EXAMINING THE LIVED EXPERIENCES OF EDUCATORS USING DIFFERENT LEVELS OF SUPPORT FOR TEACHING MATH TO STUDENTS WITH LEARNING DISABILITIES IN MATH COMPUTATION AND PROBLEM-SOLVING FOR TEACHERS AT PUBLIC CYBER CHARTER HIGH SCHOOLS IN THE NORTHEASTERN UNITED STATES: A TRANSCENDENTAL PHENOMENOLOGICAL STUDY

by

LeeAnn Elaine McCullough

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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Abstract

The purpose of this transcendental phenomenological study was to describe the lived experiences of educators using different levels of support for teaching math to students with learning disabilities in math computation and problem-solving for teachers at public cyber charter high schools in the Northeastern United States. The theory guiding this study was Sweller's cognitive load theory, as it explained the learning process of students with learning disabilities and how educators developed instructional methods that complement the learner's needs. The central research question was, "What is the lived experience of 9-12th-grade mathematics teachers in supporting students with differing learning abilities in math computation and problem-solving?" This study design was based on the transcendental phenomenological methodology of Moustakas (1994). The participants included 12 high school cyber teachers of general and special education students with specific learning disabilities in math computation and math problem-solving. Data were gathered through a journal prompt, individual interviews, and focus groups. The data analysis identified trends in the data and highlighted the successes and failures of various approaches used in the classroom. Three themes emerged from the study: enhanced engagement and learning environment, cognitive load and assessment strategies, and supportive and inclusive instructional practices. This study uncovered educators' lived experiences using personalized instructional strategies, interactive and adaptive technology, and instructional design approaches to reduce learners' cognitive load. This research provided insights into high school educators' experiences using these methods of teaching math in cyber classrooms to students with disabilities.

Keywords: cognitive load theory, specific learning disability, math computation, math problem-solving, Sweller, learning theory

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Dedication

I dedicate this dissertation to the memory of my Mother, Beverly, who always believed in me.

To my loving husband that never let me give up on my dream. If it were not for him, I never would have thought this would be possible.

To my dad, who listened to my stories, concerns, and battles.

To my children who never doubted me for a moment.

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List of Abbreviations

Association of Christian Schools International (ACSI)

Chief Executive Officer (CEO)

Individualized Education Program or Plan (IEP)

Multi-tiered system of support (MTSS)

National Center for Education Statistics (NCES)

Universal Design for Learning (UDL)

CHAPTER ONE: INTRODUCTION

Overview

Only 25% of 12th-grade students in the United States performed at or above proficient in mathematics (Saenz et al., 2023). Only seven states required math support for struggling students, and none were in the Northeastern part of the United States (Schwartz, 2023). The purpose of this transcendental phenomenological study was to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teacher at public cyber charter high schools in the Northeastern United States. This chapter provides the historical, theoretical, and social background of the problem that demonstrates the purpose of this study and forms the research questions that answer the study's focus. The learning theory examined was the cognitive load theory of instruction (Sweller, 1988). Definitions to clarify terms relevant to the study appear at the end of the chapter.

Background

Several works examined best instructional practices in various classrooms, including online instruction. Significant contributors included Evelyn Deno (1970), who began the journey to change special education into a tool for developing better ways to meet the learning needs of children who learned differently. Padilla and Tan's (2019) research on valuing student differences as a reflection in the curriculum and tools for assessment provided an excellent perspective. Stadler-Heer's (2019) study explored methods used to increase differentiation for the needs of all learners in online and brick-and-mortar classrooms. Further, Lindner and Schwab (2020) encouraged differentiation to address the concerns of all learners while responding to their diverse needs to reduce exclusion in the education process. Researchers found that instructional practices for educating all learners were critical in any setting, regardless of ability (Bondie et al., 2019). The literature mentioned above was a small part of a growing body of work. The effectiveness of the instructional practices for teaching high school-level math online to students with deficits in computation and problem-solving was explored further in this study, significantly improving the educational experience for these learners (Matney et al., 2020).

Historical Context

Historically, there was a detailed legal framework that contextualizes this issue. The disability rights and inclusion movement began with the Education for Handicapped Children Act (1975). However, Brown v. Board of Education, 347 U.S. 483 (1954) was arguably the landmark case to assist special education law and disability rights in the United States (Lengyel & Vanbergeijk, 2021). Later the Individuals with Disabilities Education Act Amendment (1997) later provided federal support to train teachers of children with mental retardation (Gordon-Gould & Hornby, 2023). Subsequently, the identification and category distinctions for learning disabilities became widely recognized and used. Integration and segregation in special education were developing to bring a new, diverse group of students to the classroom (Crockett & Martin, 2024). Curriculum development demonstrated ways instruction can be modified to meet different needs (Spooner et al., 2019). Inclusion was a way to meet the demands of the law that mandated free and appropriate education in the least restrictive environment (Merrigan & Senior, 2023). The development of Sweller's (1988) cognitive load theory opened further avenues for the exploration of new methods of instruction. Experiences led to the current practices seen in the classroom today (Chandler & Sweller, 1991; Gheyssens et al., 2022; Goddard et al., 2019). Understanding the needs of diverse learners led to examining how students learn and some of the obstacles students with learning disabilities face in the classroom (Grigorenko et al., 2020).

Online learning presented new and productive venues for 21st-century students (Macarena-Paz & Maoulida, 2022). John Sweller (1994) explained the learning process of students with disabilities. John Sweller's cognitive load theory examined the cognitive capacity of the learners when compared to their working memory and processing speed skills (Sweller, 2010).

Social Context

Educational practices for students with disabilities are becoming the norm in today's classroom (Buchner et al., 2021; Morris-Mathews et al., 2021; Nilholm, 2021). Children with mild to moderate learning disabilities were increasingly included in the general classroom more and more (Pozas et al., 2020). The academic and social effects of including students with disabilities revealed that students' experiences were primarily positive (Kart & Kart, 2021). Lambert and Tan (2020) found in the research that when identifying two groups needing different mathematical pedagogies, teachers often separated the students with disabilities from the students without disabilities for instruction. Students had more problems participating socially with their peers through peer interaction and peer acceptance in the general classroom (Lindner & Schwab, 2020). Interaction with peers in the online setting mitigated social isolation, as recognized by the research (Baber, 2022). The extra supports developed positive learning outcomes and social relationships for students with their non-disabled peers (De Boer & Kuijper, 2021). However, Yngve et al. (2019) described that students who needed the most accommodations still needed individualized changes to the school environment to participate in the regular education classroom. Further, preparing students to advocate for the accommodations they need during the transition to post-secondary education helped students with disabilities to close the gap from their same-aged peers without disabilities (Lopez et al., 2020).

Theoretical Context

The theoretical context of this study was addressed in parallel areas that examined issues inherent to online instruction and learning. From the literature reviewed, numerous studies have been conducted on math instructional strategies for students with learning disabilities and teaching online. However, research examining teaching math online to students with math disabilities and cognitive load is lacking. Other theories that evaluate math instruction and online learning have not received much support. For example, Meda and Waghid (2022) proposed an integrated multimodal model for online education. This study emphasized various modes of instruction in an online learning environment. Behaviorism, cognitivism, and social constructivism were other learning theories that investigated online learning and instruction. Behaviorism focuses on observation. Cognitivism focuses on memory and problem-solving. Social constructivism focuses on personal interactions and collaborative learning. Problem-solving for these theories attempted to integrate online tools with human interaction to impact mathematics instruction positively (Santos-Trigo, 2024).

Research using cognitive load theory in an online environment teaching math would add to the existing literature. Sweller's (1988) cognitive load theory serves as the focal point for the literature examined in this study, which highlights the limited capacities of students to learn new information and retain content (Chieffo et al., 2023; Mavilidi et al., 2019). Sweller identified deficits in working memory as a significant challenge for students with learning disabilities (Paas & Van Merriënboer, 2020; Shearer et al., 2021). Overloading the working memory reduces teaching effectiveness (Loveless, 2022). Understanding how extraneous cognitive load can be minimized by identifying and eliminating irrelevant factors such as complex instructions. Design factors, such as multimedia and ease of navigation, can help to reduce cognitive load. Further, it is important to understand how to balance learning efficiency with the degree of inclusion. Engagement can be increased but may come at the cost of increasing cognitive load (Skulmowski & K. Xu, 2022). This research can carry numerous positive benefits for educators and curriculum developers. Practical guidelines can be enacted to create an effective balance between learning and cognitive load. Better informed decisions can be made about the use and integration of technologies in the virtual classroom.

Problem Statement

The problem is that students with math learning disabilities often have working memory deficits (Paas & Van Merriënboer, 2020). Students struggle with tasks that become more complex, depleting their working memory resources, and learning is significantly more challenging (Chen et al., 2024; Draheim et al., 2019; Paas & Van Merriënboer, 2020; Sambol et al., 2023). Incorporating lower-level schemas into higher-level ones, highlighting the need for educators to determine appropriate levels of support for these students, improves performance (Agostini et al., 2022; Kala & Ayas, 2023; Puntambekar, 2022). Researchers have emphasized the critical need to develop best practices for teaching math computation and problem-solving to students with disabilities (Shin et al., 2021).

Further research is necessary to understand math difficulties in high school and the consequences of the current research gap on students' ability to learn math effectively (Myers et al., 2023; Zacharopoulos et al., 2021). The role of working memory in learning outcomes and school success has been widely discussed (Alloway & Carpenter, 2020; Chieffo et al., 2023). However, comprehensive data is necessary for educators' instructional delivery options (Bondie et al., 2019; Chew & Cerbin, 2021). More studies are needed to explore how varying levels of support in instructional settings can benefit students with learning disabilities in math (Bowman et al., 2019; Shin et al., 2023). External factors such as digital distractions significantly impact cognitive load and learning (Skulmowski & K. Xu, 2022). Accurate assessment of students' skills and deficits is crucial for proper placement and support, requiring more research to advance knowledge in this area (Almulla & Al-Rahmi, 2023; L. R. De Bruin, 2019). This research could uncover effective instructional practices that support students' cognitive capacity and mathematical needs (Namkung & Bricko, 2021).

Purpose Statement

The purpose of this transcendental phenomenological study was to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teachers at public cyber high schools in the Northeastern United States. At this research stage, this study defined the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving as students with disabilities. The theory guiding this study was cognitive load theory (Sweller, 1988).

Significance of the Study

According to the Pew Research Center, there were between 13 to 15% school-age students in the United States identified with learning disabilities (NCES, 2023). A search of available articles produced 56 results, with nine relevant articles addressing effective online instructional practices teaching high school math to students with disabilities. Teachers' perspectives on instructional practices based on cognitive load theory developed similar results. Not conducting this research excluded the perspective of online instructional practices for teaching students with math disabilities in the Northeastern United States. Online teaching requires specialized online teaching strategies to optimize the use of time and resources (H. Xu, 2022). There was also a need for methodologies to support and prepare students for online learning in northeastern public cyber high schools (Shipp, 2022).

This study significantly expanded the knowledge base and theories available to explore effective instructional practices for teaching math in the cyber classroom from a teacher's point of view. The information gained added to the body of literature available to enhance online instructional practices. Ideally, the research question responses would provide a framework for understanding the appropriate cognitive load for learners of differing abilities. A collaborative approach between general and special education teachers was found to be the most effective for students with disabilities (Iacono et al., 2023).

This study aimed to discover the lived experiences of high school cyber educators teaching math to students with math deficits. The findings of this study demonstrated how cognitive load theory could positively impact online classroom instruction. Understanding the development of instructional practices for students with cognitive deficits was essential in successful cyber education for students with learning disabilities, making this study's findings particularly important.

Theoretical

This study illustrated the lived experiences of high school math educators teaching students with math disabilities online (Sweller, 2020). Balancing effective instructional practices incorporating cognitive load theory was necessary to develop processing speed (Ginns & Leppink, 2019). Cognitive load theory presented an opportunity to investigate and refine levels of informational input for learners (Smets et al., 2022; Sweller, 2010). Cognitive load theory was a powerful tool for assessing students and developing education plans per their capacity to absorb information (Siregar, 2023). This study planned to add to the literature regarding how cognitive processes affected the learning process of cognitive load theory through the teachers' perspective. Limited research existed on teacher perspectives regarding how cognitive processes worked in the learning process for teaching at public cyber high schools, particularly in the Northeastern United States. Examination of instruction for general and special education students was vital to developing successful approaches that benefited all learners (Sweller, 2020). Unfortunately, the research was limited in the teachers’ perspective regarding best instructional practices for teaching students with math deficits, which are specific areas of difficulty in math, online. Addressing this gap in the literature helped shed light on best practices, successful outcomes, and evidence-based practices needed to improve the learning environment for all learners (Biwer et al., 2020). Examining those factors attempted to help educators develop successful models in their classrooms in the future (Ginns & Leppink, 2019). This transcendental phenomenological study expanded upon the lived experiences of cyber teachers' instructional practices for students with learning disabilities.

Empirical

Researchers called for more research regarding teachers' online instructional approaches (Costley, 2020; Estacio et al., 2022). This study’s empirical aspects addressed and thoroughly examined teachers online instructional approaches used in cyber high school math classrooms. Empirical data identified the lived experiences of math teachers providing instruction to students with math disabilities and multiple levels of support in an online environment (Braun et al., 2020; Choi et al., 2020). In a study conducted by Lodge et al. (2017), researchers found that teachers who created a minimal amount of confusion or imbalance in the learning equilibrium could help the students respond to resolve the confusion of the content with their peers and the assistance of the teacher. This study attempted to uncover the teachers' lived experiences of teaching high school math online to students with disabilities.

Practical

The practical perspectives arose from the empirical and theoretical information regarding best instructional practices. Those best practices could be categorized and adapted for the classroom (Ricci et al., 2021). Understanding the teacher's view of effective instructional practices in math instruction would help future teachers and students. Students with effective instruction were more likely to view education and learning positively (O'Handley et al., 2022). The information gained in this study could be essential to provide insight into effective practices that could impact instruction in the future, changing the way teachers present math instruction online. Specifically, a better understanding of effective cognitive load instruction could positively impact the outcomes of student performance in math nationally. This study aimed to understand the teacher's cognitive load perspective as a critical factor in developing effective assessment and instruction while providing higher-quality instruction for disabled students in a cyber classroom.

Research Questions

The focus of this study was to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving to achieve above basic by 12th grade on the National Assessment of Educational Progress in Mathematics (NCES, 2023). How teachers overcame the working memory deficits of students with math disabilities could help instructional practices in an online environment. Investigating instruction through the lens of the educator's teaching methods in mathematics would shed light on the shared experiences of best practices in the online classroom.

Central Research Question

What is the lived experience of 9 - 12 grade online mathematics teachers supporting students with differing learning abilities in math computation and problem-solving?

Sub-Question One

What are the experiences of 9 - 12 grade online mathematics teachers using universal design instruction when assessing students who have a disability in the area of math?

Sub-Question Two

What are the lived experiences of 9 – 12 grade online mathematics teachers determining the most appropriate instructional approach that uses cognitive load theory for students with differing abilities when learning math computation and problem-solving?

Sub-Question Three

What are the experiences of 9 – 12 grade online mathematics teachers determining the appropriate amount of content related to the cognitive load of mathematical computation and problem-solving when providing practice activities for students with a math-related disability?

Definitions

1. *Cognitive load* - When the student has absorbed the maximum amount of information (Sweller, 2020).

2. *Cognitive load theory* - An instructional theory based on evolutionary psychology for the architecture of human cognition (Sweller, 2020).

3. *Inclusion* - Meeting all students' social and academic needs (Krischler et al., 2019).

4. Limited capacity - the increments of learning *limited to the capacity and duration of working memory (Sweller et al., 2019).*

5. Multi-tiered system of support, or MTSS - A targeted support framework for students struggling with content in a particular course (Braun et al., 2020).

6. *Specific learning disability in math computation or calculation* - Specific learning disability means a disorder in the basic psychological processes of understanding or using language, spoken or written, that affects the ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as specific disabilities, brain injury, and other developmental delays (Individuals with Disabilities Education Improvement Act, 2004).

CHAPTER TWO: LITERATURE REVIEW

Overview

This literature review explores the problem and the benefits of instructional practices in the classroom for students with learning disabilities. This chapter reviews the current literature related to the topic of study. First, the theory of cognitive load (Sweller, 1988) and its application to students with learning disabilities are discussed, followed by a synthesis of recent literature on instructional practices in the classroom. Second, literature illustrating how various levels of support can benefit all learners in math and online is examined. Finally, the need for the current study is addressed by identifying a gap in the literature regarding instructional benefits for students with learning disabilities.

Theoretical Framework

Learning is constructing meaning from sensory inputs (Srivastava, 2021). Cognitive learning is the process of thinking, knowing, and perceiving information related to brain function and mental capabilities, which could be affected by internal and external factors (McSparron et al., 2019). Cognitive learning theory explains and facilitates how the brain retains and transfers knowledge (Bates, 2023). Cognitive load theory is a learning theory associated with individual learning (Biwer et al., 2020; Sweller et al., 2019; C. Wang et al., 2020). John Sweller et al. (2019) explained that cognitive load theory is crucial in assessing the capacity of children with varying levels of specific learning disabilities (Ginns & Leppink, 2019). Limited research exists on teacher perspectives regarding the levels of support educators used when teaching math online to students with math disabilities in public cyber high schools, particularly in the Northeastern United States.

Cognitive Load Theory

Cognitive load theory refers to the cognitive processing demands placed on working memory (Sweller, 1988). Cognitive load theory is the synthesis of the work of John Sweller (2020). Sweller (1988) worked with several colleagues to synthesize cognitive load theory. Cognitive load theory became popular among educators and psychologists, describing working and long-term memory as the crux of the issue for a learner's ability to absorb information (Shearer et al., 2021).

Cognitive load theory applies the knowledge of how people learn, think, and solve problems to create new instructional designs for learning (Tindall-Ford et al., 2019). The application of the cognitive load theory enabled instruction tailored to an individual's ability to process the information (Sepp et al., 2019). Improvements to the instructional design that substituted unproductive cognitive load for productive cognitive load were the premise for new methods to manage the working memory load of the learner completing complex tasks during learning (Paas & Van Merriënboer, 2020). Cognitive load theory explains the learning process and the structure, or architecture, of the processes for thinking and solving problems (Paas &

Van Merriënboer, 2020; Tindall-Ford et al., 2019). Processes for thinking and problem-solving were pivotal to the individual's working and long-term memory to develop independent thought (Sach, 2022).

Sweller et al. (2019) worked with several colleagues to develop a working load hypothesis. Those theorists explained that working memory was limited and could be overloaded, while long-term memory was expansive and contained the factual and procedural knowledge to solve problems (Sweller et al., 2019; C. Wang et al., 2020). Developing instructional strategies to reduce the cognitive load on the learner would elicit higher performance (Shearer et al., 2021). Bolkan and Goodboy (2019) found that the students presented with concrete examples first, compared to those given a definition, scored better on their recall application skills because they had a reduced cognitive load that did not impede their learning.

Conceptualism

Cognitive load theory took cognitive architecture and developed its theoretical basis in evolutionary psychology (Tindall-Ford et al., 2019). When an overload of information stresses the learner's working memory, their learning is impaired (Sweller et al., 2019; C. Wang et al., 2020). Cognitive load theory researchers tested many instructional designs that target different barriers to learning to develop strategies to reduce working memory impairment (Ginns & Leppink, 2019). Cognitive load theory explains how the information processing load affects students' ability to process new information and construct knowledge in long-term memory (Sepp et al., 2019). Chen et al. (2024) emphasized that understanding the limitations of human cognitive processing restricted our working memory, in which only a small amount of information is processed at a time, is critical to effectively implementing an approach that reduced cognitive load and increased working memory. This study investigates effective approaches for educators to determine the proper supports for students with math disabilities in the online classroom at the high school level.

Summary

Students with math learning disabilities often have working memory deficits (Paas & Van Merriënboer, 2020). The purpose of this transcendental phenomenological study was to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teachers at public cyber high schools in the Northeastern United States. Cognitive load theory was a promising method to improve the determination of the perceived effectiveness of teaching and learning practices and interventions for learners in the math classroom (Sweller, 2020). All learners could benefit from preparation based on the strengths and needs of others to form an enriching environment (Alstete et al., 2021). Throughout history, the education arena has weighed the pros and cons of pedagogy methodology for instruction. These pedagogical methods had to address the needs of a more comprehensive range of students than ever before. Researchers have shown the need for increased differentiation to accommodate all learners in the classroom (Stadler-Heer, 2019). However, implementing appropriate and intentional instructional practices depended mainly on teachers' flexibility, knowledge, and experiences (Kazmi et al., 2023). C. Hord (2023) noted that few studies have explored and understood teachers' various levels of support and choices in mathematics for students with specific learning disabilities in math computation and problem-solving, particularly in online teaching for grades 9 - 12 in the Northeastern United States. For these reasons, this topic was a relevant and appropriate focus for research.

Related Literature

Through the history of cognitive learning research, investigators uncovered how cognitive load could affect student performance outcomes. Cognitive load theory emphasizes working memory and processing speeds as the primary deficits for students with specific learning disabilities (Ginns & Leppink, 2019). Methods of instruction focusing on increasing working memory and processing speeds could positively impact instruction and instructional design. Incorporating cognitive load interventions could positively impact the outcomes of students with and without disabilities. The literature described below focused on best practices in instruction, instructional design, and online learning in math.

Working Memory

Working memory is the ability to retain a small amount of information that can be accessed immediately (Bichler et al., 2020; N. Cowan, 2023). Cognitive load theory asserts that children with learning disabilities have deficits in working memory and processing speed (Sweller, 2020). When imparting valuable data, working memory and processing speed deficits inhibit the student's ability to store and process information needed to transfer long-term memory to short-term memory (Chieffo et al., 2023). Therefore, applying more load than the child's brain can process decreases retrieval efficiency (Loveless, 2022; Martin et al., 2021; Mavilidi et al., 2019). The instructional methods that incorporated the students' cognitive load increased differentiation for the needs of all learners in the classroom by teaching to the needs of each learner (Stadler-Heer, 2019). Without relevant literature and a clear recognition of the student's cognitive load capacity, teachers need more methodology to evaluate a student's cognitive load abilities. There was a lack of literature on how the teacher guided the student to a proficient or better performance level.

Cognitive load theory emphasizes working memory deficits as a limited area for students with and without learning disabilities (Y. M. Wang et al., 2024). Cognitive load theory explains that acquiring new knowledge is limited by the learner's working memory capacity (Sweller et al., 2019; C. Wang et al., 2020). The theory of cognitive load includes three components that contribute to cognitive load: intrinsic (intensity), extraneous (extra unnecessary information), and germane (relevant information) cognitive load (Krieglstein et al., 2022; Noushad & Khurshid, 2019). Intrinsic cognitive load refers to the working memory resources devoted to dealing with the learning objectives given (Sweller, 1994). The complexity of the learning material determined the intrinsic load, and the interaction between the learner and the material determined the degree of intrinsic load (Kala & Ayas, 2023).

Extraneous load refers to the unnecessary information that gets in the way of learning. Extraneous load was excessive interactive elements in the material taught (Paas & Van Merriënboer, 2020). Extraneous load impacted learning through different instructional activities during class (Klepsch & Seufert, 2020). The germane load was the amount of effort related to learning stored in long-term memory that added to the student's prior knowledge (Greenberg & Zheng, 2023). To gain new knowledge, learners had to allot their working memory capacity (mental effort) to learning the tasks (Paas & Van Merriënboer, 2020). Ideally, the resources needed for learning were, at most, the availability of working memory needed to assist in the learning process (Ginns & Leppink, 2019). However, high cognitive load occurs when a large amount of working memory is needed to process the elements to complete tasks and extraneous activities (J. Cowan, 2019). Synthesizing the subject matter's primary elements presented a learning opportunity (Shearer et al., 2021). Instructional design impacts the extraneous cognitive load, the learner's intrusive thoughts about failure, and distracting information in the learning environment (Klepsch & Seufert, 2020; Paas & Van Merriënboer, 2020).

Working memory deficit assessment was necessary to utilize the breadth of a learner's ability to retain information (Bichler et al., 2020; Sambol et al., 2023). Working memory is another term for short-term memory (Noushad & Khurshid, 2019; Sweller, 2020). Working memory is critical to synthesizing information for problem-solving (Biwer et al., 2020). The ability to synthesize information is the basis of problem-solving and progression beyond rote learning (Rahman, 2019). Automaticity is critical to working memory (Y. M. Wang et al., 2024). That is the ability to recall information from long-term memory through practice and rehearsal of the information so that it is an automatic response (Noushad & Khurshid, 2019). Effective instruction and working memory practice are critical in cognitive load theory. This study will examine teachers’ perceptions of cognitive load theory-based instructional design and how it affects how they teach math online to high school students with learning disabilities.

Increase Working Memory

The instructional design focused on controlling intrinsic load and reducing the extraneous load to increase the germane load necessary for processing information in working memory to long-term memory for future use (Sentz et al., 2019). Leahy and Sweller (2019) explained that the information processing load created from learning tasks could affect the learners' ability to process and store new information in their long-term memory. Pouw et al. (2019) further explained that cognitive processing restricted one’s limited working memory, which could only process a small number of information elements at a time. A. B. H. De Bruin et al. (2023) explained that methods to manage a learner's working memory capacity expanded from tweaking the instructional design to maximizing the learning outcomes for the student. A homogeneous group of learners could collaborate on the learning tasks to increase their working memory capacity by using other learning modalities, such as other students' gestures and teacher motivational cues (Sweller et al., 2019; Y. M. Wang et al., 2024). Instructional practices that use the cognitive load theory could increase students' working memory in an online classroom. This study explored the lived experiences of high school teachers using a variety of supports for teaching math online to students with computation and problem-solving deficits.

Increase Retention

Retention is a necessary precursor to the practical use of information (Sweller et al., 2019). Developing feedback loops to measure the amount and quality of information retained accurately is critical to assessing retention (Lin et al., 2023). A feedback loop is extracting information from learners regarding their ability to approach and retain information differently (Carless, 2019). Retention of more than a "by rote" information style is necessary (Wright & Park, 2022). The retention quality is necessarily a function of the integration of information (K. Xu et al., 2021). Promoting long-lasting learning through instructional design and instructional practices that focus on retention based on cognitive load can increase the capacity of the student's long-term memories (Miller & Krajcik, 2019). Retention is an area the teacher must emphasize in the classroom in order to keep learners proficient in the subject matter (Leahy & Sweller, 2019). This study uncovers how teachers perceive the use of cognitive load to instruct students with math disabilities online.

Instructional Practices for Students with Working Memory Deficits

Instructional practices incorporating cognitive load theory in the classroom is a learning model that addresses all learners in one environment (Paas & Van Merriënboer, 2020). Students can join a shared community of diverse learners by integrating general and special education students in the same classroom to support each other throughout the day (Elen, 2020). Differentiated instruction is how a teacher interacts with positive responses to the learner's variations in needs and interests (Goddard et al., 2019). The instruction is scaffolded (leveled) to respond to the student's abilities on their journey to mastery of a concept (Gheyssens et al., 2022). Instruction that nurtures academic and social learning facilitates differentiated instruction that gives the learner an individualized learning program within the same classroom (Kong & Y. Q. Wang, 2024). Pozas et al. (2020) noted that using differentiated instruction in the classroom will increase the learning of diverse students.

Developing a curriculum to enhance the unique differences of all learners increases achievement for all (Pusic et al., 2022). However, how and to what extent differentiated instruction is used impacts all learners (Heilporn et al., 2021); Winter, 2020). Students benefit from individualized instruction and appropriate support for their challenges (Pozas et al., 2021). The initial discussions on the basic cognitive architecture needed to address how working memory and long-term memory reacted when a load was placed on the learner (Sweller et al., 2019). Thus, cognitive load theory became the first to research how the brain processes learning and how learning can become impaired by overloading the learner's capacity (Sweller et al., 2019). Instructional practices attuned to the capacity of individual learners are a powerful tool for instructors (Smets et al., 2022). Learners can provide feedback through mechanisms developed by educators to continuously calibrate information absorbed and adjust rates of delivery and redelivery (Putra, 2023). The instructor, not the student, usually solves instructional design issues by adding visualizations to text-only materials (Sentz et al., 2019). However, Castro-Alonso et al. (2021) proposed that the learner can use those strategies to manage solutions to instructional formats that do not promote a reduction of cognitive load. Managing working memory deficits is a significant part of the successful use of cognitive load in the classroom. Researchers concluded that cognitive load is an effective component of instructional practices for students with working memory deficits. All the methods mentioned above are currently used online through synchronous and asynchronous learning models (Long et al., 2021). This study will demonstrate how teachers use these methods in online math classrooms.

Classrooms to Address Working Memory

Ultimately, effective teaching, regardless of approach, must analyze the cognitive abilities of the class and adapt instruction to address all students for optimal learning (Chew & Cerbin, 2021). Another critical finding regarding effective instructional practices for student learning showed how examples to reduce cognitive load and increase retention were applied (Y. M. Wang et al., 2024). However, a study by Puma and Tricot (2019) discovered that the pacing of instruction presentation may play a more significant role in the learner's working memory capacity. Instructional practices that avoid working memory overload are effects (Sweller, 2022). Effects are the relationship between the amount of mental work an individual uses to complete a task versus the amount of mental work an individual can exert (McKendrick & Harwood, 2019).

The effect of learning is evident in the amount of interactivity with the content (Leahy & Sweller, 2019). More interactivity during learning will help the student retain the information (Sweller, 2010). In other words, the student must have more than experience exposure to the content (Leahy & Sweller, 2019). The seven cognitive load theory effects include goal-free effect, worked example effect, completion problem effect, split-attention effect, redundancy effect, modality effect, and variability effect. First, the goal-free effect removes the goal of the problem. The goal-free effect reduces the cognitive load by replacing conventional tasks with goal-free tasks that provide the learner with a non-specific goal (Sweller & Levine, 1982). The goal-free effect still needs to be reconciled with self-regulated learning theory and its ideas on motivation. Second, the worked example effect provides examples of the entire problem solution for the student to study (Sweller & Cooper, 1985).

Third, the completion problem effect replaces the conventional task by providing a partially completed task for the learner to finish (Cheng et al., 2023). Fourth, the split-attention effect replaces multiple pieces of information with one integrated piece of information (Tarmizi & Sweller, 1988). Fifth, the redundancy effect replaces multiple sources of information with one (Chandler & Sweller, 1991). Sixth, the modality effect replaces a written explanation and a visual piece of information with a spoken explanation and a visual piece of information (van Nooijen et al., 2024). Finally, the seventh effect is the variability effect, which replaces similar tasks representing real-world differences (Lee & Ayres, 2024). The best instructional practice relies on the learner's needs and working memory capacity. Utilization of cognitive load relies on the successful assessment of instructional methods to accomplish that goal. Working memory is the mental storage system that monitors the data to retain the relevant material needed to complete a task (Bichler et al., 2020; Sambol et al., 2023). Unfortunately, the capacity is limited due to the inability to process and maintain the information simultaneously (Bichler et al.; (Draheim et al., 2019). Heitz and Engle (2007) found that the learning modality was distinguishable. In other words, how the information is received does not change the result. All data travels through the same system with a limited capacity (Chen et al., 2024). A study by Sepp et al. (2019) determined that learners can develop skills and use the information more efficiently if the knowledge integrates with the instruction rather than disseminated. Knowledge integration is why educators use graphic organizers and visual representations that show relationships between concepts, creating cognitive load and more significant knowledge gain that increases short-term memory and long-term memory and retrieval speeds (Estacio et al., 2022; Lin et al., 2023). This study explains the relationship between working memory, cognitive load, and teacher perspectives supporting online high school students with math computation and problem-solving needs.

Processing Speed

Processing speed is how quickly and efficiently an individual can accomplish a task in a given time (Forchelli et al., 2022; Schubert et al., 2023). Grigorenko et al. (2020) noted that an essential element of processing speed is understanding individual differences in a child's development concerning interventions and cognitive, genetic, neurological, and environmental factors. Processing speed is directly related to the ability to retrieve and synthesize information (Schubert et al., 2023). Zhou and Deng (2023) determined that today's learners use media multitasking daily, impairs the limited capacity of their information processing, thus reducing their meaningful learning storage space.

A learner's ability to efficiently and effectively retrieve information is critical to synthesis (Chen et al., 2024). Processing speed indicates a relative ability to produce a result from retrieved information (Schubert et al., 2023). Sweller (1988) found that instructional methods should avoid overloading the learner with unrelated activities because of the learner's limited working memory and inability to process the information needed to transfer to long-term memory (Agostini et al., 2022). This study adds to the knowledge concerning processing speed, cognitive load, and teachers' perceptions of effective instructional practices for online teaching high school students with math deficits.

Measuring Cognitive Learning to Reduce Load

Cognitive load theory provides a determinative framework around investigating and assessing the capacity of students to receive and comprehend data (Paas & Van Merriënboer, 2020). Rubrics can reduce a student's cognitive load to increase accuracy and enhance performance (Berrocal et al., 2021). A rubric is a scoring guide for grading a student's performance on a specific task (Merriam-Webster, 1999). When using a rubric, the student's mental capacity is expanded on the task, especially when self-monitoring, such as using a rubric (Biwer et al., 2020). Rubrics aid in the self-assessment of a task assignment (Muddle et al., 2023). A rubric increases the quality of the work while decreasing the cognitive load needed to determine the appropriate criteria for the assignment (Krebs et al., 2022). As the learner performs a complex new task, the working memory capacity drastically reduces, leaving little power for self-monitoring (Sweller et al., 2019). However, Panadero and Jonsson (2020) argue that a well-designed rubric is not beneficial if poorly implemented and vice versa. Nückles et al. (2020). Moning and Roelle (2021) concurred that rubrics do not motivate students to complete tasks, engage in a sophisticated learning strategy, or reduce cognitive load. If the rubric is appropriately scaffolded, the expected cognitive load reduction can occur (Krebs et al., 2022). Another method to reduce cognitive load is having students construct a graphic organizer (Jeon et al., 2023). When added to the text, graphic organizers can help the student learn the relationships of the content and achieve higher transfer and causal comprehension scores (Y. Wang et al., 2022). Further, when teachers ask students to use a visual medium other than the graphic organizer, students become active learners (Colliot & Jamet, 2019).

Students increase their learning by selecting, organizing, and integrating the information needed to perform a specific task (Zhou & Deng, 2023). Colliot and Jamet (2019) concluded that the cognitive load placed on the student to complete a graphic organizer could hinder the student's learning based on the extraneous load of the task itself. However, extraneous cognitive load disappears if proper supports and scaffolding techniques are used (Bolkan & Goodboy, 2020). Providing graphic organizers showed that students with scaffolding retained more than students without (Brod, 2021). Finding methods that increase learning while decreasing the cognitive load on the learner is the premise for the instructional design of the cognitive load theory (Krieglstein et al., 2022; Noushad & Khurshid, 2019). Cognitive load theory research regarding effective instructional design has found that three elements are needed to facilitate learning. The three components to optimize learning include the learning task, learning material design, and ignition of the student's cognitive processes during learning (Klepsch & Seufert, 2020).

The first component to optimize learning is the learning task of a lesson. The task is the objective of the lesson and the learning content the educator wants to teach. Understanding the complexity and the prior knowledge needed to reach the lesson's goal helps the teacher define the learning outcome and the task performance goal for the learning task (Klepsch & Seufert, 2020). The learning material design is the second component needed for optimizing learning. The learning material design refers to the physical materials used to present the content to the student and how it impacts the learner (Castro-Alonso et al., 2021). Finally, the third component that optimizes learning is the spark that starts the student's cognitive processes during learning (Klepsch & Seufert, 2020). The activation of the cognitive process is what compels the students to invest in their learning. Using schemas and prior knowledge, a student can activate learning through teacher prompting. The prompts guide the student toward completing the objective (Sweller, 1988). A closer look at those components can help understand how the student optimizes learning (Aspiranti et al., 2019). Instructional practices based on cognitive load are only effective if implemented and executed appropriately by the teachers. Understanding the teachers' experiences instructing high school students online with math computation and problem-solving needs adds to the knowledge for determining the proper supports for those students.

The Learning Task

The instructional design focuses on how and what needs to be presented for the given goal of the lesson (Klepsch & Seufert, 2020). Many instructional approaches focus on the learning task of the lesson (Xie et al., 2024). That is one of the most critical portions of the lesson. Educators must determine the prior knowledge needed for the content and the complexity of the task itself to maximize the lesson's learning objectives (Paas & Van Merriënboer, 2020). Sweller (2020) explained that explicit instruction is the best delivery method.

Explicit instruction is a method supported by cognitive load theory researchers (Siregar, 2023). Explicit instruction presents information by chunking content into smaller parts and guiding the student to mastery through fading supports (Humphries & Clark, 2021). Fading supports refers to the amount of support provided to a student over a period of time. As the student grows cognitively and behaviorally, educators reduce the level of support to keep pace with the student's development (Kim, 2020). Explicit instruction that uses step-by-step teacher demonstrations of examples, student participation, discussion, and independent practice assists in acquiring and mastering skills (Enders & Kostewicz, 2023). Followers of cognitive load theory believe that explicit instruction is one of the best approaches to presenting the content to learners of all levels (Siregar, 2023). Explicit instruction involves breaking down the learning task into segments and explicitly explaining each portion of the lesson and its objectives or goals (Brownell et al., 2020).

Another powerful instructional approach is to give specific feedback to the learner (Manson & Ayres, 2021). Specific feedback provides a level of trust for the learners to reach mastery (Dolan et al., 2019). Giving learner-specific feedback encourages the students to take risks in their learning. Knowing that the teacher will support their risks gives the learner a level of comfort that challenges the student to achieve mastery. A study of whole-task and partial-task conditions that used the task-centered and part-task instructional strategies with explicit instruction found that the whole-task, task-centered approach was more effective in the student's performance in reducing cognitive load and higher performance levels (Rosenberg-Kima et al., 2022). The whole-task approach breaks down the entire task from beginning to end. Partial-task instruction takes each component of the complex task and teaches it as a separate topic. At the end of the unit, the whole task is performed for the first time (Ashman et al., 2019; Sweller, 2016). However, Meece (2023) found that self-assessment and learning task selection are essential for secondary students because teachers must give explicit instruction or order of importance for individual tasks. Therefore, self-regulated learning skills are more critical in the classroom (Biwer et al., 2020; Radović et al., 2024).

Finally, List and Lin (2023) argued that learners must incorporate multiple texts through integrated instruction. Integration is the key to bringing prior and new knowledge together to construct meaning and optimize learning. Cognitive load theory and its application are essential for the educator to support the needs of all learners in the online setting. Therefore, focus on learning tasks, explicit instruction, and self-assessment are critical components for cognitive load-based instructional strategies for students with learning disabilities in the online classroom.

This study will show the different levels of support necessary to teach math online to high school students with math computation and problem-solving disabilities.

The Learning Material Design

The focus of the design of learning material for instruction using cognitive load theory depends on the goal or objective of the lesson (Lindner & Schwab, 2020). The dissemination of material drives the learning material design and its goals (Klepsch & Seufert, 2020). One effective method is adding a relevant picture to the text (Pouw et al., 2019). Adding a relevant picture to the task improves learning more than just showing text alone (Jajdelska et al., 2019). Integrating the text and the picture would have enhanced results in the learning outcomes and performance of the students rather than presenting the text or image alone (Jajdelska et al., 2019; Sepp et al., 2019). The split-attention effect uses a picture with integrated text to guide the learner between two sources. The split-attention effect increases demands on working memory (Schroeder & Cenkci, 2020).

Another material design method is for the teacher to read the text aloud while presenting a picture (Jajdelska et al., 2019; Reinwein & Tassé, 2022). Having the teacher read the text while showing a picture can ensure the student's working memory can absorb the information presented (Jajdelska et al., 2019; Schroeder & Cenkci, 2020). Presenting a picture while the teacher reads aloud is called the modality principle (Reinwein & Tassé, 2022). In the modality principle, the information is shown through one modality while simultaneously saying the text in another modality (Klepsch & Seufert, 2020). The modality principle method helps the learner eliminate the need to look up the information in another modality, increasing learning and reducing the cognitive load (Pouw et al., 2019). Experts agree that cognitive load-based learning material design must focus on presenting the material in the classroom. This study sheds light on math teachers' perspectives on using different levels of support to teach students online with math deficits in computation and problem-solving at the high school level.

Cognitive Processes During Learning

Some approaches focus on igniting learners' cognitive processes to invest in their learning (Almulla & Al-Rahmi, 2023). The prompting effect is when teachers guide students in the right direction of the learning content in the lesson (Klepsch & Seufert, 2020). The student responds to the prompting by completing a portion of the task while the teacher prompts the student to go in the direction needed to accomplish the task (Hettinger et al., 2023). Those methods encourage the construction of schemas and mental models to enhance the student's learning in the classroom (Armougum et al., 2020).

Another instructional method found to elicit a deeper understanding of the content is self-explanations. Self-explanations are an activity that encourages the student to explain the content to themselves during the learning (Brod, 2021). Using self-explanations along with worked examples increased the effectiveness of the worked examples (Ayres, 2020). Using self-explanations encourages the students to be active and engage in their learning. Increasing learners' engagement in using think-aloud methods is ineffective for the learner's retention (J. Cowan, 2019). However, reflection using the think-aloud did not negatively affect learning (Park et al., 2020; Schroeder & Cenkci, 2020). Learner reflection shows how the cognitive load impact can differ based on information processing. Understanding cognitive processing gives instructors an accurate view of the appropriate content and practice so learners can effectively absorb information (Özkubat & Özmen, 2021). Processing works with timely and accurate information (Puma & Tricot, 2019).

Recognition of learners' strengths and deficits would enable educators to tailor their instruction effectively (Putra, 2023). Presenting instruction in a less complex way in smaller portions will reduce the cognitive load on the learner. Cognitive load theory is particularly significant in education in recognizing the possibility of developing education tailored to a learner's learning capacity (King-Sears et al., 2023; C.A. Tomlinson & Imbeau, 2023). The realization is that understanding cognitive load enables learners to enjoy the benefit of instruction tailored to their ability to absorb information (Rosenberg-Kima et al., 2022). Understanding educators’ experiences in providing varied levels of support when teaching math online to high school students with math disabilities adds to the body of literature.

Effective Instructional Practices

Instructional designers use three activities when developing instruction: identify strategies to solve the problem, choose which strategies to use, and implement the design based on strategies that best suit the task (Sentz et al., 2019). Direct instruction helps identify strategies to overcome working memory deficits (Sach, 2022). Examples of those strategies include worksheets with fewer problems, distinct visuals, and increasingly complex tasks (Shareefa, 2023). Direct instruction strategies assist the learner in using readily available resources to reduce reliance on working memory and refine the ability to reason out a problem (Bondie et al., 2019). Implementing the instructional design includes providing the appropriate material for the students to engage and creating organized mental models (schemas) integrated into the learner's current knowledge (Bolkan & Goodboy, 2020). Studying the lived experiences of educators teaching math online shows the proper supports needed to enhance the learning of students with math computation and problem-solving deficits at the high school level.

In the Classroom

Utilization of cognitive load theory presents educators and learners alike with tremendous opportunities. A study conducted by Hadie et al. (2018) determined that effective practices can reduce the learner's cognitive load and stimulate the learning of new knowledge, impart prior knowledge, challenge its views, and provide guidelines on many topics. Student instruction must be tailored to their ability, allowing all learners to participate in the proper learning process for their learning capacity (K. Xu et al., 2021). Differentiated instruction can equal the playing field of all the learners in the classroom (Barrett-Zahn, 2019). Educators can utilize differentiated instruction that permits instruction to respond to the interventions of each learner so that teachers can develop lessons to monitor and guide progress and maintain rigor (Bondie et al., 2019). The B. Tomlinson (2023) instruction framework uses flexible grouping that evolves with the student's learning level and pace. Differentiated instruction embraces cognitive differences, and the groupings change as the learner's needs change (Smets et al., 2022). Another differentiated instruction method is scaffolding. Scaffolding uses a tiered or guided strategy of instruction that caters to each learner and their needs in an online classroom (Puntambekar, 2022; B. Tomlinson, 2023). Flexible grouping and scaffolding are two instructional approaches that decrease cognitive load. Recognizing each approach's differences in cognitive load is critical to successful instruction. The methods and approaches described above are used in the math classroom online, making the instruction more learner-centered (Dwivedi et al., 2019). The approaches revealed in this study explain the educators' lived experiences using different levels of support for teaching math online to high school students with math computation and problem-solving disabilities.

Current Instructional Practices Using Cognitive Load

Implementing a successful classroom utilizing effective instructional practices for students with learning disabilities depends mainly on the teachers (Kazmi et al., 2023). That is because the responsibility of executing online instructional practices falls on the teacher leading the classroom (Kong & Y. Q. Wang, 2024). Researched-based principles of instruction can produce a reduced cognitive load on the individual and increase the students' learning outcomes (Skulmowski & K. Xu, 2022). Implementation, knowledge, skill, and attitudes play a significant role in the positive outcomes for all learners (Kennedy & Romig, 2021). Allowing students to struggle productively is a way that teachers can facilitate the learning process of all students in the classroom (Cai & Hwang, 2023). A productive struggle refers to eliciting student thinking with a concept they do not understand yet or are starting to understand by working through their confusion via verbal or written communication (Murdoch et al., 2020). A clear understanding of a learner's abilities permits the adjustment of instruction to match the cognitive load demonstrated by the student (Pozas et al., 2021). Teachers must know that some frustration and confusion are necessary for optimal learning (Mangaroska et al., 2022). Productive confusion will encourage long-term problem-solving skills for students to learn how to work together outside the classroom (Sweller, 1988). Castro-Alonso et al. (2021) agreed that educators should use materials that will not overload the learners' working memory capacity for maximum learning benefits. This study explains teachers’ perceptions of best practices for using cognitive load in an online high school classroom.

Significance of Cognitive Load in Education

Cognitive load theory has heavily influenced educational psychology (Ginns & Leppink, 2019). Cognitive load theory states that reducing erroneous cognitive load is necessary so the learner has enough cognitive resources for learning to occur (Skulmowski & K. Xu, 2022). Based on cognitive load theory, direct, explicit instruction became the model for best practices in the classroom rather than the inquiry learning model (Derry, 2020). The empirical data of Sweller et al.'s (2019) work has become the premise for direct instruction. Using an expert to teach the class directly removes the extraneous cognitive load of discovery learning (Sweller et al., 2019). Adding material to the lesson is a design that enhances the learning, called complementary information. Complementary information is an effective instructional approach rather than diffusing information (Sepp et al., 2019). The empirical data provides a practical explanation of how cognitive load can shape instruction. Investigating the lived experiences of educators' practices of varied support for teaching math online to students with math disabilities will help instruction for all learners.

Outcomes

Learning mathematics is essential due to its long-term outcomes, such as entering post-secondary institutions (Nelson et al., 2022). Lack of access to education and technology hinders opportunities to improve outcomes for students with learning disabilities online (Ntombela, 2020). Identifying a subject's level of knowledge can predict outcomes (Foreman-Murray & Fuchs, 2019). Integrating methods of instruction is vital to positive outcomes for online learners throughout their educational experience (Le et al., 2023). Evidence points to a data-driven, flexible, and well-integrated model of instruction that leads to positive outcomes for learners with disabilities in the online environment. This study includes a description of the long-term outcomes from the teachers' points of view.

Online Learning

In recent years, online learning has become more integrated into instruction. Students increasingly use technology as part of their daily routine. When delivering instruction through technology, online safety and cognitive load must be considered (Mayer, 2019). Online learning is more popular for students with and without learning disabilities at the secondary level (Enders & Kostewicz, 2023). Strides must improve online learning by increasing students' problem-solving and thinking skills (Almulla & Al-Rahmi, 2023). Students must be self-motivated and self-regulated when learning online (Costley, 2020). Online learning must be more than learning through a digital device (Ashraf et al., 2021). Evidence-based practices are essential to determining the most effective methods for online learning (Mayer, 2019). Ensuring appropriate cognitive load on students is a best practice. An assessment tool is needed to determine the effectiveness of online instructional methods in reducing cognitive load. Tools such as self-reporting, perceived difficulty, and mental effort are examples of measuring the learner's cognitive load (Ouwehand et al., 2021; Radović et al., 2024). Student's descriptions of the perceived difficulty of a task can help the educator determine the next steps in the instruction through self-reporting (Meece, 2023). The student can assess their performance level on a topic or task, leading to the performance measurement compared to the desired learning outcome (Meece, 2023). Determining the mental effort needed for each task contributes to the student's cognitive load and success in completing each task to the best of their ability (Radović et al., 2024). Cognitive load measurements should occur during the learning time and not after the learning (Mayer, 2019). Based on the student's prior knowledge, teachers can reduce the cognitive load on the individual (Sweller et al., 2019).

Intrinsic cognitive load is the complexity of instructional activity and materials used for the lesson (Sepp et al., 2019). In comparison, the extraneous cognitive load is how the instruction is presented for the lesson (Martin et al., 2021). High levels of intrinsic and extraneous load are found to be unproductive (Paas & Van Merriënboer, 2020). Germane load refers to how the learner processes the information and constructs a schema for the material presented. A high germane load is very productive for learning (Costley, 2020). Too much extraneous load can impair the germane load of the learner (Zu et al., 2020). Opening the window of opportunity for students with disabilities to engage in online learning has become a beneficial trend. Finding ways to reduce the cognitive load of students who use a digital format for learning can come from analysis and facilitation (Ashraf et al., 2021). Online instructional practices must focus on the learner's problem-solving abilities and thinking skills. Focusing on reducing cognitive load is necessary for a successful online learning environment. Discussing the teachers' perception of the effectiveness of the methods mentioned above adds to the knowledge for teaching math online to students with disabilities.

Learning Engagement Online

A critical indication of learner engagement in the evaluation of quality online education is student performance (X. Wang et al., 2021). Online learning is the use of technology for communication. This communication uses the internet to deliver instruction to students in a physical location different from the teacher (Johnson et al., 2023). Synchronous learning uses technology simultaneously, so the students and teachers can interact via video conferencing tools like Zoom or Teams (Hutton, 2020). Best practices involve teachers developing activities and giving regular feedback to the students to maintain engagement in the online environment (Sahni, 2023). In a study by Inada (2023), the researcher found that students were significantly more engaged in reflective discussions that enhanced their experience and collaboration. Positive discussion discourse makes the online environment comfortable for students to express their knowledge. Giving the teachers' perspective of using discussion to reflect and collaborate aids the study's explanation of best practices to encourage engagement in the online high school classroom.

Best Practices of Instruction for Applications in Math

Mathematics is a subject that utilizes a significant cognitive load (Asmara et al., 2021). For many students, mathematics is an exercise in memorizing the material, which does not translate into applying the knowledge to improve their math application skills (Asmara et al., 2019). Reducing the complexity of the content to allow the student to learn new information helps to reconfigure the old knowledge of the learner and prepare for the new knowledge presented (Ngu & Phan, 2022). The worked example effect is a model of instruction that shows high performance (Paas & Van Merriënboer, 2020). Worked examples give the learner step-by-step examples of a problem with the solutions worked out for the student (Lee & Ayres, 2024; Sweller & Cooper, 1985). Students perform better using the worked examples method rather than asking the student to generate an answer independently (Van Peppen et al., 2021).

In contrast, the borrowing and reorganizing principle is the most efficient method of gaining knowledge by borrowing it from others (O. Chen & Woolcott, 2019). Borrowing work others have developed is an effective method for gaining knowledge. Sweller (2016), the founder of cognitive load theory, found that direct instruction is the best instructional practice for teaching problem-solving in math. Direct instruction reduces the student's cognitive load, allowing them to gain new knowledge and transfer it to their long-term memory. Worked examples, borrowing from other researchers, and direct instruction are three instructional practices that the researchers agree are the best practices using cognitive load theory in the classroom for secondary math students with learning disabilities (Bowman et al., 2019; Shin et al., 2023). An explanation of the teacher's perspective on how direct instruction, worked examples, and borrowing ideas from others can assist high schoolers with disabilities in an online classroom.

Online Instruction for Math

Instructional practices for teaching math online and in person are similar. An advantage to online learning is that students can work synchronously or asynchronously. Synchronous learning happens in real-time (Chapman & Mitchell, 2020). Asynchronous learning does not happen simultaneously as the teacher presents the lesson (Mcelrath, 2020). Asynchronous learning, in which the teacher records a lesson for students to watch later, is suitable for teaching math. For math, stopping, starting, and rewinding the lesson is a great way to accommodate the learner's needs, allowing the student to self-direct their learning (Mcelrath, 2020). The National Council of Teachers of Mathematics (2007) found that students who actively monitored and regulated their learning produced much better results.

Evidence-Based and Best Practices for Teaching Math Online

One evidence-based practice that works well for math online is explicit instruction (Zarate et al., 2023). Explicit instruction is a systematic approach that sets forth concrete steps for instructors to disseminate information to learners (Long et al., 2021). The first step includes an overview of the concept by the teacher. Next, the teacher exposes the students to the content by demonstrating the concept (Porter et al., 2021). Teachers guide the learner through the problems that need to be solved. The next step in the process is for the students to practice the concept with the teacher there to give feedback as necessary (Bouck et al., 2019). Finally, the students work on the problems independently (Johnson et al., 2023).

A trend is developing that a mix of methods tailored to learner needs can be compelling. Some evidence-based practices paired with explicit instruction are schema-based instruction, video modeling, or task analysis (Spooner et al., 2019). Whether the instruction uses explicit instruction by itself or paired with other intervention practices, the process of explicit instruction stays the same (Porter et al., 2021). Satsangi et al. (2020) agreed that using explicit instruction and the other interventions and best practices discussed supports students with disabilities in the virtual setting for math.

Scaffolding is another best practice for students with disabilities in the virtual setting (Riccomini & Morano, 2019). There are many barriers to learning for students. Some discussed include limited background and vocabulary knowledge, decoding deficits, unfamiliar text features, synthesizing and recognizing main ideas, and completing multi-step equations (Smith & Juergensen, 2023). Supporting students using a scaffolding approach uses models, feedback, prompts, and guidance to address their deficits (Bolkan & Goodboy, 2020). Nelson et al. (2022) found that integrating methodologies to accommodate cognitive load in online mathematics instruction is another example of best practices for the virtual learner. This study uncovers the teachers' perceptions of integrating methodologies and proper supports for students with math disabilities in the online classroom.

Instructional Practices for Students with Disabilities in the Online Environment

Children with learning disorders, difficulties, or disabilities often display underachieving academic performance (Yngve et al., 2019). The student's performance is attributable to a wide range of issues. Identifying disabilities helps determine the proper accommodations and modifications for effective instructional design (Bachrach & Woods, 2023). Lockwood et al. (2022) claimed that the variation of identification practices and procedures for qualifying students with disabilities is a significant problem across the United States. However, with the proper support and evidenced-based instruction, those students can achieve age-appropriate levels as their non-disabled peers (Agran et al., 2020; A. Mawila, 2023). A critical aspect of the development process of learning is understanding how instructional practices can shape the environment to nurture a child's sense of belonging and ability to gain knowledge from others (Darling-Hammond et al., 2020). A study by C.A. Barrett et al. (2020) noted a positive relationship for students with learning disabilities between time spent in regular education classes for reading and math and scaled scores on state assessments. Understanding strengths and deficits is crucial in developing strategies to enhance learning (Pavão et al., 2019; Pratt & Hodges, 2023). Recognizing that everyone has strengths and deficits in absorbing and digesting information helps the learner to identify their struggles and assets. Developing instructional practices for students with learning disabilities that focus on the learner's strengths and remediate their weaknesses can increase their achievement in the online classroom.

Differentiated Instruction

Differentiated instruction is an instructional practice to include all learners in the classroom (Sweller et al., 2019; C. Wang et al., 2020). Educators consider education for all learners equal and use approaches and strategies to respond effectively to student diversity in the classroom (Schoen & LaVenia, 2019). Instructional approaches that bridge the diversity gap among students based on their learning abilities and social, political, and economic status are necessary when educators focus on differentiation for special education students (Inês et al., 2022). Bolkan and Goodboy (2019) suggested concrete examples to make the lesson clearer and easier to understand than abstract concepts. Concrete examples are necessary for the instruction of special education students because they are meaningful visual models that help keep the information organized (Bolkan & Goodboy, 2020).

Differentiated instruction uses five components where the teacher varies the level of complexity of the lesson (D'Intino & Wang, L., 2021). The first component is the new information presented to the student. The new information should be in the form of segmenting or chunking, or the amount of content given at a designated time (Idrus et al., 2021). The second element is when the student makes sense of the information given (Fu, 2022). Information reception is the processing portion of the lesson. Varying the level of complexity for students helps them make sense of the content at their level (Estaiteyeh & DeCoito, 2023). During the third component, the teacher checks for understanding. Measuring understanding can be accomplished through flexible grouping or learning centers. Fourth, the classroom environment is assessed and used to assist learners in completing tasks (Blackburn & Miles, 2020). Specific teaching strategies such as cooperative learning, tiered activities, and scaffolding can make the classroom environment more favorable for teaching students. Finally, the last component considers the content taught. The content taught must be flexible to accommodate all learners to attain mastery of the product (C. A., Tomlinson & Imbeau, 2023). The teacher can use different instructional modalities and assessments to track the students' progress (Blackburn & Miles, 2020; Estaiteyeh & DeCoito, 2023). The high school teacher determines the levels of support needed for online students with math deficits.

Universal Design for Learning

Universal Design for Learning (UDL) is not new (Pusic et al., 2022). However, understanding how to incorporate the tools to support the needs of all learners does need guidance and practice to achieve effective and efficient delivery of instruction (Rao et al., 2023). Navigating the online world is just as challenging for the teacher to determine the best practices, proper materials, and delivery methods to engage the student in a topic (Sahni, 2023). UDL is a mindset that addresses the learner's needs and incorporates the methods into everyday practice in the classroom (Seymour, 2024). Universal Design Learning helps to accommodate students of all levels and abilities (King-Sears et al., 2023). UDL is a different way of thinking than providing accommodations and modifications for students as a way to give the resources needed to support individuals in the general classroom (J. R. Root et al., 2020). Students with disabilities need more or different access to resources than their non-disabled peers (Florian, 2019). UDL benefits all learners with varying abilities and improves the rigor of a challenging environment (Marks et al., 2021). Professional development in UDL training is necessary for teachers to design and implement that approach efficiently (King-Sears et al., 2023). Applying that teaching method under the UDL framework benefits all learners when teachers understand the modeling of that philosophy of instructional practices (Craig et al., 2022). Like many other techniques and practices, the instructional model requires the educator to know the learners' capabilities (Krieglstein et al., 2022).

Successful delivery must utilize different approaches for all lessons and learners. It is necessary to consider the capabilities of all learners, instructors, and assistants. That tailored delivery requires a great depth of understanding with a significant level of coordination to develop practices that work for all learners (Mangaroska et al., 2022). UDL uses flexibility and scaffolding to reduce the barriers for all learners (Pusic et al., 2022). King-Sears et al. (2023) concluded that secondary teachers could develop and adapt the effective UDL, research-based approaches they already use for all students. Students with learning disabilities who need further interventions can use the UDL framework to design adaptations to improve their skills and access to the grade-level curriculum (Marks et al., 2021). Researchers agree that properly implemented Universal Design instruction methods address the students' diverse needs and cognitive load in the online classroom. This study highlights the use of Universal Design in an online math classroom from the teachers' perspective.

Collaboration and Teamwork

Instructional practices regarding collaboration and teamwork among teachers to provide instruction to all students are the greatest asset in education (Marschall, 2023). Teachers can use many effective methods and techniques to create differentiated, individualized lessons through collaboration and teamwork (Lindner & Schwab, 2020; Sweller et al., 2019; C. Wang et al., 2020). Teacher collaboration is also a way to exchange successful strategies among peers (Beninghof, 2020). Collaboration also builds personal, interpersonal, and organizational improvement in instructional approaches, and student learning (Wullschleger et al., 2023). Collaboration achieves those goals by providing a framework for instructors to share their results, successes, and failures. Group interventions in small groups, leveled groups, or skill-based learning groups, actively cooperating, have positively impacted those with and without learning disabilities (Peltier et al., 2023). Collaboration, teamwork, and group interventions are integrated daily into the online learning environment (Inada, 2023). Collaboration is also a powerful tool for the community of teachers in the field to maintain their networks for mutual support and understanding of their efforts (Wullschleger et al., 2023). Sharing ideas and methods of instruction can give general and special educators tools to assist all learners in the classroom (Simón et al., 2021). Collaboration and teamwork are necessary to develop instructional practices that enable the students in the online classroom to thrive. Giving insight into the teachers' perspective of using collaboration and teamwork to enhance the learning of students with math disabilities was an integral part of this study.

Co-teaching

An effective instructional method used quite often today is co-teaching. Co-teaching is the general education teacher, special education teacher, and related service providers jointly delivering instruction to students with and without learning disabilities in an inclusive online general education math classroom (Friend et al., 2010, p.11; Paulsrud & Nilholm, 2023). Co-teaching enables all learners to benefit from the instruction (Beninghof, 2020). A collaborative approach between general and special education teachers is the most effective for students with disabilities (Iacono et al., 2023). However, Marschall (2023) argued that the teacher's pedagogical knowledge influences the student's achievements more than collaboration and co-teaching.

Further, the special education teacher had higher teacher efficacy than the subject teachers (Peltier et al., 2023). While general education teachers had higher pedagogical knowledge to teach low-achieving students, special education teachers reported higher subject knowledge (Marschall, 2023). Therefore, collaboration and co-teaching did not play a valuable role in facilitating math concepts to students with learning disabilities (Stephen, 2021). Teacher efficacy, pedagogical, and subject knowledge are essential to the enrichment or enhancement of students with disabilities in the classroom (Tometten et al., 2021). Therefore, when used properly, co-teaching models that incorporate the general and special education teachers' knowledge can be effective for all learners in the online classroom. How teachers perceive the importance of co-teaching to increase the understanding of students with disabilities in math is an area that this study describes.

Multi-Tiered System of Support

A multi-tiered system of support, or MTSS, is a targeted support framework for students struggling with content in a particular course (Braun et al., 2020). MTSS is a three-tiered system of support, using varied levels of intense, evidence-based instruction for the remediation of skills to transfer knowledge to the content taught (Sailor et al., 2021). Tier 1 refers to the curriculum and support offered to all students (Kouvonen et al., 2022). Tier 2 is for the student who needs more support than Tier 1 and focuses on specific skill development in a small group intervention (Braun et al., 2020). The students not responding to the Tier 1 or 2 interventions go to Tier 3. Instruction in Tier 3 intensifies, targeting skills for each student in small groups or one-on-one sessions with the teacher (Braun et al., 2020). MTSS can include students with disabilities in the general education classroom (McLeskey et al., 2021). Using the tiered approach can increase positive behaviors and the academic performance of all the students in the class (Choi et al., 2020). MTSS practices for students in the inclusive online classroom apply to all learners. Any learner can move from the different tiers as they come upon the content of difficulty. Thus, the cognitive capacity of each learner is assessed and remediated (K. Xu et al., 2021). The teacher's point of view regarding MTSS supports and the application of interventions gives an understanding of the process needed to incorporate MTSS into instruction in an online high school math class.

Biblical Worldview

As stated in Jeremiah 29:11, "For I know the plans I have for you, declares the Lord, plans for welfare and not for evil, to give you a future and a hope" (*English Standard Bible,* 2001/2024). The scripture is an example of the focus of the viewpoints mentioned above. The Lord tells us in many ways to plan. The work we do can be effective as well as compassionate.

Utilizing pragmatism in preparing for life and success in a Christian manner is undoubtedly filled with challenges. Those challenges must face a clear vision and the ability to play to strengths.

Further, we can accomplish this task by ensuring people know there is a tangible benefit to doing the "right thing." In this instance, we can benefit from a moral imperative. We can have high achievers who are well grounded and see their peers as assets in their given life. The alternative is isolation and stigma, which is not the future God wants for his children.

We must help one another prosper; as stated in Proverbs 27:17, "As iron sharpens iron, we must sharpen one another." Scriptures of the Bible consistently tell us that we must help our neighbor. As an educator, I am a public servant tasked with helping my community. I need more than this to complete the job; I want to do it well. I recognize that many of the scholars I serve possess learning deficits. Therefore, I have incorporated my constructivist research style to implement experiential learning. Proverbs 9:9 tells us to teach so that the righteous may increase their learning. In my case, that means finding alternative ways to teach to build bridges and learning gaps, but the Lord said all good things would come to those who are working in their purpose, called by the Lord (Romans 8:28).

Summary

The literature indicated that tailored instruction is effective in addressing cognitive load. Further, teachers do not often have the resources or knowledge to determine appropriate increments of information to present to the learner at one time. Another concern is how teachers approach deciding appropriate increments of subject matter to present in each lesson. How many students receive the appropriate amount of information for their capabilities is unknown. This study can address these gaps by determining teacher activities and emphasis using a journal prompt, individual interviews, and focus groups. Addressing cognitive load and supports is the focal point throughout the study. Balancing instructional strategies, evidence-based methods, best practices, and successful outcomes for children of all ages will encourage differentiation. Addressing the concerns of all learners to adjust cognitive load is a critical element in the education process (Murdoch et al., 2020). Three critical areas of mathematical instruction emerged from the literature review – strategies, instructional design, and instructional practices incorporating cognitive load. The main themes seen were strategies that used cognitive load alignment to tailor the student's needs for learning. Tailored instruction addresses the cognitive load that individual students can absorb (H. C. Hord et al., 2021). Understanding the limits of a student's cognitive processing capacity enables the educator to develop lessons that remove the unnecessary concepts for the teacher to deliver (Sweller et al., 2019). Instructional design emerged as another theme relevant to the teacher's ability to focus on the content. Students can assist in determining the appropriate amounts of information presented in a lesson. The third theme, instructional practices, was an area that highlighted the types of instructional practices that work best to assist learners' cognitive load in all environments. Mayer (2019) maintained that the practices that worked for online students with learning disabilities in math were explicit instruction, modeling/demonstration, pretraining, and chunking of material. These practices show a need for a better understanding of implementing cognitive load. Available instructional practices focused on the salient issue of this population – working memory and processing speed (Agostini et al., 2022). The literature does an excellent job of presenting individual issues for the community. Current literature does not illustrate integrating the instruction, design, and materials. Determining effective methods of relaying information to students with learning disabilities will help refine how teachers regard their online instructional practices. Using multiple levels of support showed that an inclusive online environment creates positive outcomes for all learners and educators (Tiernan et al., 2020). An area of note is that the perceived knowledge and self-belief in the content are positive factors in the ability to carry out a task (Mintz et al., 2020). Peers help to minimize confusing content with teachers working as facilitators. The literature described the best instructional practices to integrate an understanding of effective cognitive load instruction.

CHAPTER THREE: METHODS

Overview

The purpose of this transcendental phenomenological study was to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teachers at public cyber charter high schools in the Northeastern United States. This qualitative study examined the teacher's lived experiences from the viewpoint of Sweller's (1988) cognitive load theory, a framework for understanding schemas that drive the knowledge retrieval to extend students' working memory (Loveless, 2022). The information gained should be added to the body of literature available to enhance instructional practices. Effective instructional practices in the classroom needed data to develop the methods and best practices for running an effective functioning classroom where all learners benefit and attain efficacy (Brix et al., 2022). This study expanded the knowledge of perceived effective instructional approaches for teaching math online to students with math computation and problem-solving learning disabilities. The learning theory this study examined is the cognitive load theory of instruction. This chapter describes the study’s research plan, design, data collection, and analysis plan.

Research Design

A qualitative study describes the characteristics of an experience or phenomenon (Savin-Baden & Major, 2023). This qualitative study utilizes the transcendental phenomenological research method to describe teachers' experiences teaching math online to students with math learning disabilities. Focusing on educators’ perspectives and what their experiences mean is best explained through a transcendental approach (Moustakas, 1994). This study uses the transcendental approach by setting my biases aside and only using the information of the participants’ experiences (Moustakas, 1994). Transcendental phenomenology takes the experiences and connections of people, and the phenomenon studied (Stolz, 2023). This design allows me to view the characteristics of the experience studied in its purest form to develop an understanding without prejudgment (Moustakas, 1994). Phenomenological studies are a model of scientific inquiry used by the social sciences for decades to examine and understand an experience (Mensch, 2023; Moustakas, 1994). A process of systematically setting aside the prejudgments of the phenomenon studied is called epoché (Moustakas, 1994; Zahavi, 2021).

To guide the participants, I focused on the intentional experience of the teacher through acts of consciousness (Moustakas, 1994). Intentional experience relates to a choice in strategy and why the teacher is changing the strategy. Making intentional choices and changes as a conscious decision helps the audience gain awareness. I want educators to describe the phenomenon based on the lived experience shared by the participants (Moustakas, 1994). The teachers reflected on their teaching practices to explore why they changed their lessons to assist the learners.

Interviews, journal prompts, and focus groups determined the data's findings. The methods described will generate a consistent portrait of data applicable to an online classroom. Those methods will shed light on the best practices identified as available, in use, or possible at present. The study will examine a real-world issue through the eyes of those who participate professionally. The results of this study add to the body of knowledge to describe high school teachers' experiences using various supports teaching math online to students with math learning disabilities in computation and problem-solving.

Research Questions

The research questions below will guide this transcendental phenomenological study. The questions will address the ability to determine the capacity to apply information in a math classroom (Bowman et al., 2019). The analysis design builds on individual answers to provide a framework for group discussion to examine methods. This study aims to contribute to the knowledge of usable information load for students in a cyber math setting.

Central Question

What is the lived experience of 9 – 12th-grade online mathematics teachers supporting students with differing learning abilities in math computation and problem-solving for teachers at a public cyber high school?

Sub-Question One

What are the experiences of 9 – 12th-grade online mathematics teachers using universal design instruction when assessing students who have a disability in the area of math?

Sub-Question Two

What are the lived experiences of 9 – 12th-grade online mathematics teachers determining the most appropriate instructional approach that uses cognitive load theory for students with differing abilities when learning math computation and problem-solving?

Sub-Question Three

What are the experiences of 9 – 12th-grade online mathematics teachers determining the appropriate amount of content related to the cognitive load of mathematical computation and problem-solving when providing practice activities for students with a math-related disability?

Setting and Participants

The study was conducted in three cyber high schools in the Northeastern United States. The schools have diverse student and faculty populations and serve students from K-12. The participating educators are from the high schools of the organizations. The teachers have experience teaching math in a cyber setting.

Setting

The setting for this study was cyber high schools in the Northeastern United States. The participants are high school cyber educators teaching math to students with disabilities. The cyber high schools in the Northeastern region of the United States targeted have over 500 math teachers and over 50,000 students, including more than 12,000 students in special education. The students came from a wide range of socioeconomic backgrounds, ethnicities, and abilities. The targeted population was cyber high school math teachers with three or more years' experience, rather than a specific site. Teachers from three cyber schools responded, creating the pseudonyms Cyber High School 1, Cyber High School 2, and Cyber High School 3. These sites are separate entities that develop the targeted group setting.

Cyber schools have similar administrative structures; most operate as nonprofit, public entities. Each cyber school has an independent board of trustees, president or Chief Executive Officer (CEO), provost, vice provosts, principals, vice principals, department chairs, teachers, and support staff (Cyber High School 3, 2024). The selected schools have main offices and headquarters in the Northeastern United States. The cyber schools that participated do not have a physical district or affiliation with a brick-and-mortar school. The schools have elementary, middle, and high schools within the K-12 structure. Each cyber school is essentially a "district;" however, the "district" encompasses an entire state (Cyber High School 1, 2024). The school's mission statements put the students and families first in preparation for life after high school (Cyber High School 2, 2024). The scheduling is flexible and tailored to each student. Support is provided to each student regardless of ability. Cyber High School 3 District (2024) provides special education services to those who qualify, focusing on the learner's cognitive, social, and emotional needs.

The cyber schoolteachers chosen for this study teach math courses in a stratified structure. Cyber schools create robust courses with modifications and accommodations offered through three levels of support. The first level of support is in the general education environment with special education students. Cyber High School 1 District (2024) placed special education students into tiers through the MTSS process and provided them with accommodations. The second level of support is general education at a slower pace, with special education students receiving accommodation and placed into tiers through the MTSS process. The third level of support is that special education courses move slower with accommodation and modifications (Cyber High School 2 District, 2024). Other math courses are available to general and special education students with accommodations, and the MTSS process and special education courses with accommodations and modifications at a slower pace.

Participants

The participants for this research study consist of special education and general education 9 – 12th-grade math teachers of students with learning disabilities in math computation and math problem-solving. Participants could be of any age, gender, race, or ethnicity with at least three years of teaching at a public cyber high school in the Northeastern United States. This study used purposeful criterion sampling to choose the participants available at three cyber high schools (Patton, 2023; Saldaña, 2021). A total of 12 high school mathematics teachers participated in the study. All participants were employed at public cyber high schools in the Northeastern United States. The participants included one male and 11 females aged 25 to 64 years. All participants were White. Three participants were special education teachers and taught grades 9-12. Two of the three special education teachers were from Cyber High School 3, and one special education teacher was from Cyber High School 2.

Eight participants were general education teachers teaching grades from 9-12. Two general education teachers were from Cyber High School 1, two were from Cyber High School 2, and four were from Cyber High School 3. One participant taught special and general ed, grades 9-12, from Cyber High School 1. The special education teachers taught pre-algebra, algebra 1B, and algebra. The general education teachers taught pre-algebra, algebra 1A, algebra 1B, algebra, consumer math, and AP Calculus. The teaching experience ranged from three to 29 years, with a minimum of three years of experience teaching math online in Cyber High Schools 1-3. The participant section in Chapter Four provides details about the cyber high school each teacher taught at and their number of years of teaching experience.

Recruitment Plan

Purposeful criterion sampling is a qualitative approach that refers to selecting participants based on the individuals' knowledge about the experience (Patton, 2023; Saldaña, 2021). For this study, the criteria for sampling are high school online math teachers using different supports to teach students with math disabilities in computation and problem-solving. The sample size of participants in the study was 12 teachers of different genders, ethnicity, and age range. The survey responses provided demographic information.

Recruitment was conducted after receiving Institutional Review Board (IRB) approval (see Appendix A), which included the site permission request letter (see Appendix B) and site response letters (see Appendix C). I emailed the administration of cyber high schools in the Northeastern United States using the permission request letter (see Appendix B) for permission to contact faculty in their math departments. Three Cyber High Schools agreed to share information with me to provide the sample pool. This research study consisted of special and general education 9 – 12^{th}-grade math teachers with three years or more experience in a cyber high school. Upon receipt of the permissions and contact information, I emailed each teacher to recruit for participation in my study using the recruitment letter/email (see Appendix D).

Upon return of a completed, affirmative response to the recruitment email/letter, I sent out a demographic survey (see Appendix E) via email. The demographic survey determined that the participants met the criteria. The criteria were teaching math for at least three years at a cyber high school, grade level 9-12, general or special education, and courses taught. Data from the survey allowed me to choose participants from diverse ethnic backgrounds, age groups, and experience levels, ensuring the study's inclusivity and diversity (Yin, 2016).

The requirement for the educators to have three years of experience in a cyber high school gives that teacher enough time to become familiar with the course content, technology, and support given. I requested that the candidates return the demographic survey by the end of one week. If candidates did not return the demographic survey within one week, I sent a follow-up email (see Appendix F) to ask if they were still interested in participating. If the candidate was still interested and returned the recruitment letter affirming participation, the participant moved to the next step. If the candidate did not respond after one week, I withdrew the candidate from the pool of possible candidates. Those candidates were sent a nonacceptance letter for participation in the study (see Appendix G). Positive responses were sent a consent form (see Appendix H) via email. The participants returned the completed consent form within one week.

Negative responses were notified via email that they had been dropped from the study (see Appendix G). The consent form (see Appendix H) asked candidates to complete a journal prompt and return it to me via email (see Appendix I). The candidates had one week to return the responses. If they did not respond within one week, I sent a follow-up email to submit their responses (see Appendix F). Completing journal prompt responses led me to email the candidate to schedule an interview via Teams. If scheduling was successful, the candidate participated in the interview. If scheduling via email failed, I called to schedule the interview. If scheduling were not possible, a drop-from-study email would be sent (see Appendix G). Upon completing all interviews, I formed three focus groups and emailed the individuals to schedule a meeting through Teams. I called candidates who have not responded to encourage participation in the meeting. Participants who did not wish to continue the study would be sent a drop-from-study email (see Appendix G). Focus group meetings were recorded in Teams and on a second device (iPhone). I discussed the results of the journal prompt and interview findings with the participants of each group. Each participant was sent their transcripts for review of accuracy.

The sample size of participants in the study was 12, a number chosen to help determine the saturation point. This number of participants provided enough information for the study to continue until data saturation (Leese et al., 2022). Data saturation, which occurs when new themes or data no longer emerge in the literature reviewed (Savin-Baden & Major, 2023), was a key milestone in the study. After reaching saturation, I discontinued interviewing new candidates for the study (Moustakas, 1994). The study was a purposeful criterion sample of the participants available at three cyber high schools in the Northeastern United States (McLoughlin et al., 2024; Saldaña, 2021). The purposeful criteria allowed me to select participants who contributed to the study because they teach math at a cyber high school in the Northeastern United States (Creswell

& Poth, 2024). This setting was suitable for the varying levels of support offered in the special education and general education math curriculum at the three cyber high schools in the targeted area. All participants could remove themselves at any point in the study.

Researcher Positionality

My topic of interest is the general area of best instructional practices for teaching math in the classroom. First, I view myself as a pragmatist. To understand the lived experiences of math teachers and the best instructional practices in a classroom, a view of the experience must come from all learning environments. Therefore, this study will involve all strata of learners and the larger community. Those learners have much to offer each other and the community around them. Practically, there is a significant value in preparing learners to function in this community.

Next, I am a researcher who is disability inquiry centered. Individuals of differing levels of ability and focus can learn in the same environment. Focusing on the accommodations and modifications for the student's needs enables the educator and me to produce a body of citizens who can function well with their peers. Educators can view the student's cognitive abilities at different levels as assets rather than problems. Finally, I am a researcher whose interpretive lens shows that disability is a facet of people's abilities. That means we need not regard differences as a defect (Fuchs et al., 2019). That also allows the educator and me to play to our strengths and craft effective instructional practice strategies. As a math teacher in a cyber high school, I have found this area of teaching to be the most interesting. I decided to study this phenomenon to reveal teacher perspectives.

Interpretive Framework

Regarding my interpretative research style, I am a constructivist. According to M.S. Barrett et al. (2023), there is a significant difference between enjoyment and pleasure because enjoyment in a person is due to their outside experiences, background, and history. Piaget (1929) fathered constructivism on the theory of social learning. Like M.S. Barrett, Piaget believed that the accurate measure of how someone is learning depends on who they are. As an educator, I rely heavily on knowing who a scholar is before teaching them. Knowing the child can help the teacher determine their learning style, how they best learn, and ways to facilitate it. I have been implementing hands-on learning to build upon scholars' knowledge. Learning should not happen independently from life, nor should learning be based on quantitative assessment methods alone. Learning is social and is best when it is an immersive experience (Aguayo et al., 2023).

Philosophical Assumptions

As a qualitative researcher, it is important to recognize my philosophical assumptions within my topic of study (Coates, 2021). I believe that a disability recognizes the differences in people, not a defect. God creates everyone for a reason with their strengths and weaknesses, whatever form they may take. It is up to us to find ways to reach everyone through His love and learning. Gathering the perspectives of teachers teaching math to students with disabilities is critical to assessing the best strategies and supports to help students in the future. Students use their foundational knowledge and build on it to create a new understanding. Teachers also build on the knowledge of strategies and support they have found that work for students. Viewing the world through a lens of teacher perception of varied levels of support, interventions, and settings will add another dimension to the best practices and supports for students with specific learning disabilities in mathematics. Teachers sharing their relationship with these types of support gave me a better understanding of their reality and viewpoints.

Ontological Assumption

My ontological assumptions originate from my belief in God. God is the greatest being. None are above him. His words are the utmost truth. Reality and truth are based on God and his word. As God is perfect, man is imperfect. However, I know others have differing beliefs and interpretations of God's truth. I explored the topic and its characteristics while describing how others perceive them (Northoff & Smith, 2022). The assumption of the nature of reality appears through various viewpoints relating to existence (Lincoln & Guba, 1985). I believe that everyone has a unique perspective when experiencing the same phenomenon. No two experiences are alike. Within my research, I want to examine how people perceive the use of MTSS (Multi-Tiered System of Support) interventions and varied levels of support for students with specific learning disabilities. It is essential for me, as a researcher, to gather as much information as I can on how others perceive MTSS and supports in hopes of shedding some light on the growing concerns regarding MTSS, accommodations, and modifications for students with and without disabilities. Understanding the perspectives of the participants' experiences using different supports to teach high school online students with math disabilities allowed me to complete this study due to my ontological beliefs.

Epistemological Assumption

Interpretation and collaboration among the participants are critical in the constructing for the study's success. Interpretation of knowledge is the active part of participants rationalizing the world around them (Ortiz-Revilla et al., 2020). Their collective interpretations construct knowledge. Collaboration highlights the group nature of knowledge construction, where mutual meaning and comprehension come from joint interactions and efforts. Enworo (2023) emphasizes that the mutual exchange of ideas is critical for qualitative research, because it requires considering many perspectives, which adds depth to the findings. I aim to uncover the participants' understanding of MTSS interventions through my epistemological assumption. It is vital to gather subjective evidence from the participants to discover their thoughts, feelings, and actions within the study. Epistemological assumptions focus on the relationship between the research topic and the researchers (Kalsoom et al., 2021). Within my research, I have had extensive training on successful practices within MTSS. Where I still need to improve, however, is how others feel about MTSS interventions. My goal within qualitative research is to explore the relationship between MTSS and the perception of other educators in education. Accurate documentation of the participant's responses and emerging themes allows me to gain knowledge from their descriptions of the experiences. My epistemological assumptions in understanding the knowledge produced helped to develop the framework for eliciting knowledge from the participants in the study.

Axiological Assumption

The axiological assumption of a qualitative study is all about the values, beliefs, and biases that researchers share about themselves that relate to the topic of study (Manik et al., 2024). Researchers discuss the study's value and share their biases and beliefs (Brewster & Miller, 2022). Axiological assumptions can include the researcher's position regarding race, gender, age, and socioeconomic status. In my research, I fully value MTSS's success within elementary school districts across the county. I believe that, when implemented correctly, MTSS interventions can have a lasting and successful effect on students with and without specific learning disabilities. I want to share my values and biases with my audience so that others will realize the benefit of MTSS for all students. My axiological assumption is that everyone can learn, regardless of ability. I am a proponent of MTSS. I must take the raw data given by the respondents and ensure nonprejudicial, organized filtering of data. I filter my personal bias through the participants’ views and perceptions of my study. To put my biases aside, I had the participants review and discuss the results in focus groups.

Researcher's Role

My role as the researcher in this study is primarily that of a human instrument. The participants are colleagues who function at the same level as I do. All names of institutions and colleagues will be pseudonyms, with the information coded to keep the information confidential. All information provided by the participants will be collected and categorized with verbatim transcription of the interviews, journal prompt responses, demographic survey answers, and focus group discussions. The study's design, which was transparent and open, minimized my personal biases and assumptions. The questions were structured as neutrally as possible, ensuring the integrity of the study.

Procedures

The first step in this process began with an application to the IRB to approve the proposed study (see Appendix A). Site approval is unnecessary for this study because I directly contacted candidates from different cyber high schools to participate. The participants were from the population of cyber high school math teachers with main offices headquartered in the Northeastern United States. The cyber schools that participated do not have a physical district or affiliation with a brick-and-mortar school. Cyber schools are their own district that covers a specific state. After the IRB approval, I emailed the administration of randomly selected cyber high schools in the Northeastern United States using the permission request letter (see Appendix B). Upon receipt of the permission response letters (see Appendix C), I emailed each teacher for recruitment to participate in my study using the recruitment letter/email (see Appendix C).

Potential candidates were emailed a demographic survey (see Appendix D). The qualifying participants were selected using purposeful criterion sampling (Creswell & Poth, 2024).

Selected participants who met the criterion moved on to the journal prompt (see Appendix I). Next, I sent the journal prompt to the participants via email, respecting their time and effort. I gave the participants two weeks to return their responses. If they did not respond by the end of the two weeks, I emailed them to encourage completion. If they still did not respond by the end of one week, I contacted the candidates via email to inform them that they were dropped from the study (see Appendix G); however, this was not necessary. The third step of the data collection process involved individual interviews via Teams. The participants and I scheduled interviews for approximately 30-45 minutes, again respecting their time. I digitally recorded the interviews through Teams with a second device (iPhone) as a backup. Finally, I created three focus groups of teachers from the previously identified procedures.

This qualitative study is a transcendental phenomenology designed to describe the lived experiences of high school cyber math educators using various supports to teach students with math computation and problem-solving disabilities. The data collection for this study included journal prompts, individual interviews, and focus groups. Journal prompts were emailed to elicit reflective responses from the participants, conducted individual interviews to explore their experiences, and facilitated focus groups to achieve a collective understanding of the phenomenon. Those three types of data collection were appropriate for qualitative data collection (Patton, 2023). Data collection was recorded in a digital format to validate the study. The data analysis consisted of digitally recording the journal prompt, individual interviews, and focus group responses. A comparison of the themes that emerged in the responses explained the phenomenon studied.

I achieved triangulation by using different sources, methods, and researchers to validate the data and findings (Lincoln & Guba, 1985). I triangulated the sources by examining each participant's responses, comparing the common themes, and identifying the strengths and weaknesses within the journal prompt responses, interviews, and focus groups. This analysis method allowed me to balance the data triangulation (Lincoln & Guba). I asked the focus group to examine the data from the journal prompts and interviews to validate the study's findings.

Data Collection Plan

This qualitative study is a transcendental phenomenology describing teachers' perceptions of high school cyber math educators using various supports to teach students with math computation and problem-solving disabilities. The data collection for this study used three types of data. The three data types were a journal prompt, interviews, and focus groups of teachers from the study. Those three data types were acceptable primary data sources for qualitative research (Patton, 2023). The data gathered was recorded in a digital format.

Journal Prompt

Participants completed a journal prompt (see Appendix H). Journal prompts were used as a counterpart to the interviews. The respondent gives more in-depth information into their perspectives of the experience studied. A journal prompt gathered information describing the lived experiences of high school cyber educators teaching math to students with disabilities. The journal prompt was the first data collection method to gather individual information to understand the participant's experiences better. The experiences were teaching special education students with disabilities in math. Additional information on processes and methods used in the classroom was elicited from the teachers to understand better their descriptions of the phenomenon (Ilie et al., 2020). The participants could spend extra time on their responses to make edits to submit an accurate assessment of the question asked (Rudrum et al., 2022). The responses to the journal prompt allowed me to find common themes for instructional practices and methods used in this environment.

I emailed the journal prompt to the participants (see Appendix H). The journal prompt addressed the respondents' background and experience teaching high school math. This prompt gave me a better understanding of the participants' background in the phenomenon studied. This prompt asked the participants to answer in approximately 200-300 words. The prompt took the participants about 10-20 minutes to complete. The participants had two weeks to return the prompt. If the respondents had not returned their responses in two weeks, I would contact them via email (see Appendix I) and phone (see Appendix J) to encourage a response (this was not necessary). If the participants did not respond within one week of the phone call date, I would drop them from the study (this was not necessary).

The journal prompt I used for this study was:

Table 1

Journal Prompt

In 200-300 words, describe your understanding of cognitive load and the methods you use to reduce cognitive load to the learner (the amount of content to teach for each lesson).

Individual Interviews

Individual interviews via Zoom were the second step of the data collection process. The interviews described the participants' lived experiences of teaching students grades 9 - 12 who have specific learning disabilities in math computation and math problem-solving. The individual interviews sought to find common strategies, ideas, and perspectives of the math teachers. Deeper questioning of the participants revealed strategies that were proven successful in an online classroom. Teachers' attitudes toward various strategies and their efforts to implement them revealed how successful and efficient they were for all students.

The interviews also included discussion questions regarding those strategies' benefits versus the cost. Avoiding leading questions during face-to-face interviews helped to construct the phenomenology's meaning (Cairns-Lee et al., 2022). In the individual interview questions, the respondents described their understanding and application of cognitive load. The interviews took place in Zoom or Teams. These interviews took approximately 30 - 45 minutes, with a digital backup recording.

Individual interviews began with a broad question prepared by Moustakas (1994) to develop a detailed description of the phenomenon studied. Individual interviews were conducted and recorded via Teams or Zoom. I recorded with a second device (iPhone) for audio clarity and accuracy. The interview participants were high school math teachers from three cyber high schools. Interviews collected data on teaching students with disabilities in math computation and problem-solving within an MTSS-formatted multi-level support classroom. The individual interviews were drawn from the teachers' experiences teaching different topics using a variety of instructional approaches. I emailed (see Appendix K) and called (see Appendix L) the participants to schedule interviews with them. The interviews took approximately 30 - 45 minutes.

Further information describing the lived experience of this phenomenon, individual interviews, gathered individual information for a complex, richer understanding of the participant's experiences in teaching special education students with disabilities in math (Moustakas, 1994). Additional information for instructional practices used in the classroom was drawn from the teachers to understand their descriptions of the phenomenon (Ilie et al., 2020).

The participant's responses allowed me to find common themes for best practices and methods used in a cyber environment.

Table 2

Individual Interview Questions

1. Please introduce yourself and describe your academic journey to becoming a math teacher. CRQ
2. Describe your experiences teaching math to special education students with specific learning disabilities in math computation and problem-solving. SQ1
3. Describe the contexts or situations that have typically influenced or affected your experiences with teaching special education students with specific learning disabilities in math computation and math problem-solving. SQ1
4. Describe the MTSS process for your learners. SQ1
5. Describe how you were exposed to cognitive load theory. SQ3
6. Describe your understanding of the connection between cognitive load and the amount of information to present to learners with disabilities in math. SQ3
7. Describe how you determine the appropriate increments of information you must present for each lesson or topic. SQ3
8. Describe how you determine the lesson must be modified because the learning increments (cognitive load) related to math computation and problem-solving are too much for the students in the classroom. SQ3
9. Describe how you use UDL to reduce the learner's cognitive load. SQ2
10. Describe how you leverage self-regulation, specifically reflection, to increase math outcomes and reduce cognitive load. SQ3

11. Please describe how you know a student has reached their maximum cognitive load. SQ3
12. Describe how working memory contributes to a student's cognitive load in mathematics. SQ2
13. Describe two methods you use to reduce the cognitive load on a student when teaching a new concept online. SQ1
14. Describe techniques you use to support a student with low processing speed. SQ3
15. Describe how you can use the cognitive load theory to improve your teaching approach. CRQ
16. How is teaching math online different from teaching in person? CRQ
17. What else would you like to add to our discussion of your experiences teaching students with math disabilities or strategies we have not discussed? CRQ

The first interview question explained the participant's academic history to obtain background information. This question allowed the participants to respond while learning more about their experiences. Interview questions two and three built rapport with the participants. The questions were easy and nonconfrontational. Moustakas (1994) explained that beginning an interview with broad questions provides an understanding of the participants' shared experiences.

Questions four, five, and six are opinion questions that allowed the participants to reflect on the issue of teaching math and the supports used for students with learning disabilities. These questions allowed the participants to express their perspectives on their experiences (Collective, 2023). The goal of an interpretive phenomenological analysis approach was to examine the lived experiences of the participants and their perception of the experience (Neubauer et al., 2019).

Thus, the responses to the above questions expressed a more in-depth approach to learning about the participants' experiences.

Questions seven, eight, and nine relate to the student's cognitive load. Teachers reflect upon their methodology and the general and special education environments within their personal experiences. Determining the engagement worth of the students with and without disabilities allowed the teacher to reflect on the rigor of the content and the performance of all learners (J. Root et al., 2023). Supports given to the student were accommodations and modifications to the curriculum that create better instruction in the inclusive online environment (Louie et al., 2021).

Questions 10 and 11 discussed the understanding of cognitive load and instructional practices. Instructional designers incorporate cognitive load theory into their design by removing extra information to reduce the extraneous load on the student (Sentz et al., 2019). The designer will make implementation decisions based on their strategy and understanding of working memory limits (Ashman & Sweller, 2023). Studying how the designer applies cognitive load theory to well-developed and underdeveloped strategies will help bridge the gap in research on developing instructional strategies for problem-solving deficits (Sentz et al., 2019).

Focus Groups

Finally, I created focus groups of teachers from the previously identified procedures. The focus group provided an opportunity to buttress information developed in the previous contacts and document a discussion of techniques for successful instructional practices. Recordings of the focus group meetings occurred in Teams and took about 30-40 minutes to allow discussion. The focus group questions discovered similarities and differences. In addition, the focus group verified my study findings. The participants further explained their experiences with the online math course using the multi-tiered support structure. The separate elements allowed for cross-checking information against the different forms of source evidence (Saldaña, 2021). The different settings also provided some flexibility to play to varying comfort levels among the respondents (Moustakas, 1994). The respondents were high school teachers in a cyber setting with more than three years of teaching experience in mathematics. Focus groups were created based on the similarities and differences drawn from the responses in the individual interviews and a journal prompt. I created three groups of four respondents per focus group for the most practical grouping. The focus group's composition contained various participants from different math courses. Participation was voluntary. I informed the participants of the risks and benefits of their involvement. I explained the participant's knowledge contribution to collating the information results.

Focus group meetings were conducted online via Teams to expand on the results centered around indicators for students absorbing instruction information. The focus group discussions centered on classroom techniques and supports, expanding on the online practices and student support levels given to the students (Richard et al., 2021). Remediation and strategies discussed focused on the interview and journal prompt information results. The feedback also involved developing scenarios and techniques not tried in the classroom.

Table 3

Focus Group Questions

1. How can cognitive load help determine the use of MTSS to increase the student's performance with the content? SQ3
2. How have the additional accommodations and modifications centered around cognitive load helped the student's performance in your classes? SQ2

3. Self-contained teachers, what additional supports are you giving the students in your classrooms to recognize and adjust cognitive load, if any? SQ3
4. General education teachers, what additional supports have you instituted around recognizing and adjusting for the cognitive load that was not originally in the system lesson, if any? SQ1
5. Describe any content or delivery method that should be changed for the general and special education students regarding cognitive load to improve their performance. SQ1
6. What remediation strategies do you recommend based on the results regarding cognitive load theory? SQ2
7. Based on the cognitive load theory and the results compiled from the interviews and questions, what would be a new strategy you could use in the classroom? SQ3

The focus groups allowed the participants to give feedback on the conclusions to verify the credibility of the findings and interpretations of the research. The feedback involved identifying scenarios and techniques that still need development. Focus groups provided an opportunity to develop an active discussion. In this manner, group members were spontaneous and forthcoming, using prompts to elicit information needed to verify a consensus of the results. The purpose of this transcendental phenomenological study was to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teachers at public cyber high schools in the Northeastern United States. Teachers with three or more years of experience teaching high school math online described their life experiences in teaching through a journal prompt, individual interviews, and focus groups.

Data Analysis

Analyzing qualitative data for this study helped me determine the how and why of responses to give a deeper insight into the perspective of educators teaching math online. I used three types of data: a journal prompt, individual interviews, and focus groups. I used an Excel spreadsheet to record and sort responses. Phenomenological reduction allowed me to analyze the data effectively and revealed similarities and differences in the participant responses. I examined the lived experiences of the teachers without judgment. I did not allow my opinions or biases to determine the elements specific to understanding the participants’ experiences. Foregoing my opinions and biases allowed me to reveal the essence of the experiences.

A journal prompt was used to gather initial information about the phenomenon in a different form than the interviews. The journal prompt allowed the participants to expand on the information provided to explain their perspective of the phenomenon. This method yielded a more in-depth description of the data in a written format rather than in the initial individual interview format. I analyzed and placed the interview responses into categories to begin the open coding process. Determining categories for further coding into primary and secondary themes will be discussed (Chang & Wang, 2021). I examined these relationships to find commonalities and interrelationships within the themes of the phenomenon studied (Saldaña, 2021). Axial coding determined the connections among the participant's responses. The data synthesis described the participants' lived experiences regarding the phenomenon. The decision to create a blind and anonymous journal prompt helped the participants to answer freely without fear of backlash or prejudice. Using peers for the educator-centric portion of the study eliminated perceptions that my position could influence their responses.

Individual interviews were conducted and recorded via Teams or Zoom. A second device (iPhone) also recorded audio clarity and accuracy. The Temi app transcribed the interviews word for word. Focus group discussions were conducted and recorded via Teams or Zoom. A second device (iPhone) recorded the audio for clarity and accuracy. The transcripts of the interviews and focus groups were shared with participants to validate the data through member checking. I analyzed the interviewers' responses from the transcripts and placed them into categories, which are called open coding. Based on the trends shown in the data, categories determined further coding (Chang & Wang, 2021). I then coded the categories into primary and secondary themes. Coding the information through reflection and interpretation of the data added meaning to experiences shared in the study. Examining the themes' relationships determined the interrelationships within the themes to find commonalities in the phenomenon studied. Axial coding allowed me to determine the differences between categories to find connections among the participant's responses. Coding allowed the categories to be reduced further or expanded across categories into themes (Nowakowski, 2019). The data synthesis described the participants' lived experiences regarding the phenomenon.

I used a process of horizonalization and ranked the answers by commonalities. This process allowed me to identify and isolate trends. Horizonalization allowed me to redirect questions created from the journal prompt, interviews, and focus groups. Following data interpretation, I composed a textural and structural description of what and how the phenomenon determines the essence of the shared experiences (Moustakas, 1994).

I categorized the significant statements from the journal prompts, focus groups, and individual interviews into themes. The respondents' answers provided the relevant categories, which assisted in removing extraneous information (Moustakas, 1994). I held extraneous information in a separate category and determined its relevance.

These identified topics were placed into categories and developed into core themes. An analysis of the core themes revealed commonalities (Moustakas, 1994). The study structure lent itself to this type of analysis. Incorporating the interviews, a journal prompt, and focus group discussions directed the categorization by the same respondents, enabling cross-checking of the information. After categorization and coding, the answers provided insight into the discovered information. The answers guided decisions on how to utilize the developed information (Moustakas, 1994). Thus, a clear understanding of best practices emerged.

Trustworthiness

As a researcher, I must show that qualitative research maintains credibility, transferability, dependability, and confirmability. Credibility addresses the steps needed to support and interpret the study's findings (Haven & Van Grootel, 2019). Dependability examines the reliability of the methods and procedures of the study. Transferability focuses on generalizing the study to a similar setting with similar results. Finally, confirmability is the process that confirms the study's results (Lincoln & Guba, 1985). Easily verifiable and vetted sources establish the trustworthiness of the study.

Credibility

Detailed descriptions of the study findings will give a realistic interpretation of the teachers' lived experience of the phenomenon. Credibility will show the accuracy of the information in an accurate description that captures the phenomenon's essence (Moustakas, 1994). Accurate, cross-checked data enhances the credibility of the study. This study will utilize member checking as its method of credibility through focus groups. The data collected can be verified and validated in a group formed by the participants in the study. The interviews and focus groups will be recorded, transcribed, and returned to the participants to check the accuracy of the information when compared to their experiences (Haven & Van Grootel, 2019). The verifiability and vetting of sources are also crucial components of a credible source.

Transferability

Transferability shows how the findings can be generalized in other applications (Lincoln & Guba, 1985). Transferability occurs through rich, detailed descriptions of the phenomenon studied. I must establish the transferability of the study to other contexts or within the context of the phenomenon at another time. I must also determine the transferability of the study to other contexts for educators who teach math to students with and without learning disabilities in a high school setting. Thus, the information reported determines if transferability is appropriate in other high school math classes. Examining the results will hopefully provide the most effective instructional approaches, strategies, and supports that work for students with disabilities. Triangulation of the data provides a context for transferability to subjects across curricula.

Dependability

Dependability shows that the study findings are consistent and repeatable through detailed descriptions of the study processes and procedures (Lincoln & Guba, 1985). The study structure, with tiers of information cross-checked through the different interviews and levels of participation, will sift through extraneous data to arrive at sustainable conclusions. This study confirmed that the methods and procedures were detailed sufficiently for reproduction in future studies. I utilized my dissertation committee to check that my thorough descriptions were appropriate to provide dependability.

Confirmability

Confirmability is the ability of the researcher to remain neutral (Carcary, 2021). Questions presented in an open-ended format allow the participants to expand on their responses. The goal of non-leading, open-ended questions is to allow the respondent to answer freely. A colleague will conduct techniques to demonstrate confirmability through the site, results, member checks, and an inquiry audit. This colleague will have experience teaching high school math, cognitive load theory, and qualitative research methodology (McGinley et al., 2021). I will triangulate the data through a journal prompt, interviews, and focus groups. I will keep this information for three years before destroying it. I will use a high-powered magnet to destroy all digitally stored data and information.

Ethical Considerations

Risks to the participants would center around the possibility of a data breach. People who disagree with conclusions could publish personal data, thus creating a risk ranging from physical harm to financial data compromise with the attendant consequences. Persons participating in the study have a chance to help make education a more effective and beneficial experience. Participants also read a disclaimer on the study's risks (see Appendix I). Incentivization for participation in this study will be used as a raffle to receive a gift card of an unknown quantity, giving all participants the same chance of getting or not getting a gift card. Using this method should maintain the objectivity of the participants.

Permissions

The submittal of the IRB site application for this study is unnecessary as the population used is from different cyber high schools in the Northeastern United States. I canvassed the area for cyber high school math teachers’ emails and contacted teachers interested in the study.

Permissions to contact the educators were obtained from the lead administration of each cyber high school via email using the permission request letter (see Appendix B). I contacted public cyber school high school head administrators for math teachers' emails. A permission response letter was attached to the email for the lead administrators to send back to me with the teacher emails (see Appendix C). The study began when respondents completed and returned the consent form. The participants were from the population of cyber high school math teachers in the Northeastern United States.

Other Participant Protections

Upon receipt of faculty emails, I emailed each teacher for recruitment for participation in my study using the recruitment letter/email (see Appendix D). If the teachers did not respond to my email, I sent a follow-up email to encourage participation (see Appendix E). I called to encourage recruitment if the teachers still had not responded (see Appendix F). Calls were not necessary. I sent a demographic survey (see Appendix G) via email. The demographic surveys helped me determine that the participants for the study were diverse. I selected the qualifying participants using purposeful criterion sampling (Saldaña, 2021). The criterion was teachers with at least three years of experience teaching high school math online. I sent nonacceptance letters (see Appendix H) to the teachers who were not selected to participate in the study (this was not necessary). After selecting participants, I obtained consent from each teacher recruited via email using the consent letter for participants (see Appendix I). The consent letter explained that the study was voluntary and that they could withdraw from the study at any time. After obtaining the participants' informed consent (see Appendix I), I sent them the journal prompt, scheduled one-on-one interviews, and formed focus groups. I kept the participants and sites for the study confidential by using pseudonyms. I stored physical and electronic data on a separate drive, with the results kept in a locked filing cabinet with password-protected electronic files. I will destroy the data after three years using a high-powered magnet.

Summary

This chapter begins with an explanation of the transcendental phenomenological research design. Next, the research questions outline the setting and participants for the study – as well as my positionality, interpretive framework, and researcher role. Further, I will include the procedures for recruitment, data collection analysis, and synthesis using interviews, journal prompts, and focus groups. Finally, there is a discussion of the study's trustworthiness with credibility, transferability, dependability, and confirmability with the ethical considerations given.

CHAPTER FOUR: FINDINGS

Overview

The purpose of this transcendental phenomenological study was to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teachers at public cyber high schools in the Northeastern United States. This study revealed that the salient themes were instructional design, online environment management, and differentiated support with timely feedback. Data was collected through a journal prompt, individual interviews, and focus groups. Data analysis used transcendental phenomenological reduction.

Participants

A total of 12 high school mathematics teachers participated in the study. All participants were employed in public cyber high schools in the Northeastern United States. The participants included one male and 11 females aged 25 to 64 years. All participants were White. Three participants were special education teachers and taught grades 9-12. Two of the three special education teachers were from Cyber High School 3, and one special education teacher was from Cyber High School 2. Eight participants were general education teachers teaching grades 9-12. Two general education teachers were from Cyber High School 1, Two general education teachers were from Cyber High School 2, and four general education teachers were from Cyber High School 3. One participant taught special and general education, grades 9-12, from Cyber High School 1. The special education teachers taught pre-algebra, algebra 1B, and algebra. The general education teachers taught pre-algebra, algebra 1A, algebra 1B, algebra, consumer math, and AP Calculus. The teaching experience ranged from three to 29 years, with at least three years of experience teaching math online.

Table 3

Teacher Participants

Teacher	Age	Number of years teaching Cyber	Content	Grade Level	General /Special Ed
Barbara	25-34	3-10	Teacher math coach	9-12	Both
Cassidy	25-34	3-10	Algebra 1A	9-10	General
Debra	35-44	11-19	Algebra	9-12	General
Alice	55-64	20-29	Pre-Algebra	9-10	General
Katerina	25-34	3-10	Algebra	9-12	General
Felicia	35-44	3-10	Pre-Algebra and Algebra	9-12	Special
Nick	35-44	11-19	Consumer Math and AP Calculus	11-12	General
Ingrid	35-44	3-10	Algebra 1B	9-12	Special
Grace	35-44	11-19	Pre-Algebra	9-10	General
Natalie	35-44	3-10	Algebra	9-12	Special
Madison	25-34	3-10	Algebra II	10-12	General
Kelly	35-44	3-10	Algebra	9-11	General

Nick

Nick taught high school math at Cyber High School 3. Nick specializes in consumer math and AP calculus. Nick became interested in teaching when he was a teacher assistant in high school. Nick enjoyed the experience and substituted for ninth-grade algebra. Nick completed his degree at university and earned a master's degree in physics to master the subject. Nick changed his focus from a college degree in flight science to physics education because physics was difficult for him in high school. Nick wanted to challenge himself by earning a physics degree. Nick’s advanced degree furthered content knowledge and teaching skills. Nick's multifaceted experiences have strengthened his subject knowledge and teaching skills. Nick does not believe that anyone is bad at math. Nick believes that students have not been adequately instructed on how to solve the problems. Nick’s various accomplishments and increased difficulty in academic achievement have bolstered Nick’s self-confidence in the virtual classroom.

Ingrid

Ingrid started with a degree in psychology. Ingrid’s degree focused on clinical psychology, particularly with adolescents. While working at a day program for therapy, she realized that special education provided a more effective means to impact students' education. This realization and introspection led to her decision to switch fields. Ingrid had to add math courses to transition from psychology to math. Ingrid’s perspective on teaching math comes from a clinical view of how a student’s brain functions and develops. This perspective allows her to analyze the challenges related to the student’s cognitive abilities. Ingrid simultaneously overcame challenges to major in math and education, giving her insights into a struggling student’s mind. A local private college provided the means to do so. Ingrid’s educational journey became a four-and-a-half-year endeavor. Ingrid currently teaches at Cyber High School 3.

Grace

Grace teaches high school math at Cyber High School 3. Grace’s career began in high school education. There, she taught remedial state testing courses, developing custom plans for each student to address individual weaknesses. This experience gave Grace information first-hand on the challenges students face and how to support weaknesses in math. Although this program was a grant-funded position for only one year, she found it highly beneficial for supporting students with and without disabilities. While at Cyber High School 3, Grace has spent the last three years teaching pre-algebra. She has also taught a wide variety of math classes. Teaching different math classes helped her recognize the pre-requisite skills needed for the current and following courses. Grace's ability to help struggling students, often working with those who have previously failed math courses, is a well-regarded talent.

Natalie

Natalie is a special education high school Algebra 1A teacher. Natalie's desire to become a math teacher began when she was a permanent substitute in a brick-and-mortar school. Natalie initially taught a third-grade class excelling in math, followed by seventh-grade foundations of math class with many special education students. These experiences gave her a new perspective on supports needed for special education students at both ends of the spectrum. Natalie also taught eighth-grade students Algebra 1 and Algebra 2, giving her the knowledge and skills needed for each course. Knowledge of these skills and experiences makes her an effective teacher in the online classroom. Natalie always enjoyed math and found it came naturally, requiring little study in high school. This natural affinity for math has guided her to her current Cyber High School 3 teaching position.

Madison

Madison earned a bachelor's degree in math from 2015 to 2019. Madison began at a brick-and-mortar school that ended in a furlough. Madison subsequently joined Cyber High School 3. The COVID-19 pandemic led to her first online teaching position. Madison began in an asynchronous online setting and transitioned to synchronous learning. Cyber High School 3 offered her a more structured environment with their support infrastructure. Madison is a very straightforward person. Madison likes data and clear lines of thought and inquiry. Madison has turned these characteristics into data-driven pathways for math instruction.

Kelly

Kelly is a trained elementary teacher who earned a degree in college. Kelly also earned a master's degree in principalship. Kelly’s Master’s degree is unique among this set of participants in the study. Kelly can see the administrative implications of incorporating cognitive load practices into her classroom instruction. Kelly expressed that she is not a math teacher. However, she has learned how to teach high school students critical thinking skills to solve problems. Kelly’s teaching experience and learning gave her a broad teaching perspective. Kelly’s experience has also provided an excellent basis for understanding student difficulty in math. Kelly currently teaches at Cyber High School 3.

Barbara

Barbara always knew she wanted to be a teacher. It was not until high school that she focused on math because she did well in math. Barbara pursued her teaching journey at university for a degree in teaching math. Barbara first taught Algebra at an inner-city school. Barbara’s next experience was a cultural shift to a rural area. Later, she switched to a cyber school, continuing to teach Algebra. Barbara has a wide range of demographic and cultural experiences that have helped her develop flexibility in teaching math to a diverse population. Barbara is currently teaching at Cyber High School 1.

Cassidy

Cassidy currently teaches Algebra mainly to ninth graders. Cassidy’s original major was Chemistry, and she subsequently switched to math. Cassidy enjoyed student teaching and obtained employment with that district, where she stayed for several years. Cassidy also participated in AmeriCorps. Cassidy has worked in student interventions for Algebra 1. Cassidy has a skill set that ranges from in-person teaching to online teaching and hands-on physical skill instruction through AmeriCorps. Cassidy's experience also includes teaching 8th grade in a school district during the pandemic year that involved rapid changes to the physical structure and methods of classroom instruction. Cassidy has become a highly adaptable and flexible educator. After this time, she switched to teaching cyber education at Cyber High School 1, where she has been for the past three years.

Debra

Debra attended college without a definite career path, enjoying dance and starting with general courses. Debra initially considered pursuing math for insurance industry purposes but ruled out an actuarial career after interning with professionals and finding the exam requirements difficult. During her senior year at college, she decided to become a teacher, completed her math degree, and obtained her teaching certificate at university. Debra began teaching at a local high school, which presented a considerable cultural contrast from her previous experiences. After a furlough, she transferred to a cyber school. There, she initially enjoyed the flexibility of online teaching but became dissatisfied with curriculum writing. Despite being laid off, she viewed it positively, which coincided with completing her master's degree. She found a teaching position at Cyber High School 1. At Cyber High School 1, she appreciates the flexibility of balancing work with family and enjoys teaching in a supportive environment, now in her fourth year there.

Alice

Alice has an extensive teaching career. Over 32 years, she began teaching in Canada, where she first taught secondary math and science. In 1998, she transitioned to teaching online in the United States, a medium she continued within various online schools. Alice may only know some of the new terms in education. However, she can adapt her approach and practice many of the concepts discussed in this study. Alice's teaching experience involves many different types of students from college-level courses to applied math for students interested in technical schools. Alice's primary focus has been teaching 10^{th} graders, but she has taught students from grades seven to 12 throughout her career. Alice has the most varied experience of the participants. Alice currently teaches at Cyber High School 2.

Katerina

Katerina decided to pursue a career in teaching while finishing high school. Katerina had initially considered elementary education but ultimately chose math based on academic strengths and guidance counselor advice. Katerina successfully pursued a four-year math degree in college and returned to her alma mater, a cyber school where she had been a student. Katerina has been teaching at this school for six years since graduating, finding fulfillment in teaching math and enjoying the continuity of working where she once studied. Katerina is always looking for new resources and supplemental material to keep her lessons exciting and engaging for her students. Katerina implements adaptive technology to assist with the content. Katerina currently teaches at Cyber High School 2.

Felicia

Felicia began her career with a bachelor's degree in psychology, working as a one-on-one aide for students with autism. Felicia enjoyed working with students with and without special needs. Felicia's interest in people and how their minds work led her to pursue a master's degree in education specializing in special education. Felicia taught various subjects, including social studies and English, at a public high school for eight years, focusing on specialized learning support for social studies and science. Felicia found working on specialized learning and remediation a good fit. Felicia incorporates many of the skills she learned in pursuit of her psychology degree to examine the needs of all types of learners effectively. In October 2020, she joined Cyber High School 2, where she initially taught learning support for Algebra 1A, followed by three years of teaching learning support for Algebra 1B.

Results

Study data revealed three main themes with two subthemes that describe the essence of educators' experiences teaching math online to students with learning disabilities. The themes that emerged from the commonalities were found in the responses to a journal prompt, individual interviews, and focus groups. Insights provided by the respondents illustrated strategies for reducing the learners' cognitive load in the classroom. Information gathered revealed approaches such as incorporating the integration of interactive, adaptive instruction, emotional learning, pacing, simplifying content, and accommodating learners while maintaining academic rigor in a virtual environment. Strategies combined contribute to developing an effective and supportive online learning environment.

The codes for the interactive and adaptive instruction subthemes combined the information on technology use and tailoring instruction. Managing online behaviors and building rapport with students in the virtual setting were combined to create the subtheme of classroom dynamics and management. Elements of the theme enhanced engagement and learning environment and appeared across all three data sources. I produced three themes from the journal. After completing the interviews, I grouped four codes from each question to create three themes and two subthemes. Each question's four codes contained the essential information. Three major themes were created, and two subthemes were created based on the four codes developed for each subtheme. The interview question themes, subthemes, and codes were then combined to create the three major themes and two subthemes encompassing all the interview questions. The next group of codes emerged from the focus group responses. I coded each focus group's responses to create three themes and three subthemes. Finally, all the themes and subthemes from all three data sets produced three overarching themes and three subthemes for the study.

Table 4

Teacher Participants

Themes	Sub-Themes
Enhanced Engagement and Learning Environment	Interactive and Adaptive Instruction
	Classroom Dynamics
Cognitive Load and Assessment Strategies	Awareness and Reduction
	Feedback and Assessment Monitoring
Supportive and Inclusive Instructional Practices	Differentiated Support
	Fostering Motivation and Positive Learning Environment

Enhanced Engagement and Learning Environment

The enhanced engagement and learning environment theme focus on strategies that include interactive and adaptive instruction, minimizing distractions, and building rapport with the students. Teachers who integrate interactive participation help to sustain engagement for the student's cognitive load. Barbara explained, "On Friday, we play Gimkit to review the skills we learned that week; this allows the students to continue practicing but have fun while doing it to help move the skills from the working memory to the long term."

Adaptive technology and individual instructional approaches tailored to the students' needs increase engagement and reduce the learner's cognitive load. Simplifying the presentation and slowing the pace by reducing the content into smaller parts optimizes learning and reduces cognitive fatigue on the learner. Offering separate tutoring sessions can also help with a student's pacing. "Having a separate session that they can attend so that they can approach [the content] at their own pace and you know you're not rushing through an entire lesson, you're covering exactly what you feel needs to be remediated," stated Madison. The theme of enhanced engagement and learning environments developed from the information on interactive and adaptive instruction, classroom dynamics, and management.

Interactive and Adaptive Instruction

Digital tools help participation and engagement. These tools can integrate videos and graphics by allowing the students to interact with the content. Fill-in-the-blank and drop-and-drag are two examples of students interacting with the content. Natalie described how she uses digital tools in the classroom, "A lot of my students actually like to annotate on my screen, and so I give them the rights to do that."

Meeting a student at their skill level reduces cognitive load. Understanding that the student may not have the prior knowledge or skill set to accomplish the task, we need to "meet them where they are, build them up so that they can take on those more advanced skills." Debra explained. Felicia recommends using a flipped classroom approach, "Giving a video for them to learn the new concept beforehand and give more time to practice problems in class" is an approach she would like to try. Katerina stated, "I'm always trying to revise and see what's the best platform for homework online and what's adaptive. And I've found that I did a lot more adaptive assignments this year than previous years, and I really liked that." Adaptive instruction allows the teacher to continuously improve and adapt the content to match students' skill levels and needs for further differentiation and scaffolding. Elements of the subtheme appeared across all three data sources 62 times for interactive instruction and 38 times for adaptive instruction. Codes were reduced to eight and were combined to create the subtheme of interactive and adaptive instruction. The codes were technology, interactive, breaking down tasks, adaptive, chunking, modeling, concept building, and increased complexity.

Classroom Dynamics and Management

Simplifying the instructional materials and providing clear, concise, structured lessons that follow the I do-we do-you do approach can scaffold the content to make learning more effective. Madison details her approach, "So, I break things down into tiny, tiny pieces so that the kids can learn it. Then, I repeat the concepts and try to tie them together so that they see how it works all together as a whole." Breaking down complex concepts into smaller steps, using examples with step-by-step models of the material, helps the learner build upon the skills to reduce their cognitive load. Nick stated, "Start with understanding a small concept and help build them up emotionally… validate what cognitive load they did put into it and go forward from there." All participants from the focus groups agreed that supporting incremental learning was one of the most effective modifications they used to reduce cognitive load.

Building on the student's prior knowledge through an activity can spark their interest and help them review and retrieve information from their long-term memory. Most participants discussed a warm-up or "Do Now" activity to address this approach. Cassidy noted, "Sometimes we have a "do now" for them to do that gets them into the content." Warm-up activities activate the learning and connect the learner to a new concept or build upon a previous skill. Madison stated, "Whenever I teach a new concept, that warm-up is reviewing material that we learned before to refresh their minds.” Warm-ups or “do now” activities help the learner recall prior knowledge to connect it to the new content.

Managing the learning environment utilizes clear presentation, visuals, and chunking of material to reduce cognitive load and aid the learner’s processing and retention of content. Minimizing the physical and digital distractions assists the learners’ focus on the content. "Present the material in a clear layout as the lesson evolves... chunking material and using clear graphics and visuals" is an example Kelly presented to reduce distractions and cognitive load on the learner. Cassidy said, “Stylistic choices are things that I try to keep very limited. I just try to make them very simple and not too over the top.” Using clear presentation, visuals, and chunking of material to manage the environment creates a quiet, focused place that establishes routines and expectations for engagement and behavior in the virtual classroom.

How the teacher presents the digital learning environment can minimize distractions and support learner focus. Removing unnecessary visuals or extra unnecessary information so the student can understand the content helps the student maintain focus and retain the information presented.

> I try to make it non-cluttered. Pretty is awesome, but my kids don't need pretty, I don't need a lot of bitmojis. I can make it clear with bullet points, step one, step two, step three, step four. And I think the kids can follow. It's not too much information for those who struggle with information overload. Debra explained.

Creating routines and consistent presentation of lessons gives the student confidence that the content will be in the designated place every time and is a tool that can help the management of the environment. As discussed by Ingrid, "Having the students be able to open up the screen for the lesson and have everything they need on the screen in the same place every time." Elements of the subtheme classroom dynamics appeared across all three data sources 11 times for classroom dynamics and 23 times for classroom management. Codes were reduced to four and combined to create classroom dynamics and management. The codes created included minimizing distractions, managing off-task behavior, natural classroom welcome, and building easier relationships.

Cognitive Load Management and Assessment Strategies

Cognitive load management and assessment strategies optimize the teaching and learning dynamic by managing the amount of content presented to students in easily absorbed amounts and structuring lessons to reduce cognitive overload, using techniques such as chunking material and streamlining instructional approaches. Teachers include pauses and brain breaks to manage cognitive fatigue. Educators adapt their delivery by adjusting the pace and difficulty of the material. Effective feedback is crucial. Immediate and specific feedback such as self-grading assignments, adaptive assignments, and detailed video explanations reinforce learning and address misconceptions rapidly. These strategies enhance the students’ ability to process information efficiently and improve performance.

Awareness and Reduction of Cognitive Load

Teachers use awareness and reduction of cognitive load strategies to improve learning efficacy by managing how content is presented to students. Understanding students’ cognitive capacity allows teachers to adjust their methods to avoid overwhelming the learner. Chunking material and simplifying delivery methods are strategies used to focus on the essential content and reduce the extraneous load on the student. Teachers can integrate pauses and brain breaks within the lesson to help students regulate their learning, process information, and manage cognitive overload. Reducing cognitive load improves comprehension and the retention of content. Engaging in the content at a deeper level helps the students' efficiency and performance.

The instructional design of a lesson is crucial to the learner's ability to understand and retain the information presented. Most participants addressed the instructional design by addressing the learner's needs. The participants understood that only essential information was needed to reduce the learners' cognitive load. "Well, I do know that less is more. When I give notes, I do bullet points. I don't do long sentences" stated Debra. The lesson design uses a specific formula to assist the student's understanding. Grace stated, "To reduce the cognitive load, I design instruction that is simplified... pulling out key concepts and problems to help learners focus on the essential content." Recognizing that teachers must only present the essential information is necessary to reduce the learners' cognitive load. Elements of the subtheme cognitive load management appeared across all three data sources ten times for awareness and reduction of cognitive load. Codes were clustered into six and combined to create awareness and reduction of cognitive load subtheme. The codes were chunking, streamlined, pausing, and adjusting information delivery.

Effective Feedback and Performance Monitoring

Timely feedback is essential to the learners' progress and understanding of a concept. Students who make the same mistake will continue to practice the mistake. Giving timely feedback with specific instructions to correct mistakes will improve the students' progress. A strategy for giving immediate feedback is to use an interactive approach. Alice explains that self-grading programs reduce the cognitive load of the learner. "Students complete an assignment that is usually self-grading... green for correct and red for incorrect." Using a program with self-grading assignments reinforces the learning immediately and guides the students' understanding of the concept taught. Timely feedback assists the student in making corrections immediately. Teachers can guide the learner in correcting mistakes and practicing the steps correctly to maximize the learning of a concept. Differentiating the supports for each learner helps the students access the information in a way they can understand and utilize to the best of their ability. Student feedback is essential for the teacher to assess the pacing and amount of material to present to the learners. Alice prefers student feedback. She says, “If things are going well, I will continue on my current path. If I find they're not grasping the material, then I revamp that concept or unit and slow down to make sure they can catch up and learn all the material.” In cooperation, the teacher and students’ feedback create a learning environment that adapts to student differentiation and cognitive load.

All participants also referred to students expressing an overload. The students may ask the teacher to slow down or repeat the steps to a problem. If students do not express their confusion, teachers use check-ins to determine if the content overwhelms the learners. Different methods of check-ins are “ask if there are any questions, or I will ask for emojis in the chat. They’re very honest,” stated Natalie. Grace will “take a pause and just say, okay, let's just let that all sink in for a minute here. And then, I'll do the stress check at that point.” Performing a stress check helps the educator adjust their pacing, allowing for repetition and review of steps in the lesson. Elements of the subtheme effective feedback and performance monitoring appeared across all three data sources - effective feedback 15 times and 12 times for performance monitoring. Codes were clustered into four and were combined to create effective feedback and performance monitoring subthemes. The codes produced were self-grading, detailed videos, attention monitoring, and formative assessment challenges (e.g., ongoing assessments that provide feedback to students and teachers about learning progress).

Supportive and Inclusive Instructional Practices

Supportive and inclusive instructional practices in the virtual classroom emphasize tailoring education to meet the diverse needs of all learners with and without disabilities. Practices that involve adjusting lessons to accommodate different learning styles and supports are effective. Strategies that include varied and inclusive teaching methods ensure that all students can engage meaningfully with the content. Additionally, educators focus on creating a positive and motivating learning environment that reduces anxiety and encourages peer support. Accommodations such as extended time for complex concepts, integration of social-emotional learning, and consistent, meaningful feedback help students navigate the learning process more effectively. These practices make the virtual classroom a welcoming space where every student feels valued and empowered to learn.

Differentiated Support for Diverse Learning Needs

Special education students with Individualized Education Plans (IEPs) have personalized, specially designed instruction that incorporates modifications and accommodations needed to be successful in the classroom. Providing differentiated supports reduces the cognitive load and accommodates the varied learning pace of the student. Teachers can apply modifications and accommodations to lessons, assignments, and assessments. Katerina suggests "Adjusting due dates on homework so that students have more time... to work in class." Madison elaborates on the accommodations to complete a project, “Where it's a multi-step task, we would break something like that down and make sure that it's very, very clear what you're being asked to do at each part of that problem.” Breaking the content down allows the teacher to scaffold the students’ steps to the final task.

Students are more engaged when the subject aligns with their interests and abilities. Providing choice options to complete assignments and projects allows for student activity and engagement. Debra stated:

> We do a lot of choice with assignments. When I would do projects, I'd get four options. One was a creative option as a project. One was a straightforward worksheet, one was a presentation or an audio, and one was a puzzle.

Integrating choice into the lesson allows learners to choose what works best. Choice also helps the learner engage in the learning. Utilizing adaptive learning technology to facilitate tailored content for individualized learning is a method Katerina uses in her classroom. Katerina uses adaptive assignments, “So, you answer five questions. If you get 'em all wrong, it's gonna keep you at the basics until you understand it. But if you get them right, it jumps you up to challenge problems.”

Teachers find ways to increase their interactions with students to increase their understanding of their needs. All participants discussed using one-on-one sessions to understand each learner’s needs and further personalize their support for instruction. Madison said, “Sitting down one-on-one with students, going through a test review, and saying, tell me how we work through this. I'm able to see the transition of those skills being used on the assessment.” Allowing the student to work out the problems in front of the teacher can relieve anxiety and permit the student to express the interventions that work for them. Working with the student one-on-one is sometimes better than small groups because “small group stuff doesn't even work for these kiddos because until you're one-on-one, they don't wanna really open up or communicate,” stated Katerina. Adaptive learning and one-on-one tutoring increase the educational support of the students. Elements of the subtheme of differentiated support and diverse learning needs appeared across all three data sources. Codes were clustered into seven and were combined to create the subtheme of differentiated support and diverse learning needs. Differentiated support and diverse learning needs appeared 15 times. The codes produced were adjustments for learning needs, inclusive, modified, supportive resources, accommodations, focus on complex concepts, and integration of SEL.

Fostering Motivation and Positive Learning Climate

Giving students a place to share their thoughts, give positive encouragement, and communicate with the families integrates social-emotional learning within the lessons to facilitate progress. Alice described her approach by saying, "If you can support them and encourage them and celebrate those small successes, then I think you'll have better results." Another aspect of social-emotional integration is engaging in conversations and encouraging the students to express the different motivational factors to personalize the learning. Cassidy relayed a strategy to encourage participation through motivation to “come to class to stay in class, and to communicate with me when it's too much. She continued, “We started putting stickers on their class kicks, and some of them really love it.” The sticker reward gave the students a sense of accomplishment and motivated them to participate and stay engaged in the lesson.

Integrating activities and breaks to support the learners’ emotional well-being and readiness to learn allows the students to engage in self-reflection and emotional regulation. One participant from the focus groups, Debra, stated, “Students by that point, halfway through our lesson, have been overwhelmed because they're learning something new… at that point, I would lose the kids. So, every day, halfway through, we take a break.” The students can come back to the lesson refreshed and ready to take on the next piece of the lesson. Elements of the subtheme appeared across all three data sources. Codes were clustered into four and combined to create the subtheme, fostering motivation and a positive learning climate. Motivational strategies appeared eight times, and encouragement and a positive learning environment appeared 17 times. The codes produced were tailoring motivational approaches, recognizing efforts, peer encouragement, and reducing anxiety.

Outlier Data and Findings

One outlier was evident in the data. This outlier did not match the responses of the other 12 participants. However, the outlying participant's expectation definition differs from the other participants. Using this participant's definition of different expectations, the other participants discussed accommodations (SDIs) and modifications. The participant finds, "Managing the cognitive load is a day-to-day shift for me. Long-term plans are impacted by what I learn as I adjust spacing and revise during reflection." Katerina stated. Katerina's perspective shows the daily management of cognitive load in teaching online. Teachers need to continuously use reflection and adapt the content to meet the learner's needs.

Different Expectation

One participant in the study discussed having a different expectation or product from students that requires a reduced cognitive load. If the student requires "reduced cognitive load," the participant teaches "the same material but expects a different product," stated Katerina. She further maintains that the different product is "a reduction in length or reduced questions to show mastery." Katerina uses adaptive questions that become more difficult with each correct answer. Therefore, Katerina states, "By reducing the amount of questions required, I ensure that the cognitive load assigned measures up to what a student can handle." Using this participant's definition of different expectations shows an outlier in the findings.

Research Question Responses

This research investigates the lived experiences of cyber high school teachers and aims to identify effective instructional practices used in the classroom to support learners with disabilities in math computation and problem-solving. This study is using the framework of cognitive load theory. Cognitive load theory examines the mental effort required to process and retain information for optimal learning. This research explores the perspectives and strategies of cyber high school teachers to find effective instructional practices used in the classroom to address students with learning disabilities. The research questions guiding this study aim to understand the lived experiences of online teachers who support students with math disabilities.

Central Research Question

What is the lived experience of 9-12th-grade online mathematics teachers supporting students with differing learning abilities in math computation and problem-solving? The participants' perspective is that supporting students with different learning abilities in math computation and problem-solving comes down to chunking content, connecting prior knowledge, slowing the pace, reducing content, building upon skills with frequent review, tailoring the instruction to meet the learner's needs, and positive encouragement. Grace explained how she helps struggling students:

> Sometimes, I'll split [the lesson] into two, and I'll have 20 minutes of just remediation for students that are struggling in a small group, and then the other 20 minutes, I used to work with the students that are on track.

Repetition is one method to review content many times. Ingrid stated, "Reiterating that over and over in the lesson that I'm teaching, they hear it more often, they're more likely to recall it." Nine participants agreed that the curriculum needs to cover less content during their course. Therefore, "I think if we had vertical communication with the" … teachers before and after our course… "to figure out where our curriculums are crossing over, we can get rid of a lot of this stuff that is totally unnecessary… There's too much [material] for the sake of covering," stated Madison.

However, several teachers mentioned encouragement for the students. "Positive encouragement all the time is really what helps when I'm teaching," said Natalie. Peer-to-peer encouragement allows learners to feel comfortable learning the content because they see others struggling and encouraging them. Natalie stated, "Encouraging the students to encourage other students, it does actually work." Finally, Nick gave his perspective on understanding math. "I hate the phrase, I'm bad at math. I think that we have different levels of understanding, and that's fine. But when you get the perception that you are bad at something, you will not seek opportunities to overcome it." Alice believes, "I just think the key is to convey to the students that they can do math because a lot of these students think they can't." The methods described above show how teachers support students with different learning abilities in the online classroom.

Sub-Question One

How do cyber teachers use universal design instruction, strategies, and methods when assessing students with a math disability? All participants noted that they begin a lesson with a warm-up or "do now" activity to activate the learners' prior knowledge. Cassidy explained, "When planning those lessons/notes, we always include a 'do now' activity that recalls prior information to help us with the new lesson." Using a learner's prior knowledge helps to reduce the cognitive load by connecting new information with existing information. Another teacher, Katerina, explains how she uses UDL. "I use UDL; everybody gets these resources because everybody can benefit. And often the kids who don't have, IEPs, they can use them just as much. That's what I do. Offer them all the resources, and then they can use it as needed."

Sub-Question Two

What are the experiences of 9 - 12 grade online mathematics teachers using universal design instruction when assessing students who have a disability in the area of math? The participants discussed several approaches. Cassidy refers to breaking lessons down into smaller segments, "I have just part 1; I think that that's a huge blessing for our students because we are able to break down the lessons a lot, and we tend to not throw any new information in more than once a day." Most teachers always use warm-ups and technology to give the students immediate feedback. "I have a warm-up, then I have a teaching session, and then I try to do an assignment to reinforce the concepts… with assignments that are self-grading... then the kids get instant feedback so that they learn that material," Debra explained. Three of the 12 participants specifically mentioned spiraling or going back to previous content to review that concept before beginning the new information. Barbara said:

> It's too much. Going back and reminding them, hey, this is how this connects to multiplying fractions, making sure to go back and review what they do know and what they feel comfortable with and then working them back up again.

Madison stated, "If we start seeing a decline in the ability to process new information, sometimes that's a good time to do a spiral review, to go back to old stuff because that gets their confidence up a little bit." The students think, "Oh, this stuff I do remember how to do." Teachers understand that "...kids can't handle anymore past this level of question. We're gonna save that for tomorrow. Let's spiral back to this other question from earlier in class." Noted Katerina.

Sub-Question Three

How do ninth – twelfth-grade mathematics teachers determine the appropriate amount of content related to the cognitive load of mathematical computation and problem-solving when providing practice activities for students with a math-related disability? Grace stated, "To reduce the cognitive load, I design instruction that is simplified... pulling out key concepts and problems to help learners focus on the essential content." Ingrid explained, “I try to keep the content to 2 or 3 related skills at one time." Presenting manageable chunks (increments) of information at one time helps to reduce cognitive load. “The way you scaffold and break down problems and the way you choose what warm-up problems you're gonna do can help with that because it can help you identify what foundational skills the student might be lacking,” said Cassidy. Scaffolding the lesson helps the teacher determine when the students are struggling with the content and where to modify the lesson. Modifying the lesson is a tool to manage the amount of information to present at one time. Kelly explained, “I do modify everything. I look at it through a set of eyes: What are my students going to see when they see this? Are they going to understand this? Is this gonna be way above them? Everything needs to be translated to the level they’re at.” Scaffolding the lesson’s steps, reducing the content to one or two concepts, and viewing the modifications through the student’s perspective help educators determine the appropriate amount of information to present at one time.

Summary

Teachers use warm-ups and “do now” activities to build on the students' prior knowledge. Digital tools like annotation and interactive activities increase engagement and help reduce cognitive load. Teachers use a structured approach to break down complex concepts into smaller, simplified steps. Minimizing distractions and providing a clear, structured presentation assists the retention of information. Meeting students at their skill level and continuously adapting instruction based on feedback helps reduce cognitive load. Students are more engaged when teachers align subjects with their interests and provide choice options compared to when subjects and choices do not reflect their interests. Adaptive learning technology tailors content to individual student needs. One participant, Katerina, had a different expectation for managing cognitive load by reducing the number of questions required for mastery, showing an outlier in the findings.

CHAPTER FIVE: CONCLUSION

Overview

The purpose of this transcendental phenomenological study was to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teachers at cyber high schools in the Northeastern United States. Educators from three cyber high schools shared their experiences teaching math online to students with learning disabilities in math computation and problem-solving through a journal prompt, individual interviews, and focus groups. This chapter includes a critical discussion of the findings from the data, implications for policy and practice based on existing literature and theory, theoretical and empirical implications, the limitations and delimitations of the research, and recommendations for future research.

Discussion

After researching the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving in public cyber high schools, three major themes emerged from the results of the journal prompt, interviews, and focus groups of the study. These themes include the effectiveness of different support levels in improving students' math skills and the role of technology in enhancing learning. The findings echo the current literature on educators' experiences teaching math to high school cyber students with math computation and problem-solving disabilities. The results also reflect the cognitive load theory of John Sweller (2020).

Critical Discussion

This study gave me a sense of how teachers view cognitive load online. In my experience, teachers have used most of the methodology presented and discussed. The commonality is that they all interpreted it differently. The results of the story bore this out. Across the different institutions, educators have a sense of using cognitive load. All saw a need to adjust to their students' best learning pace and style. There is a lack of standards for assessing and implementing appropriate student cognitive loads.

Further, the use of assistive technology is in its infancy. Teachers can use many combinations of technology to assess students and for teachers to use during instruction. Different levels of supports for teaching math to high school cyber students with math computation and problem-solving disabilities benefit students and ensure success in the virtual classroom. This study captured the essence of teachers' experiences, grounded in Sweller's cognitive load theory (1988), which states that students should not be overloaded with information beyond their processing capacity. Teachers commonly used strategies such as developing instructional design, managing of the virtual environment, and providing immediate feedback and differentiated support. The findings highlighted how teachers strategically determined the amount of information to present in each lesson. Teachers focused on essential content, eliminating extraneous information to reduce cognitive load and optimize student understanding. Successful techniques such as repetition, scaffolding, and pacing adjustments were essential in helping students process information more efficiently and store it in long-term memory, aligning with cognitive load theory principles.

The study also underscored the importance of personalized instructional strategies, adaptive technology integration, and differentiated support. Personalized learning, crucial for students with math disabilities, involves adapting lesson plans and pacing, reducing content, and offering one-on-one tutoring, positively impacting student outcomes (K. Xu et al., 2021). Adaptive learning tools enhance engagement and self-regulation, with learning management systems allowing teachers to track progress and adjust instruction accordingly (L. R. De Bruin, 2019).

Differentiation helped manage diverse learning needs, fostering an inclusive environment through group work, peer support, and individualized learning, enhancing academic and social-emotional outcomes (Wullschleger et al., 2023; Zacharopoulos et al., 2021). Sweller's framework guided instructional design to reduce cognitive load, emphasizing the presentation of essential information and the continuous adjustment of teaching strategies based on student feedback (Sweller et al., 2019; Smets et al., 2022; Putra, 2023; A. DeBoer & Kuijper, 2021). These findings contribute significantly to understanding effective online mathematics instruction for students with disabilities.

Participants may not have explicitly identified with cognitive load theory or universal design for learning (UDL); they inherently used techniques to reduce cognitive load. The lack of uniform understanding and application of these concepts among educators highlighted the need for further professional development in online mathematics education. Teachers also employed differentiated support strategies to build on students' previous skills, integrating real-world applications, independent practice, reflection, and feedback. The study's findings contribute to the body of knowledge by exploring the lived experiences of educators and their methods for supporting high school students with math disabilities in a virtual learning environment, extending Sweller's cognitive load theory (1988) into the realm of online education.

Summary of Thematic Findings

After creating relevant codes from the three data mediums for three schools, I synthesized these codes into three themes about the supports for teaching math to high school cyber students with math computation and problem-solving disabilities. The three themes that emerged were the development of instructional design, management of the virtual environment, and the use of immediate feedback and differentiated support. These themes led to the essence of teachers' experiences using various supports to assist high school cyber students with math computation and problem-solving disabilities. The cognitive load theory (Sweller, 1988), which states that students should not be overloaded with more information than they can process to store in long-term memory, roots the findings. Teachers determine the amount of information to teach for each lesson. The lesson's design is developed based on the relationship between the content and the essential information needed to complete the topic's tasks. When teaching a lesson, educators determine how much information to display, how to present it, and what the student's cognitive load needs to be to accomplish the objective. When considering students with disabilities, teachers may revamp the lesson by focusing on essential information and removing extraneous content. Teachers constantly assess whether they are breaking down the information adequately or adjusting the pace effectively to reduce the cognitive load on the learners for optimal understanding. Techniques such as repetition and scaffolding help reduce the student's cognitive load.

Additionally, teachers have developed strategies to minimize distractions in the virtual environment. The strategies include:

- using plain backgrounds
- no filters during Zoom sessions
- limiting the amount of information displayed on the screen at one time, and
- focusing on only one section of the screen during instruction.

Results of this study showed that participants may not know what cognitive load or cognitive load theory (Sweller, 1988) is; however, they are using techniques to reduce the load on the learner. An element revealed in the study was that the participants did not have the same understanding or definition of concepts such as universal design for learning (UDL), cognitive load, and modifying content. Lack of understanding of the definitions of concepts highlights the need for further professional development in online mathematics education for students with disabilities. The terminology is not universally applied or understood. The participants use differentiated support strategies to build upon previous skills related to real-world applications, independent practice, reflection, and feedback.

Results of this study discovered thematic findings that illustrated the lived experiences of educators using personalized instructional strategies, technology using adaptive learning, and the development of instructional design strategies and approaches to reduce the cognitive load on the learner. Teachers must constantly work on the amount of information, pacing, and curriculum constraints to deliver a lesson that does not overwhelm the learners' cognitive load. The educators discussed the supports and methods they use to conquer cognitive overload in virtual classrooms.

The findings of this study add to the body of knowledge and the theoretical framework of John Sweller (1988). Previous research explained methods developed to reduce a learner's cognitive load. However, little research has involved the experiences of educators using methods in a cyber classroom at the high school level. Findings from this study discuss the educators' experiences providing various supports when teaching math virtually to students with math disabilities.

Personalized Instructional Strategies

Teachers in this study emphasized the importance of tailoring their instructional approaches to meet the needs of each student. This personalized learning in math is crucial for students with disabilities in math. Incorporating personalized learning helps teachers address the specific challenges and strengths of the learner (K. Xu et al., 2021). Individualized support provides targeted assistance that can positively impact student learning outcomes. Examples include adapting lesson plans, adjusting the pace of the lesson, reducing content, and offering one-on-one tutoring sessions. These examples of support help improve mathematical skills and boost students' confidence and engagement.

Integration of Technology with Adaptive Learning

The integration of technology, particularly adaptive learning tools, plays a vital role in facilitating effective online mathematics education for students with disabilities. In this study, teachers used interactive activities and adaptive tools to enhance learning in a virtual classroom. This approach increased learner engagement and gave students more control over their learning in the educational process and more leverage in reflection and self-regulation (L. R. De Bruin, 2019). Various learning management systems also permitted teachers to track progress and adjust instructional approaches, demonstrating the practical applications of technology in reducing cognitive load.

The Empowerment of Differentiation

Differentiation is an essential technique teachers use to manage the diverse learning needs within their classrooms. Instructional methods and materials allow teachers to create an inclusive learning environment for different learning styles and paces (Zacharopoulos et al., 2021). Teachers can combine group work, peer support, and individualized learning to promote collaboration among educators and students. Collaboration enhances academic achievement and promotes social and emotional learning (Wullschleger et al., 2023).

Instructional Design and Cognitive Load

Sweller’s (2020) framework highlights the development of lessons that reduce the cognitive load on the learner. Teachers present only the essential information with no distracting material that takes away from the learning to reduce the learners’ cognitive load. Cognitive load theory accounts for the brain processes of learning information and how learning is impaired when overloading the learner's capacity (Sweller et al., 2019). Instructional practices that recognize the cognitive capacity of the individual learners’ strengths and weaknesses are powerful tools for instructors (Smets et al., 2022). Feedback from the students allows the educators to continuously adjust the rates of delivery and redelivery (Putra, 2023). In addition, understanding and managing cognitive load is critical to creating effective online learning. Teachers must weigh the content’s complexity against the students’cognition, ensuring that instruction is challenging and attainable (DeBoer & Kuijper, 2021). The focus on these themes permits teachers to create a supportive and inclusive virtual learning environment. Attention to cognitive load fosters academic success and personal growth for all students.

Implications for Policy and Practice

This study reveals the need for teachers to use personalized learning strategies for students by enhancing engagement through interactive and adaptive instruction, reducing cognitive load, developing assessment strategies, and using supportive, inclusive instructional practices. Policies should focus on implementing differentiated instruction and incorporating interactive and adaptive learning environments. Professional development is needed for educators to concentrate on cognitive load theory to support the needs of all learners effectively.

Furthermore, integrating social-emotional learning activities and structured breaks can improve the students’ stress levels and cognitive load. Teachers who establish consistent routines and manage the emotional and cognitive needs of the learner foster a supportive and inclusive classroom. Integrating feedback and reflection from the teacher and students improves instruction to tailor strategies based on the student's progress and diverse needs. Implementing these policies and practices can create a more dynamic and responsive education for all learners in the virtual classroom.

Implications for Policy

Educational technology advances and personalized learning have created opportunities. This opportunity allows policymakers to put forth standard definitions for classroom practices. It is clear from participant responses that there needs to be a universal understanding of cognitive load, universal design for learning, accommodations, and modifications. In addition, the terminology is also not universally understood to mean the same thing. Standard practice and recognition of terminology are valuable for the successful implementation of instruction based on cognitive load theory.

Personalizing and tailoring instructional strategies based on the students' needs helps the educator meet the needs of general and special education students with disabilities in the classroom. Educational policies should mandate the implementation of individualized learning plans emphasizing technological integration. Such measures can create more inclusive learning environments that accommodate diverse learning styles and reduce cognitive load. Additionally, schools should provide ongoing professional development for teachers, focusing on cognitive load theory principles and effective differentiation techniques to effectively support students' varying needs. Schools should invest in training educators to utilize these techniques effectively and provide the necessary technological resources to support their implementation. Additionally, regularly integrating feedback and reflection practices into the teaching process allows educators to adjust their strategies based on student needs and progress. By adopting these policies, schools can create a more dynamic and responsive educational system that supports the development of all students.

Implications for Practice

Students are more engaged when the teacher provides students with choices for assignments and projects than they are not offered choices. Learners are also more engaged when topics appeal to their interests and abilities when provided with topics that reflect their interests and abilities. Adaptive learning and interactive activities that integrate social-emotional learning create an atmosphere that facilitates individualized learning, support, and rapport. Activities and brain breaks are vital for reducing stress and cognitive load. Educators who establish routines and expectations for the virtual learning environment create structured support for academic success, a positive environment, and an inclusive school culture. Instructional methods that include interactive activities and adaptive learning enhance student engagement and reduce cognitive load. Professional development for educators to learn techniques to engage the learner, incorporating brain breaks and social-emotional learning, should be taught and supported through policy and practice.

Empirical and Theoretical Implications

The theoretical findings of this study indicate that cognitive load theory (Sweller, 1988) is foundational for teachers to develop curriculum and lessons. The three themes of this study are enhanced engagement and learning environment, management of cognitive load and assessment strategies, and supportive and inclusive instructional practices. The study supports the literature and theoretical framework of cognitive load theory. Examination of the available literature showed the following comparisons. Sweller et al. (2019) maintain that demands on working memory and processing impact learning. Reducing cognitive load through tailored instruction and strategies that reduce cognitive load improves a leaner’s retention and the ability to apply the knowledge learned (Shearer et al., 2021; Sweller et al., 2019).

This study expands upon the literature that instructional design minimizes extraneous cognitive load and maximizes germane cognitive load (Pozas et al., 2020). Works by Paas and Van Merriënboer (2020) and Tindall-Ford et al. (2019) support approaches such as explicit instruction, differentiated instruction, and scaffolding as reliable strategies for reducing cognitive load. Sweller (2020) discussed that cognitive load theory emphasizes working memory's limited capacity. The study confirms that instructional methods focusing on reducing cognitive load through chunking, breaking down information into smaller parts, visual aids, and modeling are critical for all learners’ success (Paas & Van Merriënboer, 2020; Sepp et al., 2019). Differentiated instruction that focuses on the individual learning capacities of the students is beneficial for all stakeholders. Differentiated instruction aligns with the study’s findings that personalized learning and integration of interactive and adaptive methods enhance learning and the online experience for students with learning disabilities (Goddard et al., 2019; Pozas et al., 2020). In addition, social-emotional learning is critical in reducing stress and cognitive load. Social-emotional learning that is part of the curriculum enhances engagement and retention. Studies emphasizing incorporating social-emotional learning for emotional well-being and inclusive classrooms corroborate the extant literature (Ginns & Leppink, 2019; Sweller et al., 2019).

The literature also recognizes the importance of working memory and processing speed in cognitive load management. Working memory and processing speed deficits are significant barriers for students with learning disabilities (Chieffo et al., 2023; Sweller, 2020). The data collected in this study confirms that working memory and processing speed are barriers to learning. Feedback loops and tailored instruction are strategies supported by the literature and are consistent with cognitive load theory principles (Shearer et al., 2021). Multi-media and interactive activities are effective management tools in the online learning environment (Mayer, 2019). The study findings support and extend the existing literature in interviews and focus groups.

In contrast, cognitive load theory applies to all learners; the literature does not always specifically address students with disabilities. This theme extends cognitive load theory to strategies for special education (Biwer et al., 2020; Sweller et al., 2019). Providing additional insight into how educators can apply cognitive load theory in collaborative teaching environments offers a novel contribution to the literature. Traditional cognitive load theory research does not extensively cover real-time assessment tools such as adaptive assignments and self-graded assessments. Innovative approaches to monitoring cognitive load in the online environment are also applied to cognitive load theory research (Mayer, 2019; Peltier et al., 2023).

Previous research has supported the idea that teaching in a virtual setting comes with many challenges. The study extends and validates previous research in this field. However, teachers interviewed believe they are more effective online (Ashman et al., 2019). The findings of this study support the importance of training and resources for educators to implement cognitive load principles in online classroom settings (Mayer, 2019; Peltier et al., 2023). Finally, this study illustrates that co-teaching and collaboration between general and special education teachers is important. However, the effectiveness of the approaches depends on the teachers' pedagogical knowledge and efficacy (Marschall, 2023; Peltier et al., 2023). Continued professional development in collaboration and competencies for reducing cognitive load in the classroom is vital for a successful online classroom.

Limitations and Delimitations

In this phenomenological study, the participants were limited to 9 – 12th-grade math educators of at least three years who virtually teach math, using varied supports to students with math computation and problem-solving disabilities in the Northeastern United States. The study included three cyber high schools. Three schools responded positively, allowing the study to proceed. Two schools presented the study to their faculty, instructing interested teachers to contact me to continue the process. The third school allowed me to contact potential participants personally. Four potential participants from the first school completed the demographic survey. I eliminated one participant due to insufficient experience teaching in a cyber setting. Three teachers agreed to move on in the study. Three teachers from the second school agreed to participate, and six from the third high school agreed.

Limitations

Three limitations of this study were evident: people and institutions willing to participate in the study, the demographic population of the volunteers, and the geographical constraints. I contacted five institutions to complete the study, and three cyber high schools replied. A study with more participants would provide a thicker, richer description of the phenomena studied. The volunteer population was limited to one male and eleven female participants, all White. A more diverse population of educators would offer a broader viewpoint. The study's geographical area was limited to the Northeastern United States. Participants from a larger area would produce more information. Therefore, this study was limited in the depth and breadth of experiences about teaching math to students with math computation and problem-solving disabilities.

Delimitations

The delimitations of this study were limited to cyber high school math teachers, the small sample size, the exclusion of inexperienced teachers, and the theoretical focus on cognitive load. Due to familiarity with the subject, I selected cyber high school math teachers for the study. The number of respondents limited the small sample size. I excluded inexperienced teachers because they needed to become familiar with their institutions learning management systems and gain experience teaching online. I chose the cognitive load theory as the basis of my study based on my experiences with students' ability to process information.

Recommendations for Future Research

Future uses for cognitive load theory (Sweller, 1988) research include adaptive learning technology to increase engagement and retention, integration of UDL practices, and professional development for educators in understanding cognitive load and its role in effective online instruction. Instructional strategies that incorporate these methods are essential to all stakeholders in increasing the recognition and use of cognitive load in the online learning environment. New assistive technologies offer support for diverse learners. Assistive technology is used online to ensure access to all learners with disabilities, giving the learner an equal playing field for academic success (Ayon & Dillon, 2021).

Additional future research recommendations include completing the study at cyber high schools to include a greater variety of schools with a more diverse representation of teachers in other areas of the United States. Future research would include more specificity in methodology for determining cognitive load. Applied and mixed-methods research could reveal different views and practices used for students with disabilities in a virtual classroom. Conducting quantitative research would provide further insight into the effective and ineffective approaches and strategies used in the classroom. The findings also highlight the need for professional development to stay up to date with the latest instructional strategies and technological advances. Designing effective online instruction requires understanding and managing learners' cognitive load. Teachers need to balance instructional content with their students' cognitive capacities, ensuring learning is both challenging and attainable.

Conclusion

Students with learning disabilities have working memory and processing deficiencies. These deficits contribute to challenges in the understanding of mathematical concepts (Paas & Van Merriënboer, 2020). This transcendental phenomenological study describes the lived experiences of educators using various methods of support to teach math online to students with math computation and problem-solving disabilities in public cyber high schools. Cognitive load theory helps to determine the effectiveness of teaching practices and interventions (Sweller, 2020). Managing individualized educational environments benefits learners using differentiation and adaptive learning (Alstete et al., 2021). Successful application depends on the teachers' understanding of cognitive load (Kazmi et al., 2023). Teachers reduce cognitive load using various methods of instruction. Assessing students' skill levels and adapting lessons based on feedback is critical. Adaptive learning technology, along with tailored instruction, addresses cognitive load. Teachers often lack the resources or knowledge to determine the appropriate amount of material to present. This study uses journal prompts, interviews, and focus groups to explore the experiences of educators teaching math to students with learning disabilities in math computation and problem-solving. Effective strategies include explicit instruction, modeling, pacing, and chunking material (Mayer, 2019). Understanding cognitive processing limits allows educators to design lessons that remove unnecessary content (Smets et al., 2022). Three major themes emerged from this study: effective instructional strategies, management of the learning environment, and the need for immediate feedback and differentiated support to reduce cognitive load. The study highlights the importance of integrating effective cognitive load instruction into practice.

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Appendix A

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

April 19, 2024

LeeAnn McCullough
Mary Strickland

Re: IRB Exemption - IRB-FY23-24-1429 EXAMINING THE LIVED EXPERIENCES OF EDUCATORS VIRTUALLY TEACHING MATH TO STUDENTS WITH DISABILITIES: A TRANSCENDENTAL PHENOMENOLOGICAL STUDY

Dear LeeAnn McCullough, Mary Strickland,

The Liberty University Institutional Review Board (IRB) has reviewed your application per the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data-safeguarding methods described in your IRB application, and no further IRB oversight is required.

Your study falls under the following exemption category, which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:104(d):

Category 2.(iii). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by §46.111(a)(7).

For a PDF of your exemption letter, click on your study number in the My Studies card on your Cayuse dashboard. Next, click the Submissions bar beside the Study Details bar on the Study Details page. Finally, click Initial under Submission Type and choose the Letters tab toward the bottom of the Submission Details page. Your information sheet and final versions of your study documents, **which you must use to conduct your study,** can also be found on the same page under the Attachments tab.

This exemption only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued exemption status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this exemption or need assistance in determining whether possible modifications to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,
G. Michele Baker, PhD, CIP
Administrative Chair
Research Ethics Office

Appendix B

Permission Request Letter

Dear [redacted]

As a graduate student in the Doctoral Education Department/School of Special Education at Liberty University, I am conducting research as part of the requirements for a Doctor of Philosophy Degree in Special Education. The title of my research project is Examining the Lived Experiences of Educators Virtually Teaching Math to Students with Disabilities: A Transcendental Phenomenological Study. The purpose of my research is to describe the lived experiences of educators using different levels of support for teaching math to students with learning disabilities in math computation and math problem-solving for teachers at public cyber high school in the Northeastern United States. This qualitative study will examine the teacher's lived experiences from the view point of Sweller's (1988) cognitive load theory, a framework for understanding schemas that drive the retrieval of knowledge to extend the working memory of students (Loveless, 2022). The information gained will add to the body of literature available to enhance instructional practices.

I am writing to request your permission to obtain emails and contact high school math teachers at [redacted] to invite math teachers to participate in my research study. Participants will be asked to complete a survey and to contact me to schedule an interview. The data will be used to compare the lived experiences of the general and special educators to find patterns of best practices in instructional approaches for students with working memory deficits. Participants will be presented with informed consent information prior to participating. Taking part in this study is completely voluntary, and participants are welcome to discontinue participation at any time.

The results of the study will be given to your office and all information remains confidential. For education research, school/district permission should be on approved letterhead with the appropriate signature(s). Thank you for considering my request. If you choose to grant permission, respond by email to lmccullough9@liberty.edu. A permission letter response document is attached for your convenience.

Sincerely,

LeeAnn McCullough
Doctoral Candidate of Liberty University

Appendix C

Permission Response

[redacted]

Dear LeeAnn McCullough,

After careful review of your research proposal entitled Examining the Lived Experiences of Educators Virtually Teaching Math to Students with Disabilities: A Transcendental Phenomenological Study. We have decided to grant you permission to contact our faculty/staff/other and invite them to participate in your study.

Check the following boxes, as applicable:

☒ I/We grant permission for LeeAnn McCullough to contact faculty that teach math to students in nine – twelfth grades to invite them to participate in her research study.

☒ I/We are requesting a copy of the results upon study completion and/or publication.

Sincerely,

[redacted]

1/26/2024

Dear LeeAnn McCullough

After careful review of your research proposal entitled Examining the Lived Experiences of Educators Virtually Teaching Math to Students with Disabilities: A Transcendental Phenomenological Study. We have decided to grant you permission to contact our faculty/staff/other and invite them to participate in your study.

Check the following boxes, as applicable:

☑ I/We grant permission for LeeAnn McCullough to contact faculty that teach math to students in nine – twelfth grades to invite them to participate in her research study.

☐ I/We are requesting a copy of the results upon study completion and/or publication.

Sincerely,

[redacted]

3/18/2024

[redacted]

Dear LeeAnn McCullough

After careful review of your research proposal entitled Examining the Lived Experiences of Educators Virtually Teaching Math to Students with Disabilities: A Transcendental Phenomenological Study. We have decided to grant you permission to contact our faculty/staff/other and invite them to participate in your study.

Check the following boxes, as applicable:

☑ I/We grant permission for LeeAnn McCullough to contact faculty that teach math to students in nine – twelfth grades to invite them to participate in her research study.

☑ I/We are requesting a copy of the results upon study completion and/or publication.

Sincerely,

[redacted]

Appendix D

Recruitment Letter/Email

Dear Potential Participant,

As a doctoral candidate in the School of Education, at Liberty University, I am conducting research Examining the Lived Experiences of Educators Virtually Teaching Math to Students with Disabilities: A Transcendental Phenomenological Study as part of the requirements for a Philosophy degree in Education. The purpose of my research is to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teachers at public cyber high schools in the Northeastern United States. This qualitative study will examine the teacher's lived experiences from the viewpoint of Sweller's cognitive load theory, a framework for understanding schemas that drive knowledge retrieval to extend students' working memory. I am writing to invite you to join my study.

Participants must be a high school educator teaching math for at least three years in a cyber school. Participants will be asked to complete a survey, a journal prompt, take part in a one-on-one, audio-recorded / video recorded interview and focus group. It should take approximately 2.5 hours to complete the procedures listed. Participation will be completely confidential, and no personal, identifying information will be collected.

To participate please click here to online survey to complete the attached survey and return it by email to [redacted]

If you meet the study criteria, a consent document will be emailed to you. The consent document contains additional information about my research.

If you choose to participate, you will need to sign the consent document and return it to me via email at the beginning of the study. I will contact you to schedule an interview.

Participants will receive a $25.00 Amazon gift card. All participants will be entered in a raffle to receive an Amazon gift card of $100.00.

Sincerely,

LeeAnn McCullough
Doctoral Candidate
[redacted]

Appendix E

Demographic Survey for Potential Participants

This survey will provide maximum variation sampling for the research study. Forms will be destroyed after participants are chosen. Please circle the appropriate categories.

1. Age: What is your age?
   • 21-25 years old
   • 25-34 years old
   • 35-44 years old
   • 45-54 years old
   •55-64 years old
   •65-74 years old
   •75 years or older
   •Prefer not to answer

2. Gender: Please specify your gender.
   • Female
   • Male
   • Prefer not to answer

3. Ethnic origin: Please specify your ethnicity. Check all that apply.
   • Asian / Pacific Islander
   • Black or African American
   • Hispanic/Latino
   • Native American or American Indian
   • White
   • Other
   •Prefer not to answer

4. Current grade teaching: What grade are you teaching now? Circle all that apply.
   • 9 • 10 • 11 • 12

5. Current course teaching:
   • Pre-Algebra
   • Algebra
   • Geometry
   • Trigonometry
   • Pre-Calculus
   • Calculus
   • Consumer Math
   • Statistics
   • Other: _____________

6. Number of years teaching Math:
   • 3 - 10
   • 11 - 19
   • 20 - 29
   • 30 - 35
   • 36+

7. Current course designation:
   • General Education
   • Special Education

Appendix F

Recruitment Follow up Letter/Email

Dear [Potential Participant/Parents/Student/etc.],

As a doctoral candidate in the School of Education, at Liberty University, I am conducting research as part of the requirements for a Philosophy degree in Special Education [Last week/two weeks ago/etc.] an email was sent to you inviting you to participate in a research study. This follow-up email is being sent to remind you to complete the survey and return to me via email if you would like to participate. The deadline for participation is [Date].

Participants must be a high school educator teaching math for at least three years in a cyber school. Participants will be asked to complete a survey, a journal prompt, take part in a one-on-one, audio-recorded / video recorded interview and focus group. It should take approximately 2.5 hours to complete the procedures listed. Participation will be completely confidential, and no personal, identifying information will be collected.

To participate please click here to online survey to complete the attached survey and return it by email to [redacted]

If you meet the study criteria, a consent document will be emailed to you. The consent document contains additional information about my research.

If you choose to participate, you will need to sign the consent document and return it to me via email at the beginning of the study. I will contact you to schedule an interview.

Participants will receive a $25.00 Amazon gift card. All participants will be entered in a raffle to receive an Amazon gift card of $100.00.

Sincerely,

LeeAnn McCullough
Doctoral Candidate
[redacted]

Appendix G

Nonacceptance/Dropped from Study Letter

Dear Potential Candidate,

Thank you for your interest in participating in my study. Unfortunately, (you do not meet the criteria listed to participate in my study / you have not returned the appropriate document to participate in my study).

If you would still like to participate, please call or email me at: [redacted]

Thank you for time,

LeeAnn McCullough
Doctoral Candidate
[redacted]

Appendix H

Consent

Title of the Project: Examining the Lived Experiences of Educators Virtually Teaching Math to Students with Disabilities: A Transcendental Phenomenological Study.

Principal Investigator: LeeAnn McCullough, Doctoral Candidate, School of Education, Liberty University

Invitation to be Part of a Research Study

You are invited to participate in a research study. To participate, you must be a high school teacher with three years' experience in teaching online. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to take part in this research.

What is the study about and why is it being done?

The purpose of the study is: A transcendental phenomenological study is to describe the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teachers at public cyber high schools in the Northeastern United States.

What will happen if you take part in this study?

If you agree to be in this study, I will ask you to do the following:

1. Complete a journal prompt that will not take more than 30 minutes.
2. Participate in Teams, audio-recorded interview that will take no more than 1 hour.
3. Participate in Teams, audio-recorded focus group that will take no more than 1 hour.

How could you or others benefit from this study?

The direct benefits participants should expect to receive from taking part in this study include an understanding of the lived experiences of educators using different levels of support for teaching math online to students with learning disabilities in math computation and problem-solving for teachers at public cyber high schools in the Northeastern United States.

Benefits to society include:
1. The information gained will add to the body of literature available to enhance instructional practices.
2. The research addresses cognitive load for learners of different abilities and illicit responses that could reveal a framework for quantifying appropriate cognitive load and potentially best practices.

What risks might you experience from being in this study?

The expected risks from participating in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

How will personal information be protected?

The records of this study will be kept private. Published reports will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records.

- Participant responses will be kept confidential by replacing names with pseudonyms.
- Interviews will be conducted in Teams in a location where others will not easily overhear the conversation.
- Confidentiality cannot be guaranteed in focus group settings. While discouraged, other members of the focus group may share what was discussed with persons outside of the group.
- Data will be stored on a password-locked computer. After three years, all electronic records will be deleted and all hardcopy records will be shredded.
- Recordings will be stored on a password locked computer for three years and then deleted/erased. The researcher and members of her doctoral committee will have access to these recordings.

How will you be compensated for being part of the study?

Participants will be compensated for participating in this study. At the conclusion of the study participants will receive a $ 25.00 Amazon gift card/and will be entered into a raffle for one participant to receive a $100.00 Amazon gift card. Any participant who chooses to withdraw from the study after beginning but before completing all study procedures will receive a $ 10 Amazon gift card. Email and physical addresses will be requested for compensation purposes; however, they will be pulled and separated from your responses at the conclusion of the survey to maintain your anonymity.

What are the costs to you to be part of the study?

None

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether to participate will not affect your current or future relations with Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time.

What should you do if you decide to withdraw from the study?

If you choose to withdraw from the study, please contact the researcher at the email address/phone number included in the next paragraph. Should you choose to withdraw, data collected from you, apart from focus group data, will be destroyed immediately and will not be included in this study. Focus group data will not be destroyed, but your contributions to the focus group will not be included in the study if you choose to withdraw.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is LeeAnn McCullough. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at [redacted] You may also contact the researcher's faculty sponsor, Dr. Mary Strickland at [redacted]

Whom do you contact if you have questions about your rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the IRB. Our physical address is Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA, 24515; our phone number is 434-592-5530, and our email address is irb@liberty.edu.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

Your Consent

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

☐ The researcher has my permission to audio-record/video-record me as part of my participation in this study.

____

Printed Subject Name

____

Signature & Date

Appendix I

Journal Prompt

In 200-300 words, describe your understanding of cognitive load and the methods you use to reduce cognitive load to the learner (the amount of content to teach for each lesson).

Appendix J

Individual Interview Questions

Individual Interview Questions

1. Please introduce yourself and describe your academic journey to becoming a math teacher. CRQ
2. Describe your experiences teaching math to special education students with specific learning disabilities in math computation and problem-solving. SQ1
3. Describe the contexts or situations that have typically influenced or affected your experiences with teaching special education students with specific learning disabilities in math computation and math problem-solving. SQ1
4. Describe the MTSS process for your learners. SQ1
5. Describe how you were exposed to cognitive load theory. SQ3
6. Describe your understanding of the connection between cognitive load and the amount of information to present to learners with disabilities in math. SQ3
7. Describe how you determine the appropriate increments of information you must present for each lesson or topic. SQ3
8. Describe how you determine the lesson must be modified because the learning increments (cognitive load) related to math computation and problem-solving are too much for the students in the classroom. SQ3
9. Describe how you use UDL to reduce the learner's cognitive load. SQ2
10. Describe how you leverage self-regulation, specifically reflection, to increase math outcomes and reduce cognitive load. SQ3
11. Please describe how you know a student has reached their maximum cognitive load. SQ3

12. Describe how working memory contributes to a student's cognitive load in mathematics. SQ2
13. Describe two methods you use to reduce the cognitive load on a student when teaching a new concept when teaching online. SQ1
14. Describe techniques you use to support a student with low processing speed. SQ3
15. Describe how you can use the cognitive load theory to improve your teaching approach. CRQ
16. How is teaching math online different than in person? CRQ
17. What else would you like to add to our discussion of your experiences teaching students with math disabilities or strategies we have not discussed? CRQ

Appendix K

Focus Group Questions

Focus Group Questions

1. How can cognitive load help determine the use of MTSS to increase the student's performance with the content? SQ3
2. How have the additional accommodations and modifications centered around cognitive load helped the student's performance in your classes? SQ2
3. Self-contained teachers, what additional supports are you giving the students in your classrooms to recognize and adjust cognitive load, if any? SQ3
4. General education teachers, what additional supports have you instituted around recognizing and adjusting for the cognitive load that was not originally in the system lesson, if any? SQ1
5. Describe any content or delivery method that should be changed for the general and special education students regarding cognitive load to improve their performance? SQ1
6. What remediation strategies do you recommend based on the results regarding cognitive load theory? SQ2
7. Based on the cognitive load theory and the results compiled from the interviews and questions, what would be a new strategy you could use in the classroom? SQ3