participant Selection

You are being invited to take part in this research because your experience as a math teacher can contribute much to our understanding of math pedagogy.

Voluntary Participation

Your participation in this research is entirely voluntary. It is your choice whether or not to participate. You may change your mind later and stop participating even if you agreed earlier.

Procedures

I am asking you to help us learn more about math instruction in our district. I am inviting you to take part in this research project. If you accept, you will be asked complete a questionnaire and an interview about how you teach math and how you go about making decisions regarding small group and whole group math instruction. Questions asked could include how you decide when to teach whole group and when to teach small group, how and what you teach in small group, and why you make the decisions you do. You will also be asked to submit some sample math lesson plans indicating whole group and/or small group instruction. If you are willing to participate, a link to the questionnaire will be sent, along with an evite to schedule a brief interview and directions on how to submit lesson plans.

Duration

The research takes place over three weeks. During that time, I will ask you to complete a brief questionnaire, take part in an interview of less than thirty minutes, and share a sample of lesson plans.

Risks

You will be asked about information regarding your instruction and your educational philosophy. You may feel uncomfortable talking about some of the topics. You do not have to answer any question or take part in the discussion or submit lesson plans if you don’t wish to do so. You do not have to give any reason for not responding to any question, and you may leave the study at any time.

Benefits

While there will be no direct financial benefit to you, your participation is likely to help with math instruction in the district, benefitting students.

Reimbursements

There will be no monetary compensation for participation in this research.

Confidentiality

I will not share information about you or anything you say to anyone. The information I collect will be kept in an encrypted computer file on a password protected computer. Any information about you will have a number on it instead of your name. Only I will know what your number is and I will secure that information in a separate, encrypted file on a separate password protected computer.

Sharing the Results

I hope to publish the results so that other interested people may learn from the research. It is possible overall findings from the study could be used in professional presentations, although no specific teacher data would be included.

Right to Refuse or Withdraw

Your participation is voluntary and includes the right to withdraw at any time for any reason.

Who to Contact

If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact me, Gary West, at [contact information] or [contact information]. This research plan has been reviewed and approved by the Institutional Review Board of American College of

Education. This is a committee whose role is to make sure that research participants are protected from harm. If you wish to ask questions of this group, email IRB@ace.edu."

Certificate of Consent

I have read the information about this study. I have had the opportunity to ask questions about the study, and any questions have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

Print name: ________________________

Sign name: ________________________

Date: _____________________________

Appendix F

Permission to Conduct Research

Re: permission to conduct research
[superintendent name]
Reply
Tue 4/7, 3:03 PM
West, Gary
Inbox
Label: 1 Year Permanently Delete (1 year) Expires: 4/7/2021 3:03 PM

Hello Mr. West, I hope you and the West family are doing well. Please use this email as verification that you have permission to conduct your research with [district name] for your dissertation. If the IRB needs something more official or if there is a form that I should sign, please let me know so that I can support you. Wishing you a great day.

Take care and stay healthy.

[superintendent name]
[contact information]

From: West, Gary
Sent: Tuesday, April 7, 2020 3:01:56 PM
To: [superintendent name]
Subject: permission to conduct research

Good Afternoon [superintendent name],

I hope this email finds you well. I am nearing the point where I will be submitting my proposal to conduct research. As you know, the Department of Health and Human Services investigators or researchers are responsible for obtaining and documenting the informed consent of research subjects or their legally authorized representatives.

I would like to confirm your permission to conduct research within [district] for my dissertation.

Thank you,

Gary West
[contact information]

Appendix G

Reminder Email

Good Evening,

I hope you had a restful weekend.

Just as a reminder, if you have not already done so, please go to the link below to schedule or interview time. So far, the interviews have been ranging from about 20 minutes to about 35.

[calendar link]

The questionnaire has been taking 10 - 15 minutes and the link is below (don’t forget, it works on your phone, too!).

[questionnaire link]

And don’t forget, 3 - 5 math lesson plans are just an email attachment away 😊

Please let me know if you experience any difficulties with any of the links or the process.

Have an outstanding week!

Appendix H

Permission to Use Interview Protocol

[researcher name] [email address]

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

Hi Gary,

Yes, It is fine to use the protocol. Best of luck with your research.
Please feel free to reach out with any questions.

Best,
[researcher name]

Happy Monday [researcher name]!

I hope this email finds you well. I sent an email on Friday, but if your district is anything like ours, it is possible the email has been caught in a spam folder. I certainly do not want to make a nuisance of myself, but I want to ensure you received this request.

I am interested in using your interview protocol. I am conducting research on the perspectives of our math teachers on using small group/workshop and your questions are perfect for my research questions. While I won't be using the entire protocol, I will be using the questions specific to differentiation and small group instruction.

If you need to reach me, my cell number is [phone number]

I appreciate your time and hope you have a great day,

Gary West
[phone number]
Mathematics Specialist
[district name]