

TEACHER KNOWLEDGE & PERCEPTION
OF MATHEMATICS DISABILITIES AND DYSCALCULIA

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Teacher Knowledge and Perception of Mathematics Disabilities and Dyscalculia

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Abstract

The inclusion of students with mathematical learning disabilities (MLD) in the general education (GE) math classroom has become increasingly prevalent, and with the adoption of the Common Core State Standards, it has become the role of GE math teachers to ensure that all students work towards grade-level math standards. The following research utilized a survey to evaluate the perceptions of Wyoming middle-level math teachers in order to: (a) determine the extent of their knowledge and understanding of MLD and the disability dyscalculia; (b) examine the nature of their attitudes regarding MLD; (c) identify what supports and interventions are utilizing within their classroom to support learners with MLD; (d) explore what they see as the perceived barriers to providing instruction and/or supports to learners with MLD; and (e) examine whether teachers feel effective when working with students with MLD.

An analysis of the data revealed that Wyoming middle-level math teachers believe they understand the impact of MLD and feel adequately prepared to teach students with MLD. However, qualitative data identified some perceived barriers related to working with students identified with MLD. The four biggest barriers overall were: (a) lack of training/knowledge about MLD; (b) lack of time to work with students in one-on-one instructional situations; (c) lack of resources (including special education personnel); and (d) pressure to have and meet the needs of all students in the GE math setting. The research also showed that perceived barriers play a part in whether teachers felt effective when working with students with MLD.

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Chapter 1

Introduction

Specific learning disabilities are believed to be a legitimate concern of many disciplines including, education, psychology, and neurology. However, because of the different foci of each discipline, there is not a consistent definition that describes a “specific learning disability.” From an educational perspective and in combination with the Individuals with Disabilities Education Act (IDEA) (2004), the general term “specific learning disability” is defined as:

A disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations.

Additionally, IDEA states that specific learning disabilities take into account various conditions including perceptual disabilities, dyslexia, brain injury, developmental aphasia, and minimal brain dysfunction. However, learning problems caused by emotional disturbances, vision or hearing impairments, motor dysfunctions, mental retardation, environmental factors, cultural factors, and/or economic factors do not fall under the auspice of a specific learning disability.

From a psychological viewpoint and as defined through the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition: DSM-5 (2013), a “specific learning disorder” is “diagnosed when there are specific deficits in an individual’s ability to perceive or process information efficiently and accurately” and is “characterized by persistent and impairing difficulties with learning foundational academic skills in reading, writing, and/or math (American Psychiatric Association, p. 32).

Other professional organizations like the National Joint Committee on Learning Disabilities and the Learning Disabilities Association refer to the term “learning disability” as

more of a general term. The National Joint Committee on Learning Disabilities (2016) states that a learning disability is:

A general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur across the life span. Problems in self-regulatory behaviors, social perception, and social interaction may exist with learning disabilities but do not by themselves constitute a learning disability. Although learning disabilities may occur concomitantly with other disabilities (for example, sensory impairment, intellectual disabilities, emotional disturbance), or with extrinsic influences (such as cultural or linguistic differences, insufficient or inappropriate instruction), they are not the result of those conditions or influences.

The Learning Disabilities Association of America (2012), an organization comprised of parents and professionals, provides a more basic definition of a learning disability, stating that it is “an umbrella term that covers a range of neurologically based disorders in learning and various degrees of severity of such disorders.”

According to the United States Department of Education’s National Center for Educational Statistics (NCES) (2015), students with learning disabilities accounted for around 4.5% of all school-aged children in the United States. Out of the 6.6 million students who received special education services during the 2014-2015 school year, thirty-five percent were identified with a specific learning disability. Additionally, the NCES has reported that even though a higher percent of males (16%) than females (9%) received special education services under IDEA, the percentage of students served with a learning disability was higher among female students at 44% while male

students accounted for 36%. Furthermore, the NCES reported that “the percentage of children and youth with disabilities receiving services under IDEA for specific learning disabilities was lower among Asian children and youth (22 percent), children and youth of two or more races (30 percent), and White children and youth (31 percent) than among children and youth overall (35 percent).”

According to Altarac and Saroha (2007), most children are not identified with a learning disability until early- to mid-adolescence. They reported that this is not because a learning disability develops during adolescence but because a learning disability is often an invisible disability. The authors further stated that there is typically a time lag of about 3.5 years between when a mother suspects there is a problem and when the child is finally diagnosed. Child Trends (2016), a nonprofit research organization, also reported that the identification of children with learning disabilities increases with age. According to the 2013 Child Trends statistics, “three percent of three- to four-year-olds, eight percent of five- to eleven-year-olds, and nine percent of 12- to 17-year olds had been diagnosed as having a learning disability.”

Since the enactment of Public Law 94-142, the Education for All Handicap Children Act (EAHCA or EHA) in 1975, the inclusion of students with disabilities, including those identified with specific learning disabilities, into the general education classroom has become the preferred method of education (McLeskey, Landers, Williamson, & Hoppey, 2012). This law, reauthorized as the Individuals with Disabilities Act (IDEA) in 1997 and again in 2004, mandated that students with disabilities be educated in the least restrictive environment (LRE). The LRE as stipulated by federal law states:

To the maximum extent appropriate, [children with disabilities], including children in public or private institutions or other care facilities, are educated with

children who are not [disabled], and that special classes, separate schooling, or other removal of [children with disabilities] from the regular educational environment occurs only when the nature or the severity of the [disability] is such that education in regular classes with the use of supplementary aids and services cannot be achieved satisfactorily (EAHCA, 1975, sec. 1412(5)(B)).

To most educational professionals, this has meant that students with disabilities should be educated with their same-aged peers who do not have disabilities. Thus, over the last forty-three years, there has been a considerable decrease in the amount of instructional time that special education students are receiving in the special education setting. According to McLeskey, Landers, Williamson, and Hoppey (2012), who investigated trends in the United States LRE placement between 1990 and 2008, there was a significant change in placement practices with a greater number of students with special needs being educated in the general education (GE) setting for most of the school day. They reported that “in 1990, 34% of students with disabilities spent most of the school day in GE settings. This proportion increased to 58% in 2007” (p. 135). Even though the results of their study revealed that substantial progress was made towards educating students, both at the elementary and secondary level, the greatest change happened at the secondary level where GE placement increased by 190% compared to 60% at the elementary level (McLeskey et al., 2012). Furthermore, the authors noted that the most extensive progress was made in educating students with learning disabilities in the least restrictive setting.

Since its enactment, Public Law 94-142 was reauthorized as No Child Left Behind (NCLB) in 2001 and as the Every Student Succeeds Act (ESSA) in 2015. NCLB created a shift towards high-stakes accountability within the United States educational system requiring that states implement standardized testing for all students in order to monitor whether districts and schools

were making adequate yearly progress (AYP) (Lavery, 2016). The ESSA in turn now requires that “all students in America be taught to high academic standards that will prepare them to succeed in college and careers,” while also advancing “equity by upholding critical protections for American’s disadvantaged and high-need students” (ESSA, 2015). In addition to these federal regulations, the 2010 Common Core State Standards (CCSS) have also advanced the movement towards all students being educated in the LRE. Since the release of the CCSS, forty-two states including Wyoming, the District of Columbia, four territories, and the Department of Defense Education Activity (DoDEA) have adopted them (CCSS, 2018). Furthermore, high-stakes tests based on these standards are now being required by most states and there is a huge push for all students to receive instruction in the core math curriculum regardless of ability in order to meet these standards.

Due to the enactment of these educational policies, there have been ongoing changes in the education field and because of these changes, new challenges are being introduced. With the movement towards high expectations for all, it is important for teachers to have the required knowledge to support the learning of all students including students with mathematical learning disabilities. However, one major issue is the lack of research that has been conducted on mathematics and students with learning disabilities. Bouck and Kulkarni (2009) stated that “the limited research in this area is a critical deficiency considering that mathematics is a core content area and, under No Child Left Behind (NCLB, 2002), is to be assessed yearly in grades 3-8 and once again in high school for all students, including students with disabilities” (p. 228). Moreover, the authors discussed the limited attention that has been given to curricular philosophy and the approaches to teaching and learning of students with a disability in mathematics. They also

mentioned the concern over the curriculum in the middle grades because of falling test scores in the United States in comparison to international achievement.

The prevalence of mathematical learning disabilities amongst the student population in the United States and the placement of these students into the general education math setting suggests the importance of general education math teachers, especially those educating students in the middle grades, being equipped with a solid understanding of what it means to have a specific learning disability (SLD) in mathematics. The purpose of this research study was to collect information from Wyoming middle-level math teachers to gain an understanding of their current knowledge and perceptions of mathematical learning disabilities and the disability dyscalculia. The disability dyscalculia is specifically investigated throughout the extent of this paper. Dyscalculia, most simply, is a neurologically based disorder of math abilities (Wadlington & Wadlington, 2008). It will be discussed and examined further within the literature review and the research conducted for this paper.

With the push towards standards-based instruction for students with mathematical learning disabilities, it is imperative that general education math teachers are adequately prepared to provide the specialized instruction required to meet the various needs of these specific students. It is assumed that middle-level math teachers across Wyoming do not feel that they are adequately prepared to work with all students who are identified with mathematical learning disabilities for several reasons: (a) a lack knowledge and understanding of mathematical learning disabilities and/or the disability dyscalculia, (b) a lack of supports and/or resources, and (c) the perceived barriers that impact instruction and/or supports.

Chapter 2

Literature Review

Theoretical Framework

The theoretical framework used to guide a portion of this research is based on Bandura's Social Cognitive Theory (SCT). One component of this theoretical framework is self-efficacy, which refers to the level of a person's confidence in his or her own abilities to be successful. Bruce (2010) stated that:

Teacher efficacy is the teacher's self-assessment of his or her ability to support student learning. Teachers with high teacher efficacy believe that they can positively impact student achievement despite a possible range of perceived challenging circumstances (such as low socio-economic status of the students or a lack of resources). Teachers with low efficacy believe that they have a limited ability to influence student learning and achievement. A teacher with low efficacy believes that the locus of control is well beyond his or herself and there is little he or she can do to enhance student learning (p. 1599).

Mohamadi et al. (2011) stated that "teachers who do not expect to be successful with certain students are likely to put forth less effort in preparation and delivery of instruction, and to give up easily at the first sign of difficulty, even if they actually know of strategies that could assist these students if applied" (p. 426). It is vital that teachers not only feel prepared but also feel that they can be successful when working with students with significant learning disabilities like dyscalculia. The majority of this research examined teacher perceptions regarding their own personal knowledge about mathematics learning disabilities and whether they felt adequately prepared to provide effective instruction to students who struggled with math in their classrooms.

Mathematics Learning Disabilities

Mathematics, while not always obvious, plays an integral part in our everyday lives. It is used for daily activities ranging from cooking and shopping to budgeting and reading statistical information in the newspaper. Moreover, research has shown that basic competencies in mathematics including simple algebraic skills influence employment and wages (Geary, 2013; Kucian & von Aster, 2015). However, math does not come easy for everyone. One reason may be due to its complex nature. Based on the definition provided in the Merriam-Webster dictionary, which states that mathematics is “the science of numbers and their operations, interrelations, combinations, generalizations, and abstractions and of space configurations and their structure, measurement, transformations, and generalizations,” one can see the complexity. Yet, another substantial reason some individuals struggle with the varying aspects of mathematics is based on more organic, biological factors. Those individuals who are achieving significantly below their same-aged peers are likely to be identified with a specific learning disability in mathematics.

Mathematical learning disabilities (MLD) are estimated to affect between 5% and 14% of the school-aged population (Geary, 2004, 2013; Geary, Hoard, Bailey, 2011). Geary (2013) suggested that it is difficult to estimate the actual prevalence of MLD because “formal diagnostic tests and criteria have not been established” (p. 240). He further articulated that both genetics and environmental factors contribute to mathematical learning disabilities. Two mathematical learning disabilities mentioned in neurological and neuropsychological clinical reports are Acalculia and Dyscalculia (Ardila & Rosselli, 2002). Acalculia (or acquired dyscalculia) is the disturbance in calculation associated with brain damage while dyscalculia, also known as development dyscalculia, is a developmental defect in the acquisition of numerical abilities.

Although Ladislav Košč, a Czechoslovakian researcher, presented research on developmental dyscalculia as far back as 1974 (Košč, 1974), this term for a mathematical learning disability has become more widespread in official documents and within the United States educational system in more recent years. In fact, U.S. Secretary of Education, Arne Duncan, issued a statement in 2015 saying approximately 2.5 million American students are identified with a specific learning disability like dyslexia, dysgraphia, and dyscalculia and parents, educators, and policymakers should understand how these disabilities impact students. Duncan stated that the U.S. Department of Education would “release information that will assist states and local school districts in recognizing the unique needs of students with learning disabilities—such as dyslexia, dysgraphia, and dyscalculia.” On October 23, 2015, Michael Yudin, the Assistant Secretary for Special Education and Rehabilitative services at the U.S. Department of Education, released a letter that stated:

The Office of Special Education and Rehabilitation Services (OSERS) has received communications from stakeholders, including parents, advocacy groups, and national disability organizations, who believe that state and local educational agencies (SEAs and LEAs) are reluctant to reference or use dyslexia, dyscalculia, and dysgraphia in evaluations, eligibility determinations, or in developing the individualized education program (IEP) under the IDEA. The purpose of this letter is to clarify that there is nothing in the IDEA that would prohibit the use of the terms dyslexia, dyscalculia, and dysgraphia in IDEA evaluation, eligibility determinations, or IEP documents.

Federal regulations and educational policies have increased the focus and emphasis on math teaching and learning in schools across the country. This new math research focus is extremely important especially regarding the teaching and learning of students with

specific learning disabilities in mathematics like dyscalculia. Because the term “dyscalculia” is becoming more synonymous with the term “mathematical learning disability,” the primary focus of this literature review will center on gaining an understanding of the mathematical disability dyscalculia and how it impacts students.

Dyscalculia

The term dyscalculia or developmental dyscalculia (DD) was coined by Ladislav Košč in 1974 (Soares & Patel, 2015). Košč (1974) defined developmental dyscalculia as “a structural disorder of mathematical abilities which has its origin in a genetic or congenital disorder of those parts of the brain that are the direct anatomico-physiological substrate of the maturation of the mathematical abilities adequate to age, without a simultaneous disorder of general mental function” (p. 47).

Although a definition was provided as far back as 1974, like the term “specific learning disability,” there does not seem to be a consistent definition for the term “dyscalculia.” In the United Kingdom (UK), dyscalculia is the common term for specific mathematical difficulty (Chinn & Ashcroft, 2007). The definition proposed in the United Kingdom’s Department for Education and Skills booklet (2001) is as follows:

Dyscalculia is a condition that affects the ability to acquire mathematical skills.

Dyscalculic learners have difficulty understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence (pg. 2).

In the United States, the American Psychiatric Association (2013) made a substantial alteration in the DSM-5 by changing the diagnostic criteria to an overarching learning

disability (LD) with specifiers to denote specific manifestations. One of those specifiers is dyscalculia. The DSM-5 states that:

Dyscalculia is an alternative term used to refer to a pattern of difficulties characterized by problems processing numerical information, learning arithmetic facts, and performing accurate or fluent calculations. If dyscalculia is used to specify this particular pattern of mathematic difficulties, it is important also to specify any additional difficulties that are present, such as difficulties with math reasoning or word reasoning accuracy (American Psychiatric Association, 2013, p. 67).

Regardless of which definition is used, both focus on early arithmetic skills and the challenges that this specific learning disability can cause an individual when it comes to understanding basic number concepts and simple calculations. The word “dyscalculia” therefore is a fitting term because it is composed of the Greek prefix dys-, which means bad or impaired, and the Latin root calculare (calculus), which means to count (Berninger & Swanson, 2013; Khing, 2016; Sousa, 2016). Thus, the word dyscalculia literally means bad at counting.

Prevalence of Dyscalculia

Research on dyscalculia suggests that its prevalence among school-aged children ranges from 3% to 14% (Soares & Petel, 2015). However, it is hard to make a definitive conclusion because of the lack of a precise definition and the lack of diagnostic criteria.

Bugden and Ansari (2015) stated:

It is evident that current findings in the DD literature are contradictory, and there is no clear conclusion as to what causes DD. Furthermore, there is no universally

agreed upon criteria for diagnosing children with DD, and as a result, it is difficult for researchers to make conclusions about what underlying cognitive mechanism impair DD children's ability to learn basic arithmetic (p. 21).

Devine, Soltész, Nobes, Goswami, and Szűcs (2013) reported that the prevalence estimates vary between 1.3% and 10.3% with a mean estimate of about 5-6%. These authors report that this variability is probably due to the different diagnostic criteria used to define developmental dyscalculia. The various diagnostic criteria used within the research include: (a) the use of IQ and achievement discrepancy scores looking at "mathematics performance that is substantially below what would be expected given general intelligence" (p. 31), (b) the use of performance cutoff scores on standardized tests where the criteria vary from performance below the 3rd percentile up to performance below the 25th percentile, (c) the use of a two-year achievement delay in which performance is equal to or below the average level of children who are two years younger, and (d) the identification of children who have shown resistance to math interventions.

In addition to reporting a prevalence range between 3-6%, Kucian and von Aster (2015) state that recent research suggested there is a greater prevalence among females than males though there does seem to be opposing findings. Devine et al. (2013) report that prior research studies have not been consistent. In their prevalence study of 766 school-age students, Dirks, Spyer, van Lieshout, and de Sonneville (2008) found that the prevalence of developmental dyscalculia was higher for girls than boys. Barbaresi et al. (2005), using public and private school records, found that the incidence of developmental dyscalculia was higher for boys than for girls. Romaa and Gowramma (2002) looked at identifying and classifying children with dyscalculia using a systematic procedure in two independent studies. They found that the ratio between boys and girls

with dyscalculia alone depended on whether the dyscalculia was diagnosed through teacher identification, through the use of diagnostic tests, or through the use of exclusionary criteria. The researchers reported that the prevalence was higher in girls when teacher identification was used. When diagnostic tests were used, there was a higher prevalence in boys. When exclusionary criteria were used, there was equal prevalence among boys and girls. Shalev, Manor, Auerback, and Gross-Tsur (1998) conducted a study that included 140 fifth-grade students identified with developmental dyscalculia. Each of the students underwent intelligence (IQ) testing and an arithmetic evaluation. Students who fell below the 5th percentile were considered to have developmental dyscalculia. Three years later, 123 out of the 140 students (88%) were reevaluated. The results showed that 95% of these students continued to fall “within the lowest quartile for their class” (p. 358). The researchers “found that 47% (n = 58) of the 123 children diagnosed” had persistent developmental dyscalculia in eighth grade. The remaining 65 students scored above the 5th percentile and no longer met the criteria for development dyscalculia. However, they continued to perform poorly in mathematics.

Although the focus of this research does not examine the co-occurrence or comorbidity of dyscalculia, it is important to note that math difficulties are often associated with other learning problems including reading disabilities and attention-deficit/hyperactivity disorder (ADHD) (Kaufmann & von Aster, 2012; Kucian & von Aster, 2015; Price & Ansari, 2013). According to Geary (2004), it is estimated that 17.9% of students struggle with combined reading and math learning problems. Soares and Patel (2015) reported that “between 17% and 70% of children with dyscalculia have dyslexia” (p. 15). Kumar and Raja (2009) reported that “40 percent of dyslexic children can also have trouble with learning mathematics” (p. 9). They stated that this is because some aspects of reading and mathematics draw on the same cognitive processes including rapid

retrieval of abstract knowledge from long-term memory. As for ADHD and dyscalculia, Soares and Patel (2015) reported that the “comorbidity rate of dyscalculia with ADHD is 11%” (p. 15). In addition to comorbidity rate, it is also important to recognize that children may develop secondary consequences from having a mathematical learning disability. For instance, dyscalculia accompanied by poor motivation, low self-esteem, lack of self-efficacy, and/or even severe math anxiety (Kumar & Raja, 2009; Wadlington & Wadlington, 2008).

Etiology of Dyscalculia

Geary and Hoard (2005) state that very little is currently known about the etiology of mathematical learning disabilities and it is thought that dyscalculia may have many contributing causes. Research suggests that like other forms of learning disabilities both environmental and genetic factors may contribute to mathematical learning disabilities (Alarcon, DeFries, Light, & Pennington, 1997; Flanagan & Alfonso, 2011; Shalev et al., 2001). Yet, “this mix and how it might vary from one student to the next are not well understood” (Geary, 2013, p. 240). According to Kaufmann and von Aster (2012), dyscalculia is “often present in children suffering from neurological diseases (e.g.: epilepsy, premature birth, metabolic disorders) and genetic syndromes (e.g.: fragile X syndrome, Williams-Beuren syndrome, velocardiofacial syndrome)” (p. 769). In addition, dyscalculia is a disability that is believed to run in families. Shalev et al. (2001) conducted a study that looked at thirty-nine children identified with dyscalculia based on a discrepancy model. When family members were looked at, sixty-six percent of mothers, forty percent of fathers, and fifty-three percent of siblings were also identified as having dyscalculia. Another study looked at forty identical twins and twenty-three same-sex fraternal twin pairs. Performance data, using a regression model for analysis, showed that fifty-three percent of the

identical twins and thirty-nine percent of the fraternal twins demonstrated low math achievement at similar levels (Alarcon et al., (1997).

Characteristics of Dyscalculia

Dyscalculia is often thought of as a synonymous term for mathematical learning disability or arithmetic learning disorder (Devine, et al., 2013; Romaa & Gowramma, 2002; Soares & Patel, 2015). Kucian and von Aster (2015) report that dyscalculia is a “heterogeneous learning impairment affecting numerical and/or arithmetic functioning at behavioral, psychological, and neuronal levels” (p. 3). Additionally, it is thought that the arithmetic difficulties are reflected differently in each dyscalculic person. Individuals identified with this math disability may struggle with mastering a wide range of numerical skills including: “counting skills, magnitude process, arithmetic, transcoding between words, digits and quantities, [and] the spatial number representation” (p. 4). Furthermore, these individuals may struggle with more domain-general skills like working memory, including visuo-spatial working memory, or attentional processing.

Ladislav Košč made an important contribution in looking at the heterogeneity of dyscalculia. In his article “Developmental Dyscalculia” (1974), he discussed six different classifications for dyscalculia: (a) verbal, (b) practognostic, (c) lexical, (d) graphical, (e) ideognostical, and (f) operational. Verbal dyscalculia refers to “the disturbed ability to designate verbally mathematical terms and relations, such as naming amounts and numbers of things, digits, numbers, operational symbols, and mathematical performances” (p. 49). Children with this type of dyscalculia are more likely to have difficulty with numbers when they are presented verbally. Practognostic dyscalculia “is a disturbance of mathematical manipulation with real or pictured objects.” These mathematical manipulations include enumerations and comparison of estimates of

quantity. Children with this type of dyscalculia are more likely to have trouble listing, comparing, and manipulating mathematical equations. Lexical dyscalculia is “a disability in reading mathematical symbols (digits, numbers, operational signs, and written mathematical operations).” Children struggling with this disability may have trouble reading and understanding mathematical symbols, numbers, mathematical expressions, and/or equations. Graphical dyscalculia “is a disability in manipulating mathematical symbols in writing.” Children with graphical dyscalculia are likely to have trouble writing or using the correct corresponding mathematical symbols. They may also be unable to write numbers verbalized to them or even copy them if written. Ideognostical dyscalculia “is a disability primarily in understanding mathematical ideas and relations and in doing mental calculation.” Students who struggle with ideognostical dyscalculia will likely have difficulty with completing mental operations and remembering mathematical concepts after learning them. Operational dyscalculia is the inability to carry out mathematical operations. Children with operational dyscalculia have difficulty with completing written or spoken math calculations. “A typical occurrence is the interchange of operations, e.g., doing addition instead of multiplication; subtraction instead of division; or substitution of more complicated operations by simpler ones” (p. 50).

Geary (2003) divided dyscalculia into three subtypes: (a) semantic memory, (b) procedural memory, and (c) visuospatial memory. The defining feature of semantic memory is “deficits in the retrieval of basic arithmetic facts” (p. 204). Furthermore, when facts are retrieved, there is a higher error rate and when facts are correctly retrieved, they are often unsystematic. The procedural subtype includes developmentally immature procedures, frequent errors when executing procedures, “poor understanding of the concepts underlying procedural use,” and difficulties sequencing the multiple steps in complex procedures (p. 205). The visuospatial subtype presents

itself with “difficulties in spatially representing numerical and other forms of mathematical information and relationships” (p. 205). There may be a misinterpretation and misunderstanding of spatially-represented information including misalignment of columns, place value errors, and/or challenges with geometry (Mather, Goldstein, & Eklund, 2015).

There is much variability in the characteristics of dyscalculia. According to Soares and Patel (2015), “there is no single presentation of dyscalculia, and symptoms may manifest at any age and are often mediated by the degree and nature of instruction” (p. 19). Appendix A provides an overview of the different characteristics and symptoms of dyscalculia identified in the literature.

Dyscalculia and the Brain

The brain is the basis of all learning and, in more recent years, research has begun to find a strong correlation between neurobiology and dyscalculia (Kucian & von Aster, 2015; Soares & Patel, 2015). Neuroimaging has shown that numerical tasks of varying difficulty induces increased brain activation (Price et al., 2007). However, this brain activation in individuals identified with dyscalculia is “not modulated” in the same ways as found in typically-developing individuals (p. 1042).

“The parietal lobe is considered the base for mathematical ability, while learning new arithmetical facts primarily involves the frontal lobes and the intraparietal sulci (IPS), and previously learned facts involve the left angular gyrus, which is also implicated in retrieving facts from memory” (Soares & Patel, 2015, p. 19). Butterworth and Laurillard (2010) report that the parietal lobe is greatly implicated in “abnormal...activity patterns indicating a deficient neuronal representation of numerosity” (p. 8). Kucian and von Aster (2015) reference two case studies which show that: (a) left parietal damage led to difficulty with numbers, usually with no other cognitive symptoms, and (b) “patients with right parietal damage were impaired on estimating the

number of dots in a visual array” (p. 528). Additionally, damage to the right parietal has also been linked with selective activation in a sequential estimation task.

According to Butterworth and Laurillard (2010), “it is well-established from neuroimaging studies that the critical area for processing numbers in the human lies in the intraparietal sulcus (IPS)” (p. 528). It has been shown that the IPS is activated when numerical magnitude is implicated, including when there is an absence of numerical demands (Kucian & von Aster, 2015). Furthermore, it has been shown that the IPS deals with the comparison of digits and dot arrays.

In addition to the IPS, there appears to be an entire neuronal network necessary for number processing, which is referred to as the triple code model of numerical processing (Kucian & von Aster, 2015). It is proposed that numbers are represented in three different codes: (a) semantic number processing in the parietal lobe, (b) “verbal-phonological number representations supporting verbal counting and number fact retrieval in left perisylvian areas,” and (c) “visual-Arabic number representation represented by strings of digits including areas associated with the ventral visual stream” (p. 7).

Although it is important to be aware of the neurological links between the brain and dyscalculia, it is also important to recognize that a big criticism of “brain imaging studies involving learning is their restricted applicability to education and classroom interventions” (Kaufmann, 2008, p. 167).

Dyscalculia and Educational Interventions

Butterworth and Laurillard (2010) stated that neuroscience research tells us that “for some learners there is a core deficit of numerosity process, indexed by dot enumeration or by magnitude comparison. However, these findings do not in themselves determine the pedagogical intervention needed to assist such learners” (p. 530). It is therefore important that interventions, informed by

neuroscience, focus on the primary goal of improved performance for all children who struggle with dyscalculia. Soares and Patel (2015) stated that interventions can take a preventive or intervention approach. Preventive approaches are often delivered at the Tier 1 level of the Response to Intervention (RTI) model with the aim of helping students who are potentially at risk and providing interventions or supports before they fall behind their same-aged peers. Evidence-based recommendations regarding curriculum, instructional materials, practices, and evaluations that focus on student learning have been provided by the National Mathematics Advisory Panel (see Appendix B for Interventions for Mathematics Learning Disabilities and Dyscalculia). Beyond universal intervention, “Tier 2 involves small group, more intensive instruction which focuses on working on specific skills like foundations of math, intentional teaching and fluency practice” (p. 22). Tier 3 specialized instructional interventions are based on three criteria: (a) multiple component, (b) individualized to the student’s specific needs (emotional and instructional), and (c) the inclusion of an evaluative or progress monitoring component. Soares and Patel (2015) stated that interventions using direct instruction have proven to be the most effective when teaching basic math skills. They further stated that while “computer-assisted instruction might be helpful to motivate students, it cannot solely suffice to remediate children’s basic difficulties” (p. 23).

In addition to intervention, accommodations and modifications are recommended for students identified with dyscalculia including: (a) breaking multiple step problems into small, manageable steps; (b) allowing the use of markers or line readers to highlight important information; (c) allowing the use of flashcards to aide in memorization; (d) the shortening of assignments in both time and amount; (e) focusing on the revision prior to a

test; (f) allowing the use of calculators and technology that uses text-to-speech (Soares & Patel, 2015).

Conclusion to the Literature

“Dyscalculia is a specific learning disability in mathematics which is gaining ground in recognition and an evidence base among professionals, educators and the lay public” (Soares & Patel, 2015). As students with mathematical learning disabilities, like dyscalculia, are increasingly being educated in the general education math setting, one has to wonder about the current knowledge and understanding of current math teachers when it comes to working with these students. The purpose of this research study was to investigate the current knowledge and perceptions of middle-level (6th thru 8th grade) math teachers by collecting answers to the following guiding research questions: (a) What is the extent of teacher understanding/knowledge about mathematical learning disabilities including the disability dyscalculia? (b) What is the nature of teacher attitudes about mathematical learning disabilities? (c) What supports and/or interventions are provided to learners with mathematical learning disabilities? (d) What are the perceived barriers felt by teachers who work with students who are identified with mathematical learning disabilities? and (e) Do teachers feel effective when working with students with mathematical learning disabilities?

Chapter 3

Research Method

The purpose of this research study was to obtain information about Wyoming middle-level math teachers' current knowledge and perceptions of mathematical learning disabilities and the disability dyscalculia. In order to gain an understanding, the following research questions were utilized to guide the research: (a) What is the extent of teacher understanding/ knowledge about mathematical learning disabilities including the disability dyscalculia? (b) What is the nature of teacher attitudes about mathematical learning disabilities? (c) What supports and/or interventions are provided to learners with mathematical learning disabilities? (d) What are the perceived barriers when it comes to working with students who are identified with mathematical learning disabilities? and (e) Do teachers feel effective when working with students who are identified with mathematical learning disabilities?

It is proposed that most Wyoming middle-level math teachers do not feel that they have the required knowledge, supports, and/or resources needed to provide effective instruction to students identified with mathematical learning disabilities.

This chapter introduces the research method utilized to answer these guiding research questions. The first section provides an overview of the survey instrument utilized in the data collection process. The second section looks at the participant sample and how they were selected. The third section looks at the procedure used to gather data from Wyoming middle-level math teachers. The final section will explain how the obtained data was analyzed.

Data Collection Method

In order to gain knowledge about current Wyoming math teachers' understanding and perceptions, a mixed-method online survey was used. The web-based survey was created by the

researcher, Theresa Graves, using Qualtrics Survey Software. The online survey asked participants to respond to six demographic questions related to job title, gender, years in current position, highest academic degree obtained, and number of special education courses taken during undergraduate and/or graduate programs of study. The survey also asked participants to respond to twenty-one item stems indicating their level of knowledge or agreement using both a 5-point and a 6-point Likert-type scale and four open-ended questions (see Table 1). The Survey of Regular Education Teacher Knowledge and Perceptions of Mathematical Learning Disabilities is located in Appendix C. This survey instrument was checked for internal consistency using Cronbach Alpha through Microsoft Excel. Because two different Likert scales were used in the survey, an alpha value was first calculated on the four item stems that used a 5-point Likert scale ($\alpha = 0.770$) and then on the fifteen item stems that used a 6-point Likert scale ($\alpha = 0.725$). The alpha value for the combined item stems was 0.698. Two item stems were not analyzed because they required only yes or no responses. According to Tavakol and Dennick (2011), the acceptable values of alpha range from 0.70 to 0.95. Thus, this survey is considered reliable.

Table 1

Research Questions and the Survey of Regular Education Teacher Knowledge and Perceptions of Mathematical Learning Disabilities (STKP)

Research Question	Item Stems	Methods	Data Source
Teacher Knowledge & Perception	1-3, 7-12, 19-21, 25	Quantitative & Qualitative	Survey
Nature of Teacher Attitude	5, 13-15	Quantitative	Survey
Supports & Interventions	4, 6, 18, 24	Quantitative & Qualitative	Survey
Perceived Barriers	16-17, 23	Quantitative & Qualitative	Survey
Teacher Self-Efficacy	22	Qualitative	Survey

Finally, a statistical analysis was conducted on ten item stems that compared teachers who have taught from one-to-fifteen years to teachers who have taught for sixteen years or more. Although it was not a focus of this research, it could be assumed that participants who have more recently completed their teacher preparation program have more knowledge regarding mathematical learning disabilities and the disability dyscalculia. The only item stem that showed statistical significance looked at years of teaching experience and whether participants felt that their special and general education courses prepared them to teach students with mathematical learning disabilities. This item stem yielded a p value of 0.0226, which is less than 0.05 and makes this finding one of statistical significance (Johnson & Christensen, 2017).

The questionnaire used in this study was adapted from a teacher survey about dyslexic learners (Elias, 2014). The items listed on the questionnaire came from a literature review conducted by the researcher, Theresa Graves, examining mathematical learning disabilities and the math disability dyscalculia.

Participant Sample

General education teachers in Wyoming who are currently teaching middle-level (6th-8th grade) mathematics were asked to participate in this study. The survey was sent to 181 elementary, middle, and junior high school principals based on a principal list obtained from the Wyoming Department of Education. Because the recruitment letter and survey could not be emailed directly to teachers, the exact number of teachers who had the option to participate in the study is unknown. On the basis of the data collected through Qualtrics Survey Software program, forty-five teachers volunteered to participate in this research study.

Procedure

The online Qualtrics survey link was sent to current Wyoming sixth-, seventh-, and eighth-grade math teachers along with a recruitment letter by means of Wyoming school district principals. The list of Wyoming middle-level principals was obtained from Julie Magee, Wyoming Department of Education (WDE), Director of Accountability (see Appendix D for WDE Principals List). On March 5, 2018, Wyoming principals were sent an initial principal contact email informing them of the research study with a request that a research recruitment email be forwarded to their sixth-, seventh-, and eighth-grade math teachers (see Appendix E for Initial Principal Email). Each principal was also sent the initial recruitment email for middle-level math teachers, which included: (a) the purpose for the research including the guiding research questions, (b) a confidentiality statement, (c) a risks and benefits statement, (d) a time commitment statement, (e) a voluntary participation and consent statement, and (f) the online survey link (see Appendix F for the Initial Teacher Recruitment Letter). Two follow-up emails for both the principals and the middle-level math teachers were also sent on March 13, 2018 and March 27, 2018 (See Appendix G for the Follow-up Emails).

Laramie County School District #1 (LCSD1) was an exception to the above procedure due to LCSD1's requirement that a research request be completed (See Appendix H for LCSD1 Research Request, Abstract, and Approval). The researcher completed the request and after reviewing it, the Instruction Data Analysis Program Administrator requested the following alterations: (a) changing the scope of recruitment to 2-3 elementary schools and 1-2 junior high school, and (b) upon LCSD1 district approval, the researcher was to contact the building Principals seeking permission to have them distribute a printed recruitment letter with survey instruction. After working with a Qualtrics Product Specialist, the following TinyURL was created:

<https://tinyurl.com/ya5rdunb> and a printable recruitment letter was distributed to four LCSD1 principals.

The researcher completed the Collaborative Institutional Training Initiative (CITI PROGRAM) on January 2, 2018 (See Appendix I for CITI Completion Report) whereupon, a proposal for the University of Wyoming Institutional Review Board (IRB) was compiled and submitted. A letter of approval for this research was received on February 27, 2018 stating that the above research qualified for exempt review giving permission to begin this research study (see Appendix J for IRB Approval Letter).

Data Analysis

Once the survey data were compiled into the Qualtrics Data Software program, the aggregated information was used to look at demographic information and descriptive statistics. The demographic information obtained included current job title, years of teaching experience, highest college degree obtained, and number of special education undergraduate and/or graduate classes taken. The descriptive statistics, including frequencies and percentages, were used to summarize information related to teacher knowledge, understanding, and perceptions related to the mathematical learning disability including the math disability dyscalculia. A coding system was used to analyze the qualitative data.

Chapter 4

Summary of Results

Chapter 4 presents the results of this research study and answers the five guiding research questions. The first section reports the demographics of the participants in this study. The second section portrays the findings related to teacher knowledge and their perceptions of students with associated mathematical learning disabilities. The third section examines the nature of teacher attitude toward said students. The fourth section reports on current supports and interventions utilized within general education math classrooms. The fifth section expounds on what these teachers perceive are the biggest barriers when working with students identified with mathematical learning disabilities. The final section examines teacher efficacy and whether these teachers believe they are effective as general education math teachers when working with students who are identified with mathematical learning disabilities.

Demographics

Demographic data were collected on gender, grade levels taught, years of mathematical teaching experience, highest degree qualification, number of special education classes taken during their undergraduate program of study, and the number of special education classes taken during their graduate program of study. The participant sample for this study was comprised of forty-five middle-level general education math teachers from fifty-seven school districts across Wyoming. Out of the forty-five participants, twenty-eight were female (62.2%) and seventeen were male (37.8%). Fifty-five percent of the participants reported teaching a single grade level, identifying him or herself as either a sixth-, seventh-, or eighth-grade math teacher. Eighteen percent of the participants reported teaching two different grade levels, identifying themselves as either a sixth-

and seventh-grade math teacher or a seventh- and eighth-grade math teacher. Twenty-two percent of the participants reported teaching math at all three-grade levels (see Table 2).

Table 2

Grade level(s) taught

Variables	Categories	Frequency	Percentage
Subject Area	6 th Grade Only	9	20.0
	7 th Grade Only	8	17.8
	8 th Grade Only	8	17.8
	6 th & 7 th Grade	4	8.9
	7 th & 8 th Grade	4	8.9
	6 th , 7 th , & 8 th Grade	10	22.2
	Not identified	2	4.4

Out of the forty-five participants, seventeen reported having obtained their bachelor's degree (37.8%). The majority of participants (twenty-eight) reported having obtained a master's degree (62.2%) (see Table 3).

Table 3

Highest degree qualification

Variables	Categories	Frequency	Percentage
Degree	Bachelors	17	37.8
	Masters	28	62.2
	Doctorate	0	0.0

As noted in Table 4, the amount of teaching experience reported by participants ranged from one year to sixteen plus years of experience. Only one first-year teacher participated in this study (2.2%). About six percent of the participants reported having between one-to-two years of

experience, two percent reported having between three-to-five years of experience, twenty-two percent reported having between six-to-ten years of experience, and seventeen percent reported having between eleven-to-fifteen years of experience. The majority of participants reported having sixteen or more years of experience (48.9%). One participant, in a qualitative response, reported teaching for twenty-seven years.

Table 4

Teaching experience

Variables	Categories	Number	Percentage
Teaching Experience	First Year	1	2.22
	1-2 Years	3	6.67
	3-5 Years	1	2.22
	6-10 Years	10	22.22
	11-15 Years	8	17.78
	16+ Years	22	48.89

When asked about the number of special education classes taken during their undergraduate program of study, fifteen percent of the participants reported that they had not taken any special education classes (see Table 5). Fifty-one percent of the participants reported taking only one special education class. Twenty-six percent reported taking three-to-five classes and six percent reported taking six or more classes.

Out of the twenty-eight participants who reported having their Master's degrees, thirteen reported taking special education classes during their graduate program of study (46%). Four Bachelor level participants reported taking Master's level classes, but did not identify holding a Master's degree. Two of the bachelor level participants reported taking one special education course, one reported taking three-to-five classes, and one reported taking six-plus classes. When

examining the participants who had already obtained their master’s degree, three reported that they had taken three-to-five classes. Ten Master level participants reported taking one special education class (41.6%) and fifteen reported not taking any special education classes during their Master’s program of study (53.5%).

Table 5

Undergraduate and graduate special education classes

Variables	Categories	Frequency	Percentage
Undergraduate Special Education Classes	0	7	15.6
	1	23	51.1
	3-5	12	26.7
Graduate Special Education Classes	6+	3	6.7
	0	26	60.5
	1	12	27.9
	3-5	4	4.0
	6+	1	1.0

Teacher Knowledge and Perceptions

The first guiding question examined the extent of teacher knowledge and their perceptions about mathematical learning disabilities, including the disability dyscalculia. The survey asked Wyoming participants to indicate their level of agreement or disagreement on twelve item stems related to their knowledge and perceptions (see Table 6). The first item stem for this section asked participants whether they understood the impact that a mathematical learning disability (MLD) had on special education students in the general education math classroom. In response, eleven participants reported that they strongly agreed with this statement (24%) and twenty-five

participants reported that they agreed (55.6%). Seventeen percent said that they somewhat agreed, while one participant reported that she disagreed with this statement (2%).

Table 6

I understand the impact that a mathematical learning disability has on special education students.

Responses	Frequency	Percentage
Strongly Agree	11	24.4
Agree	25	55.6
Somewhat agree	8	17.8
Somewhat disagree	0	0
Disagree	1	2.2
Strongly disagree	0	0

The second item stem questioned teachers on whether or not they felt adequately prepared to support the learning of students identified with mathematical learning disabilities within the general education (GE) math setting (see Table 7). Twenty-one participants reported that they felt adequately prepared with thirty-three percent stating that they agreed and thirty percent stating that they strongly agreed. Thirty-five percent felt that they somewhat agreed with the statement, while close to nine percent of the participants felt that they somewhat disagreed with the statement. A little over eight percent of the participants felt that they did not feel adequately prepared to support the learning of special education students.

Table 7

I am adequately prepared to support the learning of students identified with MLD within the GE classroom.

Responses	Frequency	Percentage
Strongly Agree	6	13.3

Agree	15	33.3
Somewhat agree	16	35.5
Somewhat disagree	4	8.9
Disagree	4	8.9
Strongly disagree	0	0

The third item stem asked participants if they had the required resources and materials needed to support the learning of students identified with a mathematical learning disability (see Table 8). Thirty-five percent of the participants reported that they do have the required resources, with twenty-eight percent stating that they agreed, and about six percent stating that they strongly agreed with the statement. Thirty-seven percent of the participants somewhat agreed with the statement, and eleven percent felt that they somewhat disagreed. One individual strongly disagreed with the statement (2.2%).

Table 8

I have the required resources and materials needed to support the learning of students identified with a MLD.

Responses	Frequency	Percentage
Strongly Agree	3	6.7
Agree	13	28.9
Somewhat agree	17	37.8
Somewhat disagree	6	13.3
Disagree	5	11.1
Strongly disagree	1	2.2

The fourth item stem asked teachers if they felt that a person with a mathematical learning disability would likely have difficulty with all aspects of mathematics (see Table 9). Twenty-four

percent of the participants did not feel that students with mathematical learning disabilities would struggle in all areas of math. However, around six percent of the participants agreed with this statement. Around nine percent of the participants somewhat agreed with this statement whereas about twenty-six percent of the participants were not sure as to whether or not a student with a mathematical learning disability would have difficulty with all aspects of mathematics.

Table 9

A person with MLD is likely to have difficulty with all aspects of mathematics.

Responses	Frequency	Percentage
Agree	3	6.7
Somewhat Agree	4	8.9
Not Sure	12	26.7
Somewhat Disagree	15	33.3
Disagree	11	24.4

The fifth item stem examined whether or not the participants knew what assistive technology would best support students with mathematical learning disabilities in the general education classroom (see Table 10). Twenty-two percent of the participants felt that they did know what assistive technology would best support students in the general education setting, with seven identifying that they agreed (15.9%) and three identifying that they strongly agreed (6.8%). The majority of participants felt that they somewhat knew what assistive technology would best support students (36.3%), while eighteen percent somewhat disagreed with the statement. Twenty-two percent of the participants did not feel that they knew what assistive technology would best support student learning, with twenty percent disagreeing with the statement and two percent strongly disagreeing.

Table 10

I know what assistive technology would best support students with MLD in the GE setting.

Responses	Frequency	Percentage
Strongly Agree	3	6.8
Agree	7	15.9
Somewhat agree	16	36.4
Somewhat disagree	8	18.2
Disagree	9	20.4
Strongly disagree	1	2.3

The sixth item stem asked participants if students with mathematical learning disabilities struggle with working memory issues (see Table 11). Twenty percent of the participants believed that working memory does play a part in mathematical learning disabilities and thirty-three percent somewhat agreed. Twenty-eight percent of the participants were not sure whether or not working memory could be an issue. Around nine percent of the participants slightly disagreed with the statement, while another nine percent did not agree with the statement at all.

Table 11

Students with MLD struggle with working memory issues.

Responses	Frequency	Percentage
Agree	9	20.0
Somewhat agree	15	33.3
Not sure	13	28.9
Somewhat disagree	4	8.9
Disagree	4	8.9

The seventh item stem asked participants if students with mathematical learning disabilities struggle with processing speed issues (see Table 12). Twenty-four percent of the participants did feel that processing speed would be an issue for students with mathematical learning disabilities. Forty-two percent somewhat agreed with the statement, whereas twenty percent were not sure about its impact. Eleven percent of the participants disagreed somewhat with the notion that processing speed can be an issue. One participant disagreed with the statement.

Table 12

Students with MLD struggle with processing speed issues.

Responses	Frequency	Percentage
Agree	11	24.4
Somewhat agree	19	42.2
Not sure	9	20.0
Somewhat disagree	5	11.1
Disagree	1	2.2

The eighth item stem asked whether a person with a mathematical learning disability may struggle with basic math facts (see Table 13). Close to fifty-eight percent of the participants reported that a person may struggle with basic math facts by stating that they agreed. Thirty-three percent of the participants somewhat agreed with the statement. One participant was not sure (2.2%). Two participants disagreed with this statement somewhat (4.4%), and one participant did not agree with this statement (2.2%).

Table 13

A person with a MLD may struggle with remembering basic math facts.

Responses	Frequency	Percentage
Agree	26	57.8

Somewhat agree	15	33.3
Not sure	1	2.2
Somewhat disagree	2	4.4
Disagree	1	2.2

The ninth item stem questioned teachers about whether they knew what teaching methods (i.e. multi-sensory teaching methods) are most helpful for students identified with mathematical learning disabilities (see Table 14). Twenty-eight percent of the participants reported knowing what teaching methods are most helpful, with twenty-four percent stating that they agreed with the statement and four percent stating that they strongly agreed. Thirty-five percent of the participants “somewhat agreed” with this statement, while twenty-four “somewhat disagreed.” Roughly nine percent of the participants did not feel that they knew which teaching method would be the most helpful. Only one participant “strongly disagreed” with the statement.

Table 14

I know which teaching methods are most helpful for students with MLD.

Responses	Frequency	Percentage
Strongly Agree	2	4.4
Agree	11	24.4
Somewhat agree	16	35.6
Somewhat disagree	11	24.4
Disagree	4	8.9
Strongly disagree	1	2.2

The tenth item stem asked teachers if they had heard of the term “dyscalculia” as it relates to a specific mathematical learning disability (see Table 15). Approximately forty-nine percent of

the participants had heard of the term before. However, a little over fifty percent of the participants reported that they had not heard of the term.

Table 15

I have heard of the term “dyscalculia” as it relates to a specific MLD.

Responses	Frequency	Percentage
Yes	22	48.9
No	23	51.1

The eleventh item stem asked teachers if they had a solid understanding of what the mathematical disability dyscalculia is and how it impacts learners (see Table 16). Two of the participants felt that they had a solid understanding of what dyscalculia is and its impact, with one male participant “agreeing” (2.2%) and one female participant “strongly agreeing” (2.2%). Twenty-four percent of the participants felt that they somewhat understood what it is and how it impacts students, while close to nine percent of the participants somewhat disagreed. The majority of participants did not feel that they had any understanding of what dyscalculia is and how it impacts students with twelve participants disagreeing with the statement (26.6%) and sixteen participants strongly disagreeing (35.5%).

Table 16

I have a solid understanding of what the MLD dyscalculia is and how it impacts student learners.

Responses	Frequency	Percentage
Strongly Agree	1	2.2
Agree	1	2.2
Somewhat agree	11	24.4
Somewhat disagree	4	8.9
Disagree	12	26.7

Strongly disagree	16	35.6
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The twelfth item stem asked teachers if they had taught one or more students who had been identified with the math disability dyscalculia (see Table 17). The majority of participants reported that they did not know (64.4%). Around seventeen percent of the participants reported having taught one or more students identified with dyscalculia and around seventeen percent reported that they had not.

Table 17

I have taught one or more students who are identified with the MLD dyscalculia.

Responses	Frequency	Percentage
Yes	8	17.7
Don't know	29	64.4
No	8	17.7

One of the open-ended questions asked teachers to define or describe the mathematical learning disability dyscalculia. The participants' responses were coded in order to determine similarities or themes. Thirty-five participants responded to the question and forty-five percent of those respondents stated that they were not sure how to define the term. The qualitative data obtained from the participants seemed to center around six different themes (see Table 18): (a) memory issues including short-term memory and working memory; (b) difficulty with processing speed; (c) difficulty with number sense; (d) difficulties with mathematical calculations; (e) difficulty with the language of mathematics; (f) difficulties with remembering math facts; and (g) difficulties with number reversals and problems "reading information correctly" comparable to dyslexia. In a qualitative response, one of the participants stated that dyscalculia is where students "struggle to hold information in their working memory long enough to complete a problem."

Another participant said that dyscalculia is “difficulty understanding numbers, operations with numbers, recalling math facts, interpreting story problems or application of computational fluency.” A third participant said, “dyscalculia can be anywhere from number reversals to switching operations to reading information incorrectly. A fourth participant define dyscalculia as “the struggle/inability to read, understand, and calculate with numbers.” A list of participant responses to this open-ended question is located in Appendix K.

Table 18

Define/Describe the MLD dyscalculia.

Themes of teacher qualitative responses	Frequency
Difficulty with math calculations	7
Difficulty with number sense	8
Difficulty learning math facts	5
Difficulty with organizing numbers	2
Difficulty with the language of mathematics/math dyslexia	7
Memory issues	3
No idea	16

Summary of Teacher Knowledge and Perceptions

Overall, eighty percent of the participants reported understanding the impact that a mathematical learning disability has on special education students in the general education math classroom. However, only about half of the participants reported feeling adequately prepared and only about a third of the participants reported having the required resources and materials needed to support the learning of students identified with mathematical learning disabilities. When asked about their understanding as to whether or not a student with a mathematical learning disability would have difficulty with all aspects of mathematics, less than twenty-five percent understood

that it is a heterogeneous disability. Additionally, only twenty to twenty-eight percent of the participants reported knowing what assistive technology and what teaching methods would be most helpful for students with mathematical learning disabilities. Furthermore, forty-six percent of the participants were either unsure or did not agree with the notion that students with a mathematical learning disability can struggle with working memory issues, while thirty-three percent were unsure or did not agree with the idea that these students can struggle with processing speed issues. The one consensus that the participants seemed to have was on basic fact fluency. A little over ninety percent of the participants recognized that these students might struggle with remembering basic math facts.

In addition to the lack of knowledge around mathematical learning disabilities, only about fifty percent of the participants had heard of the math disability ‘dyscalculia.’ Although seventeen percent of the participants reported having taught one or more students identified with dyscalculia, only four percent of the participants reported having an understanding of what the disability is and how it impacts students.

Nature of Teacher Attitudes

The second guiding question examined the nature of teacher attitudes regarding mathematical learning disabilities. The teacher survey included four statements in which teachers were asked to indicate their level of agreement or disagreement about whether students with mathematical learning disabilities should: (a) receive all of their math instruction in the general education classroom; (b) whether working with students with mathematical learning disabilities takes away from the learning of other students in the classroom; (c) whether the label “mathematics learning disability” is an excuse for students to stop trying; and (d) whether teacher

perceptions about “student ability” can impact the learning of students with mathematical learning disabilities.

The first item stem that examined the nature of teacher attitudes asked teachers whether they felt students with mathematical learning disabilities should receive all of their instruction in the general education math classroom (see Table 19). Out of the forty-five participants, three agreed (6.7%) and five strongly agreed (11%) with this statement. Twenty-four percent of the participants somewhat agreed with the statement, while close to twenty-seven percent disagreed somewhat. Thirty-one percent of the participants did not feel that all of the instruction should happen within the general education math classroom.

Table 19

Many students with MLD should receive ALL of their instruction in the GE math classroom.

Responses	Frequency	Percentage
Strongly Agree	5	11.1
Agree	3	6.7
Somewhat agree	11	24.4
Somewhat disagree	12	26.7
Disagree	9	20.0
Strongly disagree	5	11.1

The second item stem asked the participants if having to spend additional time working with students identified with mathematical learning disabilities takes away from the learning opportunities of other students in their classrooms (see Table 20). A little over fifteen percent of the participants agreed with this statement with around seven percent saying they strongly agreed. Fifty-one percent of the participants said that they somewhat agreed with this statement, while eleven percent said that they somewhat agreed with this statement. Around fifteen percent of the

participants did not feel that working with students with mathematics learning disabilities takes away from the learning of other students.

Table 20

Having to spend additional time working with students identified with MLD takes away from the learning opportunities of the other students in my classroom.

Responses	Frequency	Percentage
Strongly Agree	3	6.6
Agree	7	15.6
Somewhat agree	23	51.1
Somewhat disagree	5	11.1
Disagree	7	15.6
Strongly disagree	0	0

The third item stems asked teachers if the label “mathematical learning disability” can be used as an excuse for students to stop trying (see Table 21). One participant strongly agreed that the label can be an excuse for students to stop trying (2.2%) and another fifteen percent said that they agreed. Thirty-three percent of the participants said they agreed somewhat with the statement, whereas eleven percent disagreed somewhat. Twenty-six percent of the participants did not agree that the label is an excuse for students to stop trying and eleven percent strongly disagreed.

Table 21

The label “MLD” can be an excuse for students to stop trying.

Responses	Frequency	Percentage
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Strongly Agree	1	2.2
Agree	7	15.6
Somewhat agree	15	33.3
Somewhat disagree	5	11.1
Disagree	12	26.7
Strongly disagree	5	11.1

The fourth item stem asked teachers whether they believed that teacher perception about “student ability” impacts the learning of students with mathematical learning disabilities (see Table 22). Seventy-one percent of the participants felt that teacher perception regarding ability does impact student learning with forty-two percent saying they agreed and about twenty-nine percent saying they strongly agreed. Approximately twenty-six percent of the participants reported that they somewhat agreed with this statement. Only one participant disagreed with this statement (2.2%).

Table 22

Teacher perceptions about “student ability” can impact the learning of students with MLD.

Responses	Frequency	Percentage
Strongly Agree	13	28.9
Agree	19	22.2
Somewhat agree	12	26.7
Somewhat disagree	0	0
Disagree	1	2.2
Strongly disagree	0	0

Summary of Teacher Attitudes

Out of the forty-five participants, only seventeen percent felt that students with mathematical learning disabilities should receive all of their instruction in the general education math classroom, while around a third of the participants did not agree. Seventy-three percent of the participants felt that spending additional time with students who are identified with mathematical learning disabilities takes away from the learning of others to some extent. In looking at the “mathematical learning disability” label, around half of the participants seemed to think that students may use it as an excuse to stop trying, while close to forty percent did not agree. When it came to teacher perception regarding “student ability,” a little more than seventy percent of the participants felt that teacher perception could have an impact on the learning of students identified with a mathematical learning disability. Only one participant did not agree with the idea that teacher perception can impact student learning.

Supports and Interventions

The teacher survey included three item stems and one open-ended question related to supports and intervention. The first item stem for this section asked teachers about their knowledge of best practice teaching interventions to support students identified with mathematical learning disabilities (see Table 23). Forty-four percent of the participants reported they did know best practice teaching interventions with around thirty-five percent of the participants stating they agreed with the statement and about nine percent saying they strongly agreed. Thirty-five percent of the participants felt that they somewhat agreed with the statement, while eleven percent felt they somewhat disagreed. Eight percent of the participants either disagreed (6.6%) or strongly disagreed (2.2%) with the statement.

Table 23

I know best practice teaching interventions to support students with MLD.

Responses	Frequency	Percentage
Strongly Agree	4	8.9
Agree	16	35.6
Somewhat agree	16	35.6
Somewhat disagree	5	11
Disagree	3	6.7
Strongly disagree	1	2.2

The second item stem asked participants if students identified with a mathematical learning disability benefit from 1:1 support from special education staff within the general education setting (see Table 24). A little over thirty-seven percent of the participants strongly agreed with this statement and another twenty-six percent agreed. Thirty-three percent of the participants somewhat agreed and only one participant disagreed (2.2%).

Table 24

Students identified with a MLD benefit from 1:1 support from special education staff within the GE classroom.

Responses	Frequency	Percentage
Strongly Agree	17	37.8
Agree	12	26.7
Somewhat agree	15	33.3
Somewhat disagree	0	0.0
Disagree	1	2.2
Strongly disagree	0	0.0

The third item stem asked participants if they co-taught general education math classes with a special education teacher when students identified with mathematical learning disabilities were in their classes (see Table 25). Seventeen participants reported that they did co-teach with a special education teacher (37.7%). Five participants somewhat agreed with this statement (11%). Three participants reported that they somewhat disagreed with this statement (6.7%). Twenty participants reported that they have not co-taught with a special education teacher (44.4%).

Table 25

I co-teach general education math classes with a special education teacher when there are students identified with mathematical learning disabilities in my math class.

Responses	Frequency	Percentage
Strongly Agree	7	15.6
Agree	10	22.2
Somewhat agree	5	11.1
Somewhat disagree	3	6.7
Disagree	13	28.9
Strongly disagree	7	15.6

The open-ended question asked teachers to list three to four resources that they have used to support the learning of students identified with mathematical learning disabilities. The participants' responses were coded in order to determine similarities or themes. The intervention and supports that the participants provided fell under eight themes: (a) standard IEP accommodations (i.e. extended time, modified assignments, preferential seating, teach/re-teach, copy of class notes, option to work in a separate location, etc.); (b) special education support from either a special education teacher (co-teaching and/or consultation) or a classroom paraprofessional; (c) the use of manipulatives (i.e. algebra tiles, + & - tiles), models, and visual

aids (GeoGebra applet, and Desmos applet); (d) assistive technology including the use of calculators and Chromebooks; (e) the use of multiplication tables; (f) small group and/or one-on-one instruction; (g) the use of online resources for instruction, reteaching, and/or additional practice (i.e. IXL, Moby Max, Think Through math, Compass Learning, Go Math, TenMarks by Amazon); and (h) supports and/or extra practice provided within the curriculum being used (i.e. CPM, Imagine Math, Foundation of Math, & Big Ideas Math).

One participant reported using physical activity to connect to content. In a qualitative response, one participant said, “for instance, to help students understand graphing, I lay out a coordinate plane on the floor and have students graph themselves. When they [the students] begin working with linear equations, I give them strings to make the lines.” One participant stated, “the only material I really use to intervene I come up with myself.” Another participant shared that she uses “hands on manipulatives to make abstract concepts concrete; IXL for individualized instruction and practice; use of calculators; extended teaching time through a flex class period; additional support through a 45-minute intervention class.” One more participant reported using “number talks, subitizing resources, counting-on, [and] math recovery.” A list of participant responses to this open-ended question is located in Appendix L.

Summary of Supports and Interventions

Close to eighty percent of the participants reported that they know best practice teaching interventions. In their qualitative responses, participants shared interventions and supports that fell within eight overarching themes that ranged from standard IEP accommodations to the use of online student resources (see Appendix L). One of the themes looked at special education adult support within the math classroom. According to sixty-four percent of the participants, students

identified with mathematical learning disabilities do benefit from one-on-one special education support in the general education classroom.

Perceived Barriers

The fourth guiding question examined what teachers perceived as the barriers to providing instruction and/or supports to learners with mathematical learning disabilities. An open-ended question was used to find out what the perceived barriers were. Thirty-eight participants responded to this question and there appeared to be sixteen overarching themes within their responses: (a) the challenge of working with “20 students” with varying abilities; (b) a lack of co-planning time with special education staff; (c) a lack of time to work with students in one-on-one situation; (d) a lack of knowledge and formal training; (e) a lack of special education support; (f) content being taught differently by different teachers; (g) a lack of home support or follow through; (h) a lack of access to resources; (i) a lack of motivation and confidence in identified students; (j) negative attitudes towards math; (k) an inability of students to work independently; (l) gaps in math skills; (m) student behavior; (n) pressure to have all students in the general education math setting; (o) the need for students to be “properly” identified; and (p) “access to possible resources to aid their learning in a more effective manner.”

In the qualitative responses, one participant stated, “the biggest barrier to teaching students with math learning disabilities is the time constraints that are present in a traditional middle school schedule. If a student doesn’t get a concept in a 45-minute time period, oftentimes, it has to be ‘tabled’ until the next class period.” Another participant responded to the question by saying, “I have not received any specialized training to teach students with math disabilities.” A third participant said the biggest barrier was “the pressure to have them in a general education classroom...when a student is a few grades below their peers, asking them to complete work along

with their peers, even when given extra time and resources, can be unrealistic.” Additional comments regarding perceived barriers can be found in Appendix M.

A common perceived barrier among the respondents was the lack of formal training regarding mathematical learning disabilities. The first item stem asked participants whether they felt the special and general education courses that they previously took prepared them to teach math to students with mathematical learning disabilities (see Table 26). None of the participants strongly agreed with this statement, while six percent did agree. Approximately, twenty-four percent of the participants felt that their special and general education courses prepared them “somewhat.” Forty-two percent of the participants reported that they did not feel their method courses prepared them to provide instruction to students with mathematical learning disabilities. Around twenty-nine percent stated that they “disagreed” with the statement and thirteen percent stated they “strongly disagreed.”

Table 26

The special and GE methods courses that I took prepared me to teach math to students with MLD.

Responses	Frequency	Percentage
Strongly Agree	0	0.0
Agree	3	6.7
Somewhat agree	11	24.4
Somewhat disagree	12	26.7
Disagree	13	28.9
Strongly disagree	6	13.3

The second item stem asked teachers if they had received additional training through professional development opportunities related to working with students identified with

mathematical learning disabilities (see Table 27). Nearly half of the participants reported that they had not received any additional training (48.8%). A little over twenty-six percent of the participants reported receiving training. Around eighteen percent of the participants somewhat agreed that they had received additional training, while around seven percent disagreed with this statement somewhat.

Table 27

I have received additional training through PD opportunities related to working with students identified with MLD.

Responses	Frequency	Percentage
Strongly Agree	0	0.0
Agree	12	26.7
Somewhat agree	8	17.8
Somewhat disagree	3	6.7
Disagree	16	35.6
Strongly disagree	6	13.3

Summary of Perceived Barriers

Participants identified sixteen different barriers when it came to providing instruction to students with mathematical learning disabilities. A couple of the biggest barriers mentioned in the qualitative responses included “lack of time” and lack of knowledge or formal training. Comments related to lack of time primarily focused on being able to work one-on-one with students. When it came to training, only around six percent of the participants felt that the special and general education courses that they took prepared them to teach math to students with mathematical learning disabilities. Additionally, only twenty-six percent reported (with certainty) receiving additional training related to working with students identified with mathematical learning

disabilities through professional development opportunities compared to forty-eight percent who reported not having received any professional development training.

Teacher Self-Efficacy

An open-ended question was used to learn whether teachers felt effective as math teachers when working with students identified with mathematical learning disabilities (see Appendix N for Self-Efficacy Responses). Out of the forty participants who responded to this question, eleven of the participants believed that they were effective (25%). In a qualitative response, one participant said that it is because “I build relationships with my students to make sure they are comfortable and safe within my room.” Another participant said, “I do believe that I am effective when working with identified students with mathematical learning disabilities . . . I choose to look at them as challenges rather than disabilities.” One participant answered the question with: “I have a strong foundation in math and understand scope and sequence well . . . it is important to know which skills are needed to understand a new concept.” An additional comment stated:

Overall, I feel very effective with students on IEPs in the general education classroom. I do have to say that my caseload is pretty minimal with 10 or less students on IEPs per year. We also co-teach with the special education teacher. I LOVE having IEP students in my classroom under this model. We help each other out as team teachers. The special education teacher helps with how to assist students with disabilities while I help teach different ways to approach the concepts so all learners can understand.

In examining qualitative comments, it appears that eleven participants believed that they are somewhat effective. Their responses ranged from just stating, “Some days yes and some days no” to “I feel that I could benefit from additional training and professional development regarding mathematical learning disabilities.” One person stated, “It depends on what they [the students] are

struggling with as some material and some concepts I can come at from different directions and this increases the understanding of the concept.” Another participant stated, “I have been effective with some students, and not so effective with others.”

Four participants stated that they do not feel effective when working with students who have mathematical learning disabilities. One participant said that he doesn’t feel effective “mainly because of time...if I could have extra time just for those students . . . but the demands of the district and state don’t allow me to spend enough time with those students.” Another participant said, “no . . . despite having a minor in SpEd, I have never had explicit instruction in how to help students with a math learning disability. The coursework that I had focused on reading and writing, and I don’t remember ever being taught how to support math students with a disability.”

Summary of Teacher Self-Efficacy

Based on the qualitative data, only a quarter of Wyoming middle-level math teachers feel effective when working with students with mathematical learning disabilities. Eight percent of the teachers do not feel effective at all. Their reasoning ranges from not having enough time to work with students to not feeling they had the background knowledge that is necessary.

Chapter 5

Discussion

The term mathematical learning disability might at first seem pretty straight forward, but a single definition does not exist due to the different disciplines and different diagnostic criteria involved. It is a multifaceted and heterogeneous learning disability that affects students at behavioral, psychological, and neuronal levels (Kucian & von Aster, 2015). Yet, middle-level mathematics teachers across the country are being asked to provide math instruction for all, regardless of (dis)ability. The purpose of this research was to investigate the current knowledge and perceptions of Wyoming middle-level general education math teachers in regards to mathematical learning disabilities and the mathematical disability dyscalculia. The focus of this chapter will be a discussion of the findings based on data collected from forty-five Wyoming middle-level math teachers, the limitations of the research study, the implications for future research, possible recommendations, and a conclusion statement.

Teacher Knowledge and Understanding

The first section of this discussion examines the findings related to teacher knowledge and their understanding of mathematical learning disabilities and then focuses on the mathematical learning disability dyscalculia. It is apparent from this research that the majority of Wyoming middle-level math teachers believe they understand the impact that a mathematical learning disability has on special education students in the general education setting. However, a little over half of the teachers did not feel adequately prepared to support the learning of these students. This finding is consistent with Brownell et al. (2006) who stated that general education teachers “play a primary role in the education of students with disabilities... [but often] report feeling unprepared to undertake this role” (p. 171).

When asked about having the required resources and materials needed to support the learning of these students, only thirty-five percent of the participants felt like they had them. This indicates that a large percent of the participants either did not believe they had the required resources or they physically did not have an adequate amount of the necessary resources. This finding coincides with DeSimone and Parmar (2006) who presented the results of a study on general educators' perceptions of inclusion, where less than one-third of the general educators thought they had adequate resources.

Additionally, only twenty-two percent of the participants reported knowing which assistive technology would best support students with mathematical learning disabilities in the classroom. Although this is not surprising, it is a concern because research has supported the potential of assistive technology for improving student outcomes, yet it continues to be under-utilized in schools (Naraian & Surabian, 2014). These researchers state that “challenges to the effective utilization of AT in schools are numerous and implicate a variety of factors including insufficient personnel training, inadequate use of service delivery models, unavailability of funds, and insufficient guidance at state policy levels” (p. 330).

Close to seventy-five percent of the participants did not know whether students with mathematical learning disabilities would have working memory or processing speed issues. According to David (2012), working memory “refers to a limited capacity memory system specialized in temporary storage and processing of information necessary to perform various tasks” (p. 68). Research has established that a number of children identified with mathematical learning disabilities perform poorly compared to same-aged peers on working memory tasks (Geary, 2013; Geary et al, 2007). Furthermore, a strong working memory is an essential pre-requisite for many areas of math including mental arithmetic (Chinn, 2016). Similar to issues with

working memory, students identified with mathematical learning disabilities may struggle with processing speed issues. Geary et al. (2012) stated that independent of the influence of working memory and intelligence, processing speed might contribute to mathematical achievement and to the development of specific mathematical competencies. The researchers expand on this point stating: “The key point is that simultaneous control of intelligence, working memory, and processing speed is necessary for isolating the specific mathematical cognition deficits that contribute to the low start points and slow achievement growth of groups of MLD” (p. 207).

When it came to knowing whether a student with a mathematical learning disability could struggle with remembering basic math facts, fifty-seven percent of the participants agreed and another thirty-three percent somewhat agreed. It is very clear from this research that students with mathematic learning disabilities often struggle with learning and remembering their math facts (Price & Ansari, 2013; Sores & Patel, 2015; Kumar & Raja, 2009). Furthermore, it is important to note that “a poor retrieval of basic facts will exacerbate working memory problems” (Geary et al., 2012, p. 189).

Even though fifty percent of the participants in the study reported hearing of the term ‘dyscalculia,’ only four percent reported having an understanding of what the disability is and how it impacts students. This result was predictable because unlike the United Kingdom and other parts of the world, dyscalculia is not, yet, a common term used in the United States (Chinn & Ashcroft, 2007). However, it is important to gain an understanding of what it is and how it impacts student learning because it is gaining recognition among educators, professionals, and the public (Soares & Patel, 2015). An additional finding from the qualitative data was that without fully understanding what dyscalculia is, the participants were able to identify a number of the characteristics of dyscalculia including difficulty with: (a) math calculations, (b) number sense, (c)

organizing numbers, (d) the language of mathematics, and (e) memory issues. Their responses did align with current research in this aspect (Kucian & von Aster, 2015; Kumar & Raja, 2009; Turkington & Harris, 2002).

Nature of Teacher Attitudes

The second section of this discussion examines the nature of teacher attitudes and perceptions about mathematical learning disabilities. According to the results, around seventy-five percent of the participants in this research study felt that spending additional time working with students identified with mathematical learning disabilities takes away from the learning of other students. Although there did not appear to be an abundance of supporting information in the literature around this concept, it was not surprising that the participants felt this way. General education math teachers are being asked to teach math content, at a high-level, to a classroom full of students, with one or more of those students performing significantly below the content level being taught. Their challenges, therefore, may either stem from their desire to take the time to ensure that all students are developing an understanding of their content or from not possessing the knowledge on how to differentiate instruction based on the diverse group of learners within their classroom (Paulsen, 2013). For the most part, teachers who have the knowledge and resources should be able to meet the needs of the majority of learners in their classes. However, it is also important to recognize that even though there is a push towards the inclusion of all students in the general education setting, it is stated that one of the overriding rules for placement is based on “the degree of disruption of the education of other students resulting in the inability to meet the unique needs of the student with a disability” (Wright & Wright, 2018)

Participants were also asked if the mathematical learning disability label could be an excuse for students to stop trying. Although only seventeen percent of the participants believed

this to be true, almost half were “in the middle” when it came to agreeing with this statement. This finding suggests that, to some extent, the participants believed that the label might be an excuse for students with mathematical learning disabilities to stop trying. Conversely, there could be a number of other reasons why a student may appear to stop trying, which were not fully understood by the participants. For some students, the rigor of the content and the lack of prerequisite mathematical skills may lead students to give up. Furthermore, the pace of the class may be too rapid for some students, which may lead to them mentally “checking out.” Moreover, Rattan, Good, and Dweck (2011) discuss how the American society promotes the idea that a person’s weakness should be accepted as long as their strengths are being maximized. They continue further saying that “one frequently encounters students embodying this idea when they claim, “I’m just not a math person” (p. 731). On top of this, students who perceive themselves as “not good” at math could potentially “develop a fearful avoidance of mathematical situations known as math anxiety” (Wadlington & Wadlington, 2008, p. 3).

When asked about whether teacher perceptions about ‘student ability’ can impact the learning of students with mathematical learning disabilities, the majority of the participants did report that it could. This is consistent with the findings of Scherer et al. (2016), who reported: “teachers’ beliefs and attitudes towards low achieving children seem to influence their teaching” (p. 643). The researchers continue further to say that students in a class that is based on low ability “experienced a learning environment characterized by low expectations” (p. 643).

The main finding in this section was that teacher beliefs and attitudes inevitably play a key role in student learning. Ekstam et al. (2017) support this conclusion reporting: (a) the teacher is the strongest element when it comes to student achievement, and (b) teacher attitude is a key quality influencing student achievement. Ultimately, teachers need to “reach beyond the

resistance” in order to find ways to listen to students, affirm their abilities, and motivate them (Van de Walle et al., 2013).

Interventions and Supports

Although it is unrealistic to expect that all teachers have a solid understanding of mathematical learning disabilities, especially when most of the teacher participants reported taking one or fewer special education classes, it is important to note that almost fifty percent of the participants did feel that they are aware of “best practice” teaching interventions to support the learning of students with mathematical learning disability within their classrooms. However, if one was to look closely at the current intervention practices being used, these interventions could potentially be brought into question as to whether or not they are truly “best practice.” The questioning of these practices is not only because of information obtained from qualitative statements made by the participants, but also based on information from existing literature. In both occurrences, there continues to be a lack of evidence-based research regarding “best practice” interventions, especially at the secondary level (Bottge et al., 2015, Bouck & Kulkarni, 2009; Scherer et al., 2016). Bottge et al. (2015) reported, “only 15.9% of the articles in special education journals between 1988 and 2006 targeted academics with reading studies outnumbering math studies five to one” (p. 158). According to Scherer et al. (2016), “the most frequently used type of intervention at this level is direct instruction and ‘drill and practice’ teaching” (p. 638). They further go on to say that at the secondary level, students have generally focused on higher mathematical domains, such as algebraic skills and concepts. Basic mathematical knowledge from primary school is no longer addressed. What can be said is that the Wyoming middle-level math teachers, who participated in this study, are currently working with the resources they have in order to try to best meet the diverse needs of all their students.

Participants were asked whether students identified with a mathematical learning disability benefit from one-on-one support from special education staff within the general education classroom. Kucian and von Aster (2015) reported that interventions are most successful in one-on-one training sessions when they include both curricular and non-curricular numerical topics. Additionally, “there is no doubt that paraprofessionals are an established and growing presence in U.S. schools” with federal data indicating that as of 2005 approximately 390,000 special education teacher aides worked in the field of special education (Giangreco, Suter, & Doyle, 2010, p. 41). Furthermore, research has shown that paraprofessional proximity within the general education setting does have a positive impact on active and passive academic engagement. However, the authors also reported that “general education teachers tended to be more engaged with their students with disabilities, a critical feature necessary for meaningful inclusion, when paraprofessionals were assigned to their classrooms rather than to an individual student” (p. 47). Furthermore, Kilanowski-Press, Chandra, and Rinaldo (2010) report:

One to one student support, plausibly the least inclusive form of instruction depending upon implementation logistics, emerged as the most prevalent type of support provided in inclusive classrooms. Though one to one support serves as a necessary and integral means of reinforcing novel information and remediation of extant skill deficits within the general education classroom, the role of such instructional formats must be carefully monitored to ensure compatibility with best practice. Students presenting with considerable need for remediation, severe delays in information processing and the retention and mastery of novel concepts, require intervention delivered with the integrity and intensity provided in a one to one situation (p.53).

The last item stem that was looked at in this intervention and support section looked at whether the participants co-taught math classes with a special education teacher when there were students identified with mathematical learning disabilities in their math classes. Only thirty-seven percent reported that they did co-teach, with an additional eleven percent reporting they somewhat agree with co-teaching opportunities. This finding seems to be consistent with the literature. According to Conderman and Hedin (2013), despite its growing popularity, co-teaching in some classrooms has yet to reach its potential. Furthermore, the researchers mention that because special education teachers frequently lack a clear role, they often assume a role similar to that of a paraprofessional.

Perceived Barriers

When asked about perceived barriers, lack of time available to work one-on-one with identified students due to time constraints, was one of the most frequently made comments. Almost half of the respondents identified the lack of “time with each student” as being one of the biggest barriers. With the expectation that all students, regardless of ability (or lack of), work towards grade-level standards, teachers may feel pressured to help all students achieve grade-level proficiency, even those who are performing two-to-three grade levels behind other students in their math class (Bottge et al., 2015). The focus in the classroom then shifts toward helping all students learn the class content and attention turns away from addressing the mathematical deficits that students with mathematical learning disabilities possess. Fuchs et al. (2015) purport: “the magnitude and persistence of [students’] academic deficits raise important questions about the nature and effectiveness of the value of relying heavily on core classroom instruction, with accommodations, to meet these students’ academic needs” (p. 135). If the content is too challenging and the academic needs of the students are not being met, as they continue to move

through the various grade levels and onto more complex math content, teachers may start to notice the negative “attitudes that are ingrained in the students” and may hear comments like “he never has been able to do math.” In the end, this issue could be considered a ‘slippery slope’ in reference to what should be the primary focus of instruction (grade-level content vs. skill deficits) and whether supplementary aids and services can meet the long-term needs of these students as they move into higher education and into the real world.

Other barriers identified by the participants in this research study included their lack of knowledge, availability of formal training, and access to resources. These barriers are consistent with those reported in literature. Berry (2011) reported that adequacy of knowledge, training, and resources (including administrative support, time for planning and consultation, and materials) have been an ongoing concern among educators when developing effective inclusive programs. In her research study, Berry reported that forty-six percent of the participants identified “instructional resources; mentoring (15 items); formal professional development opportunities, including preserve course work and in-service workshops...” (p. 638) as areas that need improvement. Berry suggests that teacher education programs need to ensure that pre-service teachers have “adequate general information about disability characteristics and effective, research-based instructional techniques” (p. 646).

It is important to note that this research did find that there was a correlation between years of teaching experience and whether participants felt that their special and general education courses prepared them to teach students with mathematical learning disabilities. Analyses calculated the *p* value to be 0.0226, which suggested that there was statistical significance. Upon further investigation, it appeared that forty-three percent of the participants, who taught between one and fifteen years agreed or somewhat agreed that their special and general education courses

prepared them to teach students with mathematical learning disabilities. This finding differed from the thirteen percent of participants who had taught for sixteen or more years, which may suggest that there have been improvements in teacher education programs for teacher preparation. However, it is also important to note that only a little over eight percent of the participants “agreed” while a little over thirty-four percent “somewhat agreed.” Even though data analysis did show a statistical significance, the findings do not necessarily suggest that the participants, who graduated more recently, feel adequately prepared. They may just feel more prepared than teachers who taught sixteen (or more) years ago.

Self-Efficacy

A final portion of this study examined teacher self-efficacy. Although this was not a part of the original focus of this study, it became apparent through the participants’ responses that teacher self-efficacy and perceptions is thought to have a huge impact on both the teaching and student learning. When participants were asked if they thought “teacher perceptions about student ability” could impact the learning of students with mathematical learning disabilities, over seventy percent of the participants indicated their agreement. Morris, Usher, and Chen (2017) supported this conclusion stating, “Teachers’ efficacy beliefs are thought to influence not only their motivation and performance but also the achievement of their students” (795). Carney et al. (2014) concurred stating, “Research indicates that teachers’ feelings of self-efficacy greatly influence their implementation of and persistence in trying reform-oriented instructional practices”, which in turn impacts student learning (p. 548). In this research study, there were variations as to whether or not teachers felt effective. There were also variations in their reasoning for whether or not they felt effective. One of the participants clearly felt effective based on an ability to build relationships with students. Another teacher reported feeling effective because of his/her patience and

understanding. Other teachers identified themselves as being effective on the basis of being able to collaborate or co-teach with special education teachers and staff. A few other teachers reported that they felt effective because of their strong knowledge base that stemmed from either their solid “foundation in math” and having a strong understanding of “scope and sequence,” or from having a strong background in special education. A number of the teachers, who reported not feeling effective or only somewhat effective, identified that this was because they did not have a strong understanding of mathematical learning disabilities. Overall, when examining the qualitative data, only about a quarter of the participants, who answered this question, felt effective when working with students with mathematical learning disabilities. How can we [principals, special education teachers, parents, students] expect all of our general education math teachers to feel effective and/or be effective with all students possessing mathematical learning disabilities when they may not have the “required” knowledge to best meet the needs of these students?

It was proposed that most Wyoming middle-level mathematics teachers would not feel that they have the required knowledge, supports, and/or resources needed to provide effective instruction to students identified with mathematical learning disabilities. The qualitative and quantitative data from this research study supported this belief. Though some mid-level math teachers reported having the knowledge, supports, and resources needed to provide effective instruction, the majority did not.

Limitations

There were several limitations to this study. The first limitation of this study can be attributed to the survey instrument that was developed by the researcher based only on personal knowledge and a brief literature review. This could have led to exclusion of certain pertinent questions that may have altered the results of this study. Additionally and although the survey was

tested for reliability (or internal consistency) using Cronbach Alpha, and the value was considered “acceptable”, the participant sample was small and there was likely a poor interrelatedness between items or heterogeneous constructs. A further limitation exists, as the survey was also a self-report measure that allowed for no control over how participants interpreted the item stems or questions. Based on participant feedback, refinement of these item-stems may lead to less variance. Another limitation arose because there were only forty-five participants, with the majority of them teaching sixteen or more years. Results, therefore, cannot be generalized to individuals who chose not to participate or those individuals who have less experience (like first year teachers). Finally, the survey was sent to principals for distribution and thus, the researcher had to rely on said principals for the recruitment of the participant population for this study, which may have restricted the number of possible participants due to ease of access to participants.

Implication for Future Research

Further research could include participants from a broader geographical range, use a higher percentage of respondents, and/or obtain information from other stakeholders like students, parents, and/or pre-service teachers. Additionally, future studies could evaluate whether current math teacher education programs (at the elementary, middle, and high school levels) are meeting the needs of pre-service teachers who will not only go out into the classroom to teach mathematics, but who will go out and teach a specific group of students whose needs may not be met through ‘typical’ teaching methods.

Possible Recommendation

When specifically looking at teacher responses to the various item stems in this research, it can be noted that a marginal number of teachers did select “strongly agree” in their responses, while a larger percentage of the teacher responses ranged from “somewhat agree” to “strongly

disagree.” Both of these answers suggested that teachers do not always feel that they had the knowledge base needed to support all students with mathematical learning disabilities. It, therefore, may benefit teachers, students, and the entire educational system to add a ‘continuing education’ requirement. This would require general education teachers, including math teachers, to take special education classes that are specifically related to their field of expertise every so often. These continuing education classes would, in theory, make it so that every single teacher could confidently answer the questions in this study with the response of “strongly agree”.

Conclusion Statement

The focus of this study was to examine general education mathematics teacher’s understanding, knowledge and perceptions about mathematical learning disabilities, including the disability dyscalculia. This research is important because students with mathematical learning disabilities are increasingly receiving their math instruction in the general education setting. It is imperative that teachers understand what these types of learning disabilities entail and how they impact the learning of each student differently. In addition to the impact, math teachers need to know: (a) about best practices when it comes to instruction and intervention, and (b) what supplementary aides and service are available to best help these students succeed in the general education setting. Furthermore, teacher education programs and school districts need to strive to provide more than adequate training that is based on current research to ensure that all math teachers are prepared to work with students who struggle significantly in math. Moreover, it is unacceptable for the educational system and/or governmental agencies to require that all students, regardless of ability, be educated within the general education math setting, especially when teachers have not been provided with the support and/or training required to sufficiently meet the various needs of these students. As for the lack of current research, with push from parents,

advocacy groups, and national disability organizations, mathematical learning disabilities including dyscalculia will continue to move to the forefront of research (including educational research) because of the wide impact that it has on students who struggle with this lifelong learning disability. It is important to remember that unless they are addressed, mathematical learning disabilities, like dyscalculia, can persist into adulthood and “impair personality development, schooling, and occupational training” (Kaufmann & von Aster, 2012, p. 767).

References

- Alarcon, M., DeFries, J., Light, L., & Pennington, B. (1997). A twin study of mathematics disability. *Journal of Learning Disabilities, 30*(6), 617-623. DOI: 10.1177/002221949703000605
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.
- Ardila, A. & Rosselli, M. (2002). Acalculia and dyscalculia. *Neuropsychology Review, 12*(4), 179-239. DOI: 10.1023/A:1021343508573
- Altarac, M. and Saroha, E. (2007). Lifetime prevalence of learning among US children. *Pediatrics, 119*, (Suppl. 1), S77-83. DOI:10.1542/peds.2006-2089L
- Aud, S. (2017). Condition of education 2017. S.l.: CLAITORS PUBLISHING. Retrieved March 14, 2018 from https://nces.ed.gov/programs/coe/pdf/coe_cgg.pdf
- Barbarese, W., Katusic, S., Colligan, R., Weaver, A., & Jacobsen, S. (2005). Math learning disorder: Incidence in a population-based birth cohort, 1976-82. *Ambulatory Pediatrics, 5*(5), 281-9. DOI: 10.1367/A04-209R.1
- Berninger, V. & Swanson, H. (2013). Diagnosing and treating specific learning disabilities in reference to the brain's working memory system. In Swanson, H., Harris, K., & Graham, S., *Handbook of learning disabilities* (2nd Ed.) (pp. 307-325). New York: The Guilford Press.
- Berry, R. (2011). Voices of experience: General education teachers on teaching students with disabilities. *International Journal of Inclusive Education, 15*(6), 627-648. DOI: 10.1080/13603110903278035

- Bottge, B., Toland, M., Gassaway, L., Butler, M., Choo, S., Griffen, A., & Ma, X. (2015). Impact of enhanced anchored instruction in inclusive math classrooms. *Exceptional Children, 81*(2), 158-175. DOI: 10.1177/0014402914551742
- Bouck, E. & Kulkarni, G. (2009). Middle-school mathematics curricula and student with learning disabilities is one curriculum better? *Learning Disability Quarterly, 32*(4), 228-244. DOI: 10.2307/27740375
- Brownell, M., Adams, A., Sindelar, P., Waldron, N., & Vanhover, S. (2006). Learning from collaboration: The role of teacher qualities. *Exceptional Children, 72*(2), 169-85. DOI 10.1177/001440290607200203
- Bruce, C. (2010). The effects of sustained classroom-embedded teacher professional learning on teacher efficacy and related student achievement. *Teaching and teacher education, 26*(8), 1598-1608. DOI: 10.1016/j.tate.2010.06.011
- Burke Johnson, R., & Christensen, L. (2017). *Educational research: Quantitative, qualitative, and mixed approaches* (6th ed.). Los Angeles, CA: Sage.
- Butterworth, B. & Laurillard, D. (2010). Low numeracy and dyscalculia: Identification and intervention. *ZDM Mathematics Education, 42*(6) 527-539. DOI: 10.1007/s11858-010-0267-4
- Carney, M., Brendefur, J., Thiede, K., Hughes, G., & Suttan, J. (2014). Statewide mathematics professional development: Teacher knowledge, self-efficacy, and beliefs. *Education Policy, 30*(4), 539-572. DOI: 10.1177/0895904814550075
- Child trends: Learning disabilities. (2016). Retrieved March 16, 2018, from <https://www.childtrends.org/indicators/learning-disabilities/>

- Chinn, S. (2016). Mathematical learning difficulties and dyscalculia. In Peer, L. & Reid, G., *Special educational needs: A guide for inclusive practice* (2nd ed.) (pp. 183-197). Los Angeles: Sage.
- Chinn, S. & Ashcroft, R. (2007). *Mathematics for dyslexics including dyscalculia* (3rd ed.). Hoboken, NY: John Wiley & Sons, Ltd.
- Conderman, G. & Hedin, L. (2013). Co-teaching with strategy instruction. *Intervention in School and Clinic, 49*(3) 156 –163. DOI: 10.1177/1053451213496158
- David, C. (2012). Working memory deficits in math learning difficulties: A meta-analysis. *International Journal of Developmental Disabilities, 58*(2), 67-84. DOI: 10.1179/204738711Y.0000000007
- DeSimone, J. & Parmar, R. (2006). Issues and challenges for middle school mathematics teachers in inclusion classrooms. *School Science and Mathematics, 106*(8), 338-348. DOI: 10.1111/j.1949-8594.2006.tb17754.x
- Devine, A., Soltész, F., Nobes, A., Goswami, U., & Szűcs, D. (2013). Gender differences in developmental dyscalculia depend on diagnostic criteria. *Learning and Instruction, 27*(n), 31-39. DOI: 10.1016/j.learninstruc.2013.02.004
- DfES. (2001). *The national numeracy strategy: Guidance to support children with dyslexia and dyscalculia*. London: DfES. Retrieved on March 25, 2018 from http://scotens.org/sen/resources/dyslexia_leaflet_maths.pdf
- Dirks, E., Spyer, G., van Lieshout, E., C.D.M., & de Sonneville, L. (2008). Prevalence of combined reading and arithmetic disabilities. *Journal of Learning Disabilities, 41*(5), 460-73. DOI 10.1177/0022219408321128
- Education for All Handicapped Children Act. (1975). (P.L. 94-142), 20USC § 1400-1461.

- Ekstam, U., Korhonen, J., Linnanmäki, K., & Aunio, P. (2017). Special education and subject teachers' self-perceived readiness to teach mathematics to low-performing middle school students. *Journal of Research in Special Educational Needs, 18*(1), 58-69. DOI: 10.1111/1471-3802.12393
- Elias, R. (2041). Dyslexic learners: An investigation into the attitude and knowledge of secondary school teachers in New Zealand (Doctoral dissertation). Retrieved from http://www.dyslexiafoundation.org.nz/dyslexia_advocacy/pdfs/re_dissertation_2014.pdf.
- Every Student Succeeds Act, Pub. L. No. 114-95 (2015). Retrieved from <https://www.ed.gov/essa>.
- Flanagan, D. & Alfonso, V. (2011). *Essentials of specific learning disability identification*. Hoboken, NJ: John Wiley & Sons.
- Fuchs, L., Fuchs, D., Compton, D., Wehby, J., Schumacher, R., Gersten, R., & Jordan, N. (2015). Inclusion versus specialized intervention for very-low-performing students: What does access mean in an era of academic challenge? *Exceptional Children, 81*(2), 134-157. DOI: 10.1177/0014402914551743
- Geary, D (2003). Learning disabilities in arithmetic: Problem-solving differences and cognitive deficits. In H. L. Swanson, K.R. Harris, & S. Graham, *Handbook of learning disabilities* (Eds.) (pp. 199-212). New York, NY: Guilford Press.
- Geary, D. (2004). Mathematics and learning disabilities. *Journal of Learning Disabilities, 37*(1), 4-15. DOI: 10.1177/00222194040370010201
- Geary, D. & Hoard, M. (2005). Learning disabilities in arithmetic and mathematics: Theoretical and empirical perspectives. In J. I. D. Campbell (Ed), *Handbook of mathematical cognition* (Eds.) (pp. 253-267). New York, NY: Psychology Press.

- Geary, D., Hoard, M., Nugent, L., & Byrd-Craven, J. (2007). Strategy use, long-term memory, and working memory capacity. In D.B. Berch & M.M. Mazzocco, *Why is math so hard for some children: The nature and origins of mathematical learning difficulties and disabilities* (Eds.) (pp. 83-105). Baltimore, MD: Brookes.
- Geary, D., Hoard, M., & Bailey, D. (2011). How sld manifests in mathematics. In Flanagan, D. & Alfonso, V., *Essentials of specific learning disability identification* (pp. 43-64). New Jersey: Wiley & Sons.
- Geary, M., Hoard, M., Nugent, L., & Bailey, D. (2012). Mathematical cognition deficits in children with learning disabilities and persistent low achievement: A five-year prospective study. *Journal of Educational Psychology, 104*(1), 206-223. DOI: 10.1037/a0025398
- Geary, D. (2013). Learning disabilities in mathematics: Recent advances. In H.L. Swanson, K.R. Harris, & S. Graham, *Handbook of learning disabilities* (2nd Ed.) (pp. 239-255). New York, NY: The Guilford Press.
- Giangreco, M., Suter, J., & Doyle, M. (2010). Paraprofessionals in inclusive schools: A review of recent research. *Journal of Educational and Psychological Consultation, 20*(1)41–57. DOI: 10.1080/10474410903535356
- Hott, B., Isbell, L., & Montani, T. (2016). Strategies and interventions to support students with mathematics disabilities [InfoSheet]. Overland Park, KS: Council for Learning Disabilities. Retrieved from https://council-for-learning-disabilities.org/wp-content/uploads/2014/12/Math_Disabilities_Support.pdf on April 29, 2018.
- Individuals with Disabilities Education Act, Pub. L. No. 108-446, § 118 Stat. 2647 (2004).
- Kaufmann, L. (2008) Dyscalculia: Neuroscience and education. *Educational Research, 50*(2) 163-175. DOI: 10.1080/00131880802082658

- Kaufmann, L., & von Aster, M. (2012). The diagnosis and management of dyscalculia. *Deutsches Ärzteblatt International*, 109(45), 767–778. DOI: 10.3238/arztebl.2012.0767
- Khing, B. (2016). Dyscalculia: Its types, symptoms, causal factors, and remedial programmes. *Learning Community*, 7(3): 217-229. DOI: 10.5958/2231-458X.2016.00022.1 217-229. DOI: 10.5958/2231-458X.2016.00022.1
- Kilanowski-Press, L. Chandra, J. & Rinaldo, V. (2010). Inclusive classrooms and teachers: A survey of current practices. *International Journal of Special Education*, 25(3), 43-56. Retrieved on May 2, 2018 from <https://eric.ed.gov/?id=EJ909035>
- Košč, L. (1974). Developmental dyscalculia. *Journal of Learning Disabilities*, 7(3), 46-59. DOI: [10.1177/002221947400700309](https://doi.org/10.1177/002221947400700309)
- Kucian, K. & von Aster, M. (2015). Developmental dyscalculia. *European Journal of Pediatrics*, 174(1), 1-13. DOI 10.1007/s00431-014-2455-7
- Kumar, S., & Raja, B. (2009). Treating dyslexic and dyscalculic students. *Journal of Educational Psychology*, 3(1), 7-13. Retrieved January from <http://libproxy.uwyo.edu/login/?url=https://search-proquest-com.libproxy.uwyo.edu/docview/1473907421?accountid=14793>
- Lavery, L. (2016). What parents still do not know about no child left behind and why it matters. *Journal of Education Policy*, 31(3), 343-361.
- Learning disabilities association of America. (2012). Retrieved March 14, 2018 from <https://Idaamerica.org/>
- Mathematics [Def 1]. (n.d.). *Merriam-Webster Online*. In Merriam-Webster.com. Retrieved May 8, 2011, from <https://www.merriam-webster.com/dictionary/mathematics>

- Mather, N., Goldstein, S., & Eklund, K. (2015). *Learning disabilities and challenging behavior: Using the building blocks model to guide intervention and classroom management* (3rd ed.). Baltimore, MD: Brookes Publishing.
- McLeskey, J., Landers, E., Williamson, P., & Hoppey, D. (2012). Are we moving toward educating students with disabilities in less restrictive settings? *The Journal of Special Education, 46*(3), 131-140.
- Mohamadi, F., Hassan, A., Hassan, A. & Farhad, J. (2011). Testing bandura's theory in school. *Procedia - Social and Behavioral Sciences, 12*(n.), 426-435. DOI: 10.1016/j.sbspro.2011.02.053
- Morris, D., Usher, E. & Chen, J. (2017). Reconceptualizing the sources of teaching self-efficacy: A critical review of emerging literature. *Educational Psychology Review 29*(4), 795-833. DOI: 10.1007/s10648-016-9378-y
- Naraian, S. & Surabian, M. (2014). New literacy studies: An alternative frame for preparing teachers to use assistive technology. *Teacher Education and Special Education, 37*(4) 330–346. DOI: 10.1177/0888406414538843
- National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common core state standards*. National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C.
- National joint committee on learning disabilities. (2016). Retrieved March 15, 2018, from <http://www.Idonline.org/about/partners/njclld>
- No Child Left Behind Act, Pub. L. No. 107–110, 115 Stat. 1425 (2002). Retrieved from <http://www2.ed.gov/nclb/landing.jhtml>

- Paulsen, K. (2013). Content area learning at the secondary level for students with learning disabilities and emotional/behavioral disorders: Introduction to the special issue. *Intervention in School and Clinic, 49*(1), 3-5. DOI: 10.1177/1053451213480027
- Press Office. (2015). U.S. secretary of education Arne Dunccan issues statement on learning disabilities: Dyslexia and attention deficit hyperactivity disorder awareness month. Retrieved on November 25, 2017 from <https://www.ed.gov/news/press-releases/us-secretary-education-arne-duncan-issues-statement-learning-disabilities-dyslexia-and-attention-deficit-hyperactivity-disorder-awareness-month>
- Price, G., Holloway, I., Räsänen, P., Vesterinen, M. & Ansari, D. (2007). Impaired parietal magnitude processing in developmental dyscalculia. *Current Biology, 17*(24), 1042-1043. DOI: 10.1016/j.cub.2007.10.013
- Price, G. & Ansari, D. (2013). "Dyscalculia: Characteristics, causes, and treatment. *Numeracy, 6*(1), 1-16. DOI: 10.5038/1936-4660.6.1.2
- Rattan, A., Good, C., & Dweck, C. (2011). It's ok - not everyone can be good at math": Instructors with an entity theory comfort (and demotivate) students. *Journal of Experimental Social Psychology, 48*(3), 731-737. DOI: 10.1016/j.jesp.2011.12.012
- Romaa, S. & Gowramma, I. (2002). A systematic procedure for identifying and classifying children with dyscalculia among primary school children in India. *Dyslexia, 8*(2), 67-85. DOI: 10.1002/dys.214
- Scherer, P., Beswick, K., DeBlois, L., Healy, L., & Moser Opitz, E. (2016). Assistance of students with mathematical learning difficulties: How can research support practice? *ZDM Mathematics Education, 48*(5), 633–649. DOI 10.1007/s11858-016-0800-1

- Shalev, R., Manor, O., Auerbach, J., & Gross-Tsur, V. (1998). Persistence of developmental dyscalculia: What counts? Results from a 3-year prospective follow-up study. *The Journal of Pediatrics*, 133(3), 358-362. DOI: 10.1016/S0022-3476(98)70269-0
- Shalev, R., Manor, O., Kerem, B., Ayali, M., Badichi, N., Friedlander, Y., & Gross-Tsur, V. (2001). Developmental dyscalculia is a familial learning disability. *Journal of Learning Disabilities*, 34(1), 59-65. DOI: 10.1177/002221940103400105
- Shalev, R. (2004). Developmental dyscalculia. *Journal of child neurology*, 19(10), 765-771. DOI: 10.1177/08830738040190100601
- Soares, N. & Patel, D. (2015). Dyscalculia. *International Journal of Child and Adolescent Health*, 8(1), 15–26. Retrieved from <http://libproxy.uwyo.edu/login/?url=https://search-proquest-com.libproxy.uwyo.edu/docview/1705546083?accountid=14793>
- Sausa, D. (2016). *How the special needs brain learns* (3rd ed.). Thousand Oaks, CA: Sage Publications.
- Tavakol, M., & Dennick, R. (2011). Making sense of cronbach's alpha. *International Journal of Medical Education*, 2, 53-55. DOI: 10.5116/ijme.4dfb.8dfd
- Turkington, C., & Harris, J. (2002). *The encyclopedia of learning disabilities*. New York: Facts on File. American Bookworks.
- U.S. Department of Education, National Center for Education Statistics. (2016). *Digest of Education Statistics, 2015* (NCES 2016-014). Retrieved March 15, 2018 from https://nces.ed.gov/programs/coe/indicator_cgg.asp
- U.S. Department of Education. (2013). 35th Annual Report to Congress on the Implementation of the Individuals with Disabilities Education Act. Retrieved on November 25, 2017 from <http://www2.ed.gov/about/reports/annual/osep/2013/parts-b-c/35th-ideaarc.pdf>

Van de Walle, A., Karp, K., & Bay-Williams, J. (2013). *Elementary and middle school mathematics: Teaching developmentally*. Upper Saddle River, NJ: Pearson.

Wadlington, E. & Wadlington, P. (2008). Helping students with mathematical disabilities to succeed. *Preventing School Failure: Alternative Education for Children and Youth*, 53(1), 2-7. DOI: 10.3200/PSFL.53.1.2-7

Wright, P., & Wright, P. (2018). Inclusion: Answers to frequently asked questions from the NEA". Retrieved April 30, 2018 from <http://www.wrightslaw.com/info/lre.faqs.inclusion.htm>

Appendix A

Characteristics and Symptoms of Dyscalculia

Skill Deficit	Reference
<ul style="list-style-type: none"> • Impaired innate number sense • Problems in quantity estimation • Reduced subtilizing range • Inaccurate mapping and transfer of different number & symbolic representations • Counting difficulties like backward counting • No understanding of the place-value system • Uses fingers as a primary counting strategy • No understanding of calculation procedures and concepts 	<p>Kucian & von Aster, 2015</p>
<p>Deficits in:</p> <ul style="list-style-type: none"> • Basic arithmetic skills such as adding, subtracting, multiplying and dividing • Mathematical signs and symbols confusion • Grasping and remembering math concepts, rules, formulae, and sequences • Number additions, substitutions, transpositions, omissions, and reversals when reading, writing, and recalling numbers • Understand place value and working with decimals • Estimating number quantities • Understanding the concept of fractions • Measures and conversion • Identifying similar signs and numerals • Identifying similar geometrical shapes • Drawing geometrical figures • Identifying three-dimensional figures • Conceptualizing time and judging the passage of time • Following directions • Organizing objects in a logical way • Comprehending financial planning or budgeting • Converting one’s arithmetic knowledge to actions • Verbal use of math concepts 	<p>Kumar & Raja, 2009</p>
<ul style="list-style-type: none"> • Impaired arithmetic fact retrieval • Use immature or inefficient problem-solving & procedural strategies (i.e. count all method) • Deficit in representing and processing numerical magnitudes • Distance effect: the phenomenon when “distance between two number • Being compared decreases (e.g. 2 – 9 versus 7 – 9), reaction times and errors increase” (p. 6). 	<p>Price & Ansari, 2013</p>

<ul style="list-style-type: none"> • Impaired basic number naming • Working memory deficits (secondary DD) • Deficits in visuo-spatial attention 	
<p>Deficits in:</p> <ul style="list-style-type: none"> • Processing numerical quantities • Working memory • Attention • Processing magnitude • Number identification • Spatial processing • Executive functions • Associating magnitudes with symbols 	<p>Rubinsten & Henik, 2008</p>
<ul style="list-style-type: none"> • Deficits in the retrieval of overlearned information • Inattention to arithmetic signs and using the wrong sign • Forgetting to regroup • Misplacement of digits • “Undertaking the arithmetic exercise in the wrong directions” (p. 338) • Dissociation between math facts and procedural skills 	<p>Shalev & Gross-Tsur, 2001</p>
<p>Difficulty with:</p> <ul style="list-style-type: none"> • Learning to count and understand 1-to-1 correspondence between objects and numbers • Estimating numbers and quantities, comparing (greater/less than) • Telling Time • Learning and remembering basic math facts • Performing mental math • Learning math concepts including rules and formulas • Single digit addition, subtraction, and multiplication • Learning more efficient strategies often relying on ‘immature strategies’ like counting on fingers • Counting or comparing numerical magnitudes 	<p>Sores & Patel, 2015</p>
<ul style="list-style-type: none"> • Poor mental math ability • Problems using money (balancing a checkbook, making change, & tipping) • Problems with math processes such as addition, subtraction, or multiplication • Problems with math concepts like sequencing numbers • Trouble retaining and retrieving concepts • Problems grasping rules • Poor sense of directions • Trouble reading maps, keeping track of time, and sequencing past and future events • Common mistakes include number substitutions, reversals, and omissions. • Trouble following directions in sports that demand sequencing rules or keeping track of scores. 	<p>Turkington & Harris, 2002</p>

Appendix B

Interventions for Mathematics Learning Disabilities and Dyscalculia

Interventions	Reference
<p>Strategies and Interventions to Support Students with Mathematics Disabilities from the 2014 Council for Learning Disabilities</p> <ul style="list-style-type: none"> Below is a link to an InfoSheet that includes various advisory panel recommendations for effectively teaching mathematics: https://council-for-learning-disabilities.org/wp-content/uploads/2014/12/Math_Disabilities_Support.pdf 	<p>Hott, Isbell, & Oettinger Montani, (2016).</p>
<ul style="list-style-type: none"> Intervention should aim to help all learners develop the ability to enumerate dot patterns in order to progress to basic arithmetic -see http://low-numeracy.ning.com/forum/topics/dots2digit-2-players -see http://low-numeracy.ning.com/forum/topics/dots2track-1 Digital intervention because they are practice-oriented, age-independent, needs oriented, meaningful, customizable, and private 	<p>Butterworth & Laurillard, 2010</p>
<ol style="list-style-type: none"> Specific intervention of children or adolescents with math difficulties can help if the intervention is specifically designed: <ul style="list-style-type: none"> In a single training (not group or class) It is adapted to individual performance level It is structured and hierarchically built It includes basic non-curricular as well as curricular numerical topics It consists of many repetitions When motivation is stimulated by reward and reduction of math anxiety Computer-based training programs with the goal of improving number representations and strengthening the link between numbers and spatial process (i.e Calcularis – see https://dybuster.com/en/calcularis) 	<p>Kucian & von Aster, (2015)</p>
<ul style="list-style-type: none"> Brain Gym Exercises – see http://www.braingym.org/about Repeated reinforcement and specific practice A systematic and explicit method that involves multiple senses (i.e. visual) Innovative use of technology like computer assisted instruction. Programs that help with data handling, graphical representations and visualization 	<p>Kumar & Raja, 2009</p>
<p>Two adaptive computerized training tools that target cognitive processes:</p> <ul style="list-style-type: none"> The Number Race – a game designed to address MLD (dyscalculia) by strengthening the brain circuits for representing and manipulating numbers and improve the precision of numerical magnitude representations. See http://www.thenumberrace.com/nr/home.php Graphogame – a game that focuses on exact numerosity and seeks to link those with number symbols See https://www.cne.psychol.cam.ac.uk/people/themes/graphogame <p>Other intervention programs (w/ insufficient results or results limited to specific socio-economic demographics include:</p> <ul style="list-style-type: none"> Fluency and Automaticity through Systematic Teaching w/ Technology 	<p>Price & Ansari, 2013</p>

<ul style="list-style-type: none"> • FASTT Math • Numberworlds 	
<p>Meta-analysis</p> <ul style="list-style-type: none"> • Direct or guided instruction (i.e. direct instruction appears to be effective when teaching basic math facts) • Self-instruction (i.e. self-regulation strategies) when it comes to problem-solving • Important instructional components (p. 637): <ul style="list-style-type: none"> ➤ teaching heuristics to solve word problems; ➤ explicit instruction; ➤ the use of graphical representations and manipulatives; ➤ thoughtful selection and sequencing of instructional examples; ➤ encouraging students to verbalize their own strategies or strategies modelled by the teacher • Techniques which focus on the representation of the structure of word problems was most effective, cognitive strategy training is next, and finally, assistive technology <p>Note: (a) computer-based instruction and peer tutoring showed smaller effects than teacher led instruction, (b) one-to-one training is more advantageous than small group interventions, computer-based programs, and interventions integrated into the classroom, (c) duration and intensity of the program as well as teacher qualifications prove important factors.</p>	<p>Scherer et al., 2016</p>
<p>RTI Intervention that focuses on:</p> <ul style="list-style-type: none"> • Foundations of Arithmetic • In depth topic coverage of whole numbers (K-5) and rational numbers (4-8) • Underlying structures of word problems • Daily fact fluency • Intentional teaching • Explanations, modeling • Visual representations • Immediate corrective feedback • Graded problem-solving • Praise for effort and engagement <p>***“A meta-analysis of 58 studies revealed that the majority of intervention studies involved basic mathematics skills (e.g. multiplication) and the effect size increased with age.”***</p>	<p>Soares & Patel, 2015</p>
<p>General instruction:</p> <ul style="list-style-type: none"> • Seated near the focus of instruction • Should be actively engaged in lessons • Break down skills and concepts into their smallest parts and present them step-by-step. • Model new ideas and provide ample time for guided practice • Break down long assignments into smaller ones and provide immediate feedback 	<p>Wadlington & Wadlington, 2008</p>

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| <ul style="list-style-type: none">• Textbooks should convey the major concepts thoroughly rather than cover many small ideas briefly• New skills might be presented in isolation and then integrated into other areas and applied to real life• Students learn best through multisensory instruction that incorporates multiple senses and movement• Allow extra time so students can learn mathematical skills until these skills become automatic• Teachers should prioritize objectives and emphasize practical skills and concepts appropriate for students' life stages• Allow students to communicate mathematics in multiple ways (i.e. writing in math journals helps many students to become comfortable with mathematical terms and ideas)• Teachers should explain and model new vocabulary using concrete examples• Post directions and procedures for future reference or pass out reminder sheets with important information written in accessible language | |
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Appendix C

Survey of Regular Education Teacher Knowledge and Perception
of the Math Learning Disabilities & Dyscalculia

Start of Block: Default Question Block

Q1 I understand the impact that a mathematical learning disability has on special education students in the general education math classroom. (6-point Likert scale)

Q2 I am adequately prepared to support the learning of students identified with mathematical learning disabilities within the general education math setting. (6-point Likert scale)

Q3 I have the required resources and materials needed to support the learning of students who are identified with a mathematical learning disability. (6-point Likert scale)

Q4 I know best practice teaching interventions to support students who are identified with a mathematical learning disability in my general education math class. (6-point Likert scale)

Q5 Many students with mathematical learning disabilities should receive ALL of their math instruction in the general education math classroom. (6-point Likert scale)

Q6 Students identified with a mathematical learning disability benefit from 1:1 support from special education staff within the general education classroom. (6-point Likert scale)

Q7 I know what assistive technology would best support students with mathematical learning disabilities in the general education math classroom. (6-point Likert scale)

Q8 A person with a mathematical learning disability is likely to have difficulty with all aspects of mathematics. (5-point Likert scale)

Q9 Students with mathematical learning disabilities struggle with working memory issues. (5-point Likert scale)

Q10 Students with mathematical learning disabilities struggle with processing speed issues. (5-point Likert scale)

Q11 A person with a math learning disability may struggle with remembering basic math facts. (5-point Likert scale)

Q12 I know which teaching methods (i.e. multi-sensory teaching method) are most helpful for students with math learning disabilities. (6-point Likert scale)

Q13 Having to spend additional time working with students identified with mathematical learning disabilities takes away from the learning opportunities of the other students in my classroom. (6-point Likert scale)

Q14 The label "mathematical learning disability" can be an excuse for students to stop trying. (6-point Likert scale)

Q15 Teacher perceptions about "student ability" can impact the learning of students with mathematical learning disabilities. (6-point Likert scale)

Q16 The special and general education methods courses that I took prepared me to teach mathematics to students with mathematical learning disabilities. (6-point Likert scale)

Q17 I have received additional teacher training through PD opportunities related to working with students identified with mathematical learning disabilities. (6-point Likert scale)

Q18 I co-teach general education math classes with a special education teacher when there are students identified with mathematical learning disabilities in my math class. (6-point Likert scale)

Q19 I have heard of the term "dyscalculia" as it relates to a specific mathematical learning disability. (Yes or No)

Q20 I have a solid understanding of what the mathematical disability dyscalculia is and how it impacts learners. (6-point Likert scale)

Q21 I have taught one or more students who are identified with the mathematical learning disability dyscalculia. (Yes, Don't Know, No)

Q22 Do you believe that you are effective as a math teacher when working with students who are identified with mathematical learning disabilities? Why or why not?

Q23 What do you believe are your biggest barriers as a teacher in working with students who are identified with mathematical learning disabilities?

Q24 Please list 3-5 resources including books, instructional materials, assistive technology devices, and/or classroom accommodations that you currently use to support the learning of students identified with mathematical learning disabilities:

Q25 How would you define/describe the mathematical learning disability dyscalculia?

Q26 What is your job title? Check all that apply. (6th Grade Math Teacher, 7th Grade Math Teacher, 8th Grade Math Teacher)

Q27 Gender (Male or Female)

Q28 Number of years teaching mathematics: (First Year, 1-2, 3-5, 6-10, 11-15, 16+)

Q29 Select the highest degree you've obtained: (Bachelors, Masters, and Doctorate)

Q30 Number of special education classes taken during your undergraduate program of study: (0, 1, 3-5, 6+)

Q31 Number of special education classes taken during your graduate program of study: (0, 1, 3-5, 6+)

Q32 Do you have any additional comments?

End of Block: Default Question Block

Appendix D

WDE Principal's List

District Name	School Name	Grades Served	Email
Albany County School District #1	Snowy Range Academy	KG-9	wilsond@acsd1.org
Albany County School District #1	Centennial Elementary	KG-6	farleyb@acsd1.org
Albany County School District #1	Harmony Elementary	KG-6	farleyb@acsd1.org
Albany County School District #1	Rock River Elementary	KG-6	wfiscus@acsd1.org
Albany County School District #1	Notch Peak Elementary	KG-8	wfiscus@acsd1.org
Albany County School District #1	Laramie Middle School	6-8	kodea@acsd1.org
Albany County School District #1	Rock River Junior High School	7-8	wfiscus@acsd1.org
Albany County School District #1	Valley View Elementary	KG-6	lengel@acsd1.org
Albany County School District #1	UW Laboratory School	KG-8	mhudson@acsd1.org
Albany County School District #1	Laramie Montessori Charter School	KG-6	mcrawford@acsd1.org
Big Horn County School District #1	Burlington Middle School	6-8	mdavidson@bighorn1.com
Big Horn County School District #1	Rocky Mountain Middle School	6-8	twinland@bighorn1.com
Big Horn County School District #2	Lovell Middle School	6-8	dhazen@bgh2.org
Big Horn County School District #3	Greybull Middle School	6-8	jrogers@bgh3.k12.wy.us
Big Horn County School District #4	Riverside Middle/High School	6-12	anson@bgh4.k12.wy.us
Campbell County School District #1	4-J Elementary School	KG-6	dhardesty@ccsd.k12.wy.us
Campbell County School District #1	Cottonwood Elementary	KG-6	dbarnhurst@ccsd.k12.wy.us
Campbell County School District #1	Hillcrest Elementary	KG-6	bwinter@ccsd.k12.wy.us
Campbell County School District #1	Westwood High School	PK-12	kmorehead@ccsd.k12.wy.us
Campbell County School District #1	Buffalo Ridge Elementary	KG-6	ksinclair@ccsd.k12.wy.us
Campbell County School District #1	Stocktrail Elementary	KG-6	kshannon@ccsd.k12.wy.us
Campbell County School District #1	Twin Spruce Junior High School	7-8	dlyman@ccsd.k12.wy.us

Campbell County School District #1	Sage Valley Junior High School	7-8	tquinn@ccsd.k12.wy.us
Campbell County School District #1	Wright Jr. & Sr. High School	7-12	kbaier@ccsd.k12.wy.us
Campbell County School District #1	Prairie Wind Elementary	KG-6	rywilliams@ccsd.k12.wy.us
Campbell County School District #1	Wagonwheel Elementary	KG-6	estremcha@ccsd.k12.wy.us
Campbell County School District #1	Paintbrush Elementary	KG-6	bknnox@ccsd.k12.wy.us
Campbell County School District #1	Conestoga Elementary	KG-6	standerson@ccsd.k12.wy.us
Campbell County School District #1	Sunflower Elementary	KG-6	tclaycomb@ccsd.k12.wy.us
Campbell County School District #1	Pronghorn Elementary	KG-6	ccates@ccsd.k12.wy.us
Campbell County School District #1	Little Powder Elementary	KG-8	ldavis@ccsd.k12.wy.us
Campbell County School District #1	Meadowlark Elementary	KG-6	bcrosby@ccsd.k12.wy.us
Campbell County School District #1	Lakeview Elementary	KG-6	dapetersen@ccsd.k12.wy.us
Campbell County School District #1	Rawhide Elementary	KG-6	bbahige@ccsd.k12.wy.us
Campbell County School District #1	Recluse School	KG-8	crashleigh@ccsd.k12.wy.us
Campbell County School District #1	Rozet Elementary	KG-6	ncassidy@ccsd.k12.wy.us
Carbon County School District #1	Little Snake River Valley School	KG-12	jthomas@crb1.net
Carbon County School District #1	Rawlins Middle School	6-8	rsearle@crb1.net
Carbon County School District #2	Elk Mountain Elementary	KG-6	mshipp@crb2.org
Carbon County School District #2	Hanna Elementary	KG-6	mshipp@crb2.org
Carbon County School District #2	Medicine Bow Elementary	KG-6	mshipp@crb2.org
Carbon County School District #2	Saratoga Elementary	KG-6	djennings@crb2.org
Carbon County School District #2	HEM Junior/Senior High School	7-12	spriest@crb2.org
Carbon County School District #2	Encampment K-12 School	KG-12	merickson@crb2.org
Carbon County School District #2	Saratoga Middle/High School	7-12	lbutler@crb2.org
Converse County School District #1	Dry Creek Elementary	KG-8	wesgamble@ccsd1.org
Converse County School District #1	Moss Agate Elementary	KG-8	wesgamble@ccsd1.org

Converse County School District #1	Shawnee Elementary	KG-8	wesgamble@ccsd1.org
Converse County School District #1	Walker Creek Elementary	KG-8	wesgamble@ccsd1.org
Converse County School District #1	White Elementary	KG-8	wesgamble@ccsd1.org
Converse County School District #1	Douglas Middle School	6-8	rmackey@ccsd1.org
Converse County School District #2	Boxelder Elementary	KG-6	dbrown@converse2.org
Converse County School District #2	Glenrock Intermediate School	5-6	dbrown@converse2.org
Converse County School District #2	Glenrock Middle School	7-8	sjames@converse2.org
Crook County School District #1	Sundance Elementary	KG-6	hartwigb@crook1.com
Crook County School District #1	Moorcroft K-8	KG-8	brownta@crook1.com
Crook County School District #1	Sundance Secondary School	7-12	oconnorj@crook1.com
Crook County School District #1	Hulett School	KG-12	wolfskilll@crook1.com
Fremont County School District # 1	Jeffrey City Elementary	KG-6	alanzketcham@landerschools.org
Fremont County School District # 1	Lander Middle School	6-8	jshanley@landerschools.org
Fremont County School District # 2	Dubois Middle School	6-8	bfarris@fremont2.org
Fremont County School District # 2	Dubois High School	9-12	bfarris@fremont2.org
Fremont County School District # 6	Wind River Middle School	6-8	charlesj@fre6.k12.wy.us
Fremont County School District #14	Wyoming Indian Middle School	6-8	scott.gion@wyo4life.net
Fremont County School District #14	Wyoming Indian High School	9-12	pam.gambler@wyo4life.net
Fremont County School District #21	Ft. Washakie Elementary	KG-6	dmeyer@fortwashakieschool.com
Fremont County School District #21	Ft. Washakie Middle School	7-8	kibach@fortwashakieschool.com
Fremont County School District #24	Shoshoni Elementary	KG-6	mrose@fremont24.com
Fremont County School District #24	Shoshoni Junior High School	7-8	crice@shoshonischools.org
Fremont County School District #25	Riverton Middle School	6-8	bnyberg@fremont25.org
Fremont County School District #38	Arapahoe Elementary	KG-8	jeffry.fuller@fremont38.com
Goshen County School District #1	Southeast Elementary	KG-6	cgilchriest@goshen1.org

Goshen County School District #1	La Grange Elementary	KG-6	cgilchriest@goshen1.org
Goshen County School District #1	Lingle-Ft. Laramie Middle School	6-8	lstratton@goshen1.org
Goshen County School District #1	Southeast Junior High School	7-8	repler@goshen1.org
Goshen County School District #1	Torrington Middle School	6-8	mhaiman@goshen1.org
Hot Springs County School District #1	Thermopolis Middle School	5-8	bdaniels@hotsprings1.org
Johnson County School District #1	Kaycee School	KG-12	jmoss@jcsd1.us
Johnson County School District #1	Clear Creek Middle School	6-8	dschmidt@jcsd1.us
Laramie County School District #1	Alta Vista Elementary	KG-6	youngb@laramie1.org
Laramie County School District #1	Arp Elementary	KG-6	don.brantz@laramie1.org
Laramie County School District #1	Baggs Elementary	KG-6	kellyb@laramie1.org
Laramie County School District #1	Bain Elementary	KG-6	Todd.Burns@laramie1.org
Laramie County School District #1	Cole Elementary	KG-6	adamsdo@laramie1.org
Laramie County School District #1	Triumph High School	7-12	helenboltm@laramie1.org
Laramie County School District #1	PODER Academy Secondary School	6-9	Nicholas.Vaughn@laramie1.org
Laramie County School District #1	Carey Junior High School	7-8	Derek.Nissen@laramie1.org
Laramie County School District #1	Johnson Junior High School	7-8	brian.cox@laramie1.org
Laramie County School District #1	McCormick Junior High School	7-8	coninej@laramie1.org
Laramie County School District #1	Freedom Elementary	KG-6	delbridgec@laramie1.org
Laramie County School District #1	Sunrise Elementary	KG-6	john.broda@laramie1.org
Laramie County School District #1	Saddle Ridge Elementary	KG-6	donald.brinkman@laramie1.org
Laramie County School District #1	Prairie Wind Elementary	KG-6	lisa.weigel@laramie1.org
Laramie County School District #1	Meadow Lark Elementary	5-6	fraleyj@laramie1.org
Laramie County School District #1	Miller Elementary	4-6	Christine.Hunter@laramie1.org
Laramie County School District #1	Pioneer Park Elementary	KG-6	gatesa@laramie1.org
Laramie County School District #1	Rossman Elementary	KG-6	pettyh@laramie1.org

Laramie County School District #1	Willadsen Elementary	KG-6	sean.ambrose@laramie1.org
Laramie County School District #1	Afflerbach Elementary	KG-6	schlagelm@laramie1.org
Laramie County School District #1	Hebard Elementary	KG-6	adamsdo@laramie1.org
Laramie County School District #1	Henderson Elementary	KG-6	lyonsk@laramie1.org
Laramie County School District #1	Hobbs Elementary	KG-6	derede.darden@laramie1.org
Laramie County School District #1	Clawson Elementary	KG-6	sean.ambrose@laramie1.org
Laramie County School District #1	Jessup Elementary	KG-6	leisethb@laramie1.org
Laramie County School District #1	Davis Elementary	KG-6	emmonsm@laramie1.org
Laramie County School District #1	Fairview Elementary	3-6	ogirimac@laramie1.org
Laramie County School District #1	Gilchrist Elementary	KG-6	kristin.cavallier@laramie1.org
Laramie County School District #1	Goins Elementary	KG-6	Amanda.Hall@laramie1.org
Laramie County School District #2	Albin Elementary	KG-6	leann.smith@laramie2.org
Laramie County School District #2	Carpenter Elementary	KG-6	wes.woodward@laramie2.org
Laramie County School District #2	Pine Bluffs Elementary	KG-6	andrea.verosky@laramie2.org
Laramie County School District #2	Burns Elementary	KG-6	jerry.burkett@laramie2.org
Laramie County School District #2	Burns Jr & Sr High School	7-12	bobby.dishman@laramie2.org
Laramie County School District #2	Pine Bluffs Jr & Sr High School	7-12	todd.sweeter@laramie2.org
Lincoln County School District #1	Canyon Elementary School	3-6	bmeyer@rangers1.net
Lincoln County School District #1	New Frontier High School	7-12	dgardner@rangers1.net
Lincoln County School District #1	Kemmerer Junior Senior High School	7-12	ozempel@rangers1.net
Lincoln County School District #2	Cokeville Elementary	KG-6	btoomer@lcsd2.org
Lincoln County School District #2	Etna Elementary	4-6	keklein@lcsd2.org
Lincoln County School District #2	Osmond Elementary	4-6	merickson@lcsd2.org
Lincoln County School District #2	Star Valley Middle School	7-8	stburch@lcsd2.org
Lincoln County School District #2	Cokeville High School	7-12	btoomer@lcsd2.org

Natrona County School District #1	Alcova Elementary	KG-6	tammy_creger@natronaschools.org
Natrona County School District #1	Ft. Caspar Academy	KG-6	richard_edwards@natronaschools.org
Natrona County School District #1	Roosevelt High School	7-12	shawna_trujillo@natronaschools.org
Natrona County School District #1	Frontier Middle School	6-8	casey_cloninger@natronaschools.org
Natrona County School District #1	Midwest School	KG-12	chris_tobin@natronaschools.org
Natrona County School District #1	C Y Junior Middle School	6-8	valerie_broughton@natronaschools.org
Natrona County School District #1	Dean Morgan Middle School	6-8	steve_ellbogen@natronaschools.org
Natrona County School District #1	Centennial Middle School	6-8	mike_britt@natronaschools.org
Natrona County School District #1	Woods Learning Center	KG-8	melissa_noah@natronaschools.org
Natrona County School District #1	Bar Nunn Elementary	KG-6	rene_rickabaugh@natronaschools.org
Natrona County School District #1	Casper Classical Academy	6-9	marie_puryear@natronaschools.org
Natrona County School District #1	Pineview Elementary	KG-6	chris_carruth-britt@natronaschools.org
Natrona County School District #1	Poison Spider Elementary	KG-8	tammy_creger@natronaschools.org
Natrona County School District #1	Powder River Elementary	KG-6	tammy_creger@natronaschools.org
Natrona County School District #1	Red Creek Elementary	KG-6	tammy_creger@natronaschools.org
Natrona County School District #1	Manor Heights Elementary	KG-6	kent_thompson@natronaschools.org
Natrona County School District #1	Paradise Valley Elementary	KG-6	aaron_wilson@natronaschools.org
Natrona County School District #1	Park Elementary	KG-6	gib_ostheimer@natronaschools.org
Niobrara County School District #1	Lance Creek Elementary	KG-8	mirichg@lusk.k12.wy.us
Niobrara County School District #1	Lusk Middle School	6-8	mirichg@lusk.k12.wy.us
Park County School District # 1	Powell Middle School	6-8	jwsleep@pcsd1.org
Park County School District # 6	Cody Middle School	6-8	kellymerager@park6.org
Park County School District #16	Meetetse School	KG-12	jwheeler@park16.org
Platte County School District #1	Chugwater Elementary	KG-6	tom.waring@platte1.org
Platte County School District #1	Glendo Elementary	KG-6	kathy.morsett@platte1.org

Platte County School District #1	Wheatland Middle School	6-8	cory.dziowgo@platte1.org
Platte County School District #1	Chugwater Junior High School	7-8	tom.waring@platte1.org
Platte County School District #1	Glendo Junior High School	7-8	kathy.morsett@platte1.org
Platte County School District #2	Guernsey-Sunrise Elementary	KG-6	gsupes@gsviking.org
Platte County School District #2	Guernsey-Sunrise Junior High	7-8	gsupes@gsviking.org
Sheridan County School District #1	Big Horn Middle School	6-8	rwelch@sheridan.k12.wy.us
Sheridan County School District #1	Tongue River Middle School	6-8	pkilbride@sheridan.k12.wy.us
Sheridan County School District #2	Sheridan Junior High School	6-8	rebecca.adsit@scsd2.com
Sheridan County School District #2	The Wright Place	6-8	rebecca.adsit@scsd2.com
Sheridan County School District #3	Arvada Elementary	KG-6	cauzqui@shr3panthers.com
Sheridan County School District #3	Clearmont K-12 School	KG-12	cauzqui@shr3panthers.com
Sublette County School District #1	Pinedale Middle School	6-8	jfluckiger@sub1.org
Sublette County School District #9	Big Piney Middle School	6-8	sdodds@sublette9.org
Sweetwater County School District #1	Desert Elementary	KG-6	hardmanj@sw1.k12.wy.us
Sweetwater County School District #1	Eastside Elementary	5-6	mcmurtreyb@sw1.k12.wy.us
Sweetwater County School District #1	Desert Middle School	7-8	hardmanj@sw1.k12.wy.us
Sweetwater County School District #1	Farson-Eden Middle School	6-8	estesm@sw1.k12.wy.us
Sweetwater County School District #1	Pilot Butte Elementary	5-6	dickmans@sw1.k12.wy.us
Sweetwater County School District #1	Rock Springs Junior High	7-8	johnsonti@sw1.k12.wy.us
Sweetwater County School District #2	Thoman Ranch Elementary	KG-8	christj3@swcsd2.org
Sweetwater County School District #2	Monroe Intermediate School	5-6	coveya@swcsd2.org
Sweetwater County School District #2	Lincoln Middle School	7-8	mikkelm@swcsd2.org
Teton County School District #1	Alta Elementary	KG-6	jbeck@tcsd.org
Teton County School District #1	Jackson Hole Middle School	6-8	matthoelscher@tcsd.org
Uinta County School District #1	Davis Middle School	6-8	cbrown@uinta1.com

Uinta County School District #1	Evanston Middle School	6-8	echristenot@uinta1.com
Uinta County School District #1	Horizon Alternative School	7-12	shamilton@uinta1.com
Uinta County School District #4	Mountain View K-8	KG-8	vandusent@uinta4.com
Uinta County School District #4	Mountain View K-8	KG-8	ericksonb@uinta4.com
Uinta County School District #6	Lyman Intermediate School	5-8	smithj@uinta6.k12.wy.us
Washakie County School District #1	Worland Middle School	6-8	rclark@wsh1.k12.wy.us
Washakie County School District #2	Ten Sleep K-12	KG-12	russ.budmayr@wsh2.k12.wy.us
Weston County School District #1	Newcastle Middle School	6-8	gundersonk@wcsd1.org
Weston County School District #7	Upton Middle School	6-8	ccoberly@weston7.org

Appendix E

Initial Principal Email

Dear [School District] Principals,

My name is Theresa Graves and I am a graduate student in the Masters of Science in Natural Science Middle Level Math (MMA) program at the University of Wyoming. For my final project, I am examining regular education teacher knowledge and perceptions of mathematical learning disabilities and the math disability dyscalculia. In order to obtain input from all mid-level (6th – 8th grade) regular education math teachers across the state, I am hoping to send out my survey to teachers through Wyoming principals. I have attached a copy of my cover letter and survey so that you can preview it.

Following this email, you should receive an email that can be forwarded to your mid-level math teachers that includes both the cover letter and the link to the online survey. I will then send you two follow up emails to send out to teachers over the next couple of weeks. Please let me know if you have any questions or concerns.

I appreciate your support as I work to collect data regarding Wyoming mathematics teachers' knowledge and perceptions regarding mathematical learning disabilities and the disability dyscalculia.

Sincerely,

Theresa Graves, BSED, MSW, NBCT

Contact Information:

Theresa Graves

UW Lab School, Dept. 3374, 1000 E. University Avenue, Laramie, WY 82072
(307)399-3623

Advisor: Dr. Jacqueline Leonard

Department: University of Wyoming School of Teacher Education

Phone number: (307)766-3106 Email: jleona12@uwyo.edu

This study has been approved by the IRB, protocol #20180227TG01907

Appendix F

Teacher Recruitment Letter

Dear Wyoming Mid-Level Math Teacher:

My name is Theresa Graves and I am a graduate student at the University of Wyoming. For my final project, I am examining regular education teacher knowledge and perceptions of mathematical learning disabilities and the specific math learning disability dyscalculia. You were selected as a possible participant for this research study because you are a valued mid-level mathematics teacher in one of our great Wyoming schools.

As a participant, you will be asked to complete an online survey which will include twenty-one closed-ended statements and four open-ended questions related to your knowledge and perceptions of mathematical learning disabilities and the math learning disability dyscalculia. All survey items are designed to gain an understanding of the following guiding research questions:

1. What is the extent of teacher knowledge and understanding of mathematical learning disabilities including the disability dyscalculia?
2. What is the nature of teacher attitudes regarding mathematical learning disabilities?
3. What supports and/or interventions are utilized within the general education classroom to support learners with mathematical learning disabilities?
4. What are the perceived barriers to providing instruction and/or supports to learners identified with mathematical learning disabilities?

Confidentiality: This research is completely anonymous. You will not be asked to provide your name or any other identifying information. Additionally, all data will be compiled through the Qualtrics Survey Solutions which prevents any identifying information from being tracked to anyone who participates.

Risks and Benefits: There are no inherent risks or benefits in participating in this study beyond the time it will take you to complete the survey and the contribution you will be making to cumulative mathematical research.

Time: It is estimated that it will take under 10 minutes to complete the survey.

Voluntary Participation: Your choice to participate in this research study is completely voluntary. You are free to withdraw from the study at any time prior to submitting the online survey, and your decision to withdraw will have no penalty to you. However, if you leave before submitting the survey, I will not be able to use your data.

By clicking the link below, I confirm that I have read this letter and have decided that I will participate in the research described. Its general purposes, the particulars of involvement, and possible risks and inconveniences have been explained to my satisfaction. I understand that I can discontinue participation prior to submitting the survey. My consent also indicates that I am at least 18 years of age. [Please feel free to print a copy of this cover letter/consent form.]

Follow this link to the survey:

[Math Teacher Knowledge & Perceptions of Math Learning Disabilities](#)

Or you can cut & paste the follow link:

<https://tinyurl.com/ya5rdunb>

Thank you for taking the time to assist me in my educational endeavors. The data collected will provide useful information regarding Wyoming mathematics teachers' knowledge and perceptions regarding mathematical learning disabilities and the disability dyscalculia. If you would like to see the results of this survey, please email tgraves@uwyo.edu or tgraves@acsd1.org after August 1, 2018.

Sincerely,

Theresa Graves, BSED, MSW, NBCT

Contact Information:

Theresa Graves

UW Lab School, Dept. 3374, 1000 E. University Avenue, Laramie, WY 82072

(307)399-3623

Advisor: Dr. Jacqueline Leonard

Department: University of Wyoming School of Teacher Education

Phone number: (307)766-3106 Email: jleona12@uwyo.edu

This study has been approved by the IRB, protocol #20180227TG01907

Appendix G

Follow Up Email 1 for Principals and Teachers

Principal Follow Up Email 1

Dear [Principal],

Hi again! As mentioned in my previous email sent out on [Date], my name is Theresa Graves and I am a graduate student in the Masters of Science Middle Level Math (MMA) program at the University of Wyoming. Last week, I emailed all Wyoming principals to see if they would be willing to send out a research survey which is designed to look at regular education mid-level (6th-8th grade) mathematics teacher knowledge and perceptions of mathematical learning disabilities and the math disability dyscalculia.

In order to increase teacher participation in this survey research, I am hoping that you will send out my first follow up email to all of your 6th through 8th grade math teachers. If you have not had the chance to preview my cover letter and survey, I have attached a copy. This cover letter includes a TinyURL link that teachers can type in if you prefer to hand out a paper copy of my recruitment letter.

Following this email, you should receive an email that can be forwarded to your mid-level math teachers that includes both the cover letter and the link to the online survey. I will then send you one more follow up email to send out to teachers in about a week. If you have the time, I would greatly appreciate an email letting me know that you have had a chance to send out my research survey.

I appreciate your support as I work to collect data regarding Wyoming mathematics teachers' knowledge and perceptions regarding mathematical learning disabilities and the math disability dyscalculia. Please let me know if you have any questions or concerns.

Sincerely,

Theresa Graves, BSED, MSW, NBCT

Contact Information:

Theresa Graves

UW Lab School, Dept. 3374, 1000 E. University Avenue, Laramie, WY 82072

(307)399-3623 / (307)721-2155

Advisor: Dr. Jacqueline Leonard

Department: University of Wyoming School of Teacher Education

Phone number: (307)766-3106 Email: jleona12@uwyo.edu

This study has been approved by the IRB, protocol #20180227TG01907

Principal Follow Up Email 2

Dear [Principal],

Three weeks ago, I invited your mid-level (6th-9th grade) math teachers to participate in a research study that will look at regular education teacher knowledge and perceptions of mathematical learning disabilities and the math disability dyscalculia.

In order to increase teacher participation in this survey research, I am hoping that you will send out my final follow up email to all of your 6th through 8th grade math teachers. If you have not had the chance to preview my cover letter and survey, I have attached a copy.

Please let me know if you have any questions or concerns.

I appreciate your support!

Sincerely,

Theresa Graves, BSED, MSW, NBCT

Teacher Follow Up Email 1

Dear Wyoming Math Teachers,

Last week, I invited you to participate in a research study that will look at regular education teacher knowledge and perceptions of mathematical learning disabilities and the math disability dyscalculia. If you have already completed and submitted the survey, I would like to thank you for your valuable input. If you have not yet completed the survey, I am hoping that you will take approximately 10 minutes to complete the web-based survey by clicking on the following link:

[Math Teacher Knowledge & Perceptions of Math Learning Disabilities](#)

Or you can either cut & paste or type in the follow TinyURL link:

<https://tinyurl.com/ya5rdunb>

Your response is greatly appreciated as your input will not only help me finish my final project moving me towards obtaining my Master's degree in Mid-Level Math, but you will also be adding to cumulative mathematical research. Remember to submit your survey no later than March 31, 2018.

I have attached a copy of my original cover letter in case you did not get a chance to read about my research. If you have any questions, please contact me at tgraves@uwyo.edu.

Sincerely,

Theresa Graves, BSED, MSW, NBCT

Teacher Follow Up Email 2

Dear Wyoming 6th - 8th Grade Math Teachers,

Three weeks ago, I invited you to participate in a research study that will look at regular education teacher knowledge and perceptions of mathematical learning disabilities and the math disability dyscalculia. If you have already completed and submitted the survey, I would like to thank you for your valuable input. If you have not yet completed the online survey, I am hoping that you will take approximately 10 minutes to complete the survey by clicking on the following link:

Math Teacher Knowledge & Perceptions of Math Learning Disabilities

Or you can either cut & paste or type in the follow TinyURL link:

<https://tinyurl.com/ya5rdunb>

Please submit your survey by March 31, 2018. As I mentioned in my previous emails, your responses are greatly appreciated as you will be helping me finish my final project while also contributing to cumulative mathematical research. Additional information about the research is provided below.

If you have any questions, please contact me at tgraves@uwyo.edu.

Sincerely,

Theresa Graves, BSED, MSW, NBCT

Appendix H

LCSD1 Research Request, Abstract, and Approval

Laramie County School District #1 Research Approval Process, Forms, and Approval

Research Studies in Laramie County School District #1

The district recognizes the value of participation in educational research. Studies using observation, surveys, and experimentation can aid in the improvement of the instructional program in the school system as well as growth in the profession and growth for individual teachers and researchers.

At the same time, the district recognizes that the amount of time available for student learning is limited and must be handled carefully. It is, therefore, important that only those research studies which are of the greatest value to the district should be allowed to be conducted in the school system.

General guidelines for access to LCSD#1 students, staff and/or parents for research purposes

- All research requests to use students, student data, faculty or staff of Laramie County School District #1 are to be in written form and submitted to the Office of the Assistant Superintendent of Instruction.
- LCSD#1 must recognize a value to participating in proposed research. LCSD#1 expects to be furnished with a copy of any final reports or relevant findings.
- The proposed research should not intrude, or only minimally intrude, upon instructional time, or disrupt the educational process.
- LCSD#1 may charge researchers for district expenses such as staff time and materials required to support the research. The researcher will be notified of any charges at the time district permission is granted.
- Researchers may contact individual principals, teachers, staff, etc. about research planning or coordination prior to receiving district permission. If you have preferences about where or with whom you want to work, please state this in your proposal.
- Initial LCSD#1 review may take place prior to IRB (Institutional Review Board) approval, however, final LCSD#1 approval will occur only after review by an IRB.
- Requests must be complete. Incomplete requests will not be reviewed. Key elements of a complete request include a completed online Research Request Approval Form, abstract of the research study, including research questions and hypotheses, procedures, data to be collected, and timeline for the study, and appropriate consent/assent materials. Include any questionnaires, test forms, interview and observation protocols, and other instruments to be used. Evidence of IRB action must occur prior to final LCSD#1 approval.
- The district will attempt to notify the researcher of approval or denial within 2 weeks of receiving a completed request.

Research Request Elements

If you are interested in submitting a research request, please attach or send the following, preferably combined into a single PDF or MS Word document:

1. Research Request Approval Form
2. Your abstract (Describe in 700 words or less what your project will address. This abstract must be a synthesized statement. Please do not simply state "see attached" as most research proposals will exceed this limit. Please include:
 - a. research questions and hypotheses
 - b. procedures you will employ
 - c. data you will collect
 - d. timeline for the study
3. Consent forms (if required)
4. Instruments (questionnaires, observation or interview protocols, tests, etc.)
5. IRB approval letter (Copy of letter sent to you from IRB, approving your research)

Research Request Approval Form

Date:	March 13, 2018
Name of Applicant:	Theresa Graves
Area code and phone	
Email	tgraves@uwyo.edu/tgraves@acsd1.org
Street Address	
City	Laramie
State	WY
Zip	82072
Title of Project:	Teacher Knowledge & Perceptions of Mathematics Learning Disabilities and Dyscalculia
Is this research being done as part of a degree program? (Yes No)	Yes
University and Department Affiliation of Researcher:	University of Wyoming Science and Mathematics Teaching Center (SMTC)
Name and institutional affiliation of faculty advisor or professor.	Dr. Jacqueline Leonard University of Wyoming School of Teacher Education (307)766-3106 jleona12@uwyo.edu
Are you an employee of LCSD#1?	No
At what school(s) will the project be conducted?	7-8 th Grade Math Teachers from Carey Junior High and Johnson Junior High School, and 6 th grade teachers from Meadowlark Elementary and Arp Elementary *Two junior high schools & two elementary schools were selected with the hope that input would potentially be gathered from 6 th , 7 th , and 8 th grade teachers.
At what grade levels is the project to be conducted?	6th, 7th, & 8th grade math teachers
Number of students (this should be a number (5) or a range (100-150). If none are required, specify "none"):	Not applicable.
Estimated total time required of each student (this should be expressed as total hours per student. If none, specify "none"):	Not applicable.
Number of teachers required:	7-8 th Grade Math Teachers from Carey Junior High and 6 th grade teachers from

	Meadowlark Elementary, Arp Elementary, Pioneer Park Elementary
Estimated total time required of each teacher (this should be expressed in total hours per teacher):	10 minutes or less.
Number of other LCSD#1 staff required (this may include Principals, support, or administrative staff):	Not applicable.
Estimated total time required of LCSD#1 staff (this should be expressed in total number of hours):	Not applicable.
Number of parents required:	Not applicable.
Estimated total time required of each parent (this should be expressed in total number of hours):	Not applicable.
Additional school resources needed (e.g. interview room, table/chairs, other equipment, etc.)	Teachers can complete the online survey on laptops, computers, or cell phones.
Specify the starting and ending months and years, (for example, September 2015 to September 2016).	The survey is open from March 1, 2018 – March 31, 2018
Date of first contact with students:	Not applicable.
Date of last contact with students:	Not applicable.
Data to be collected	Non-identifying survey data which will include: 1) six item stems looking at demographic information, 2) twenty-one item stems that ask participants to indicate their level of knowledge or agreement using Likert-type scales, and 3) four open-ended questions.
Will material from the cumulative records of students or teachers be required? (Yes No) If yes, what material? Be specific, e.g., specify math grades instead of grades; or reading test scores instead of just test scores.	No
How will subjects' anonymity be protected?	Participants will not be identified by name, appearance, or nature of the data. The Qualtrics Survey Solutions online software program being used states that the survey link is "A reusable link that can be pasted into emails or onto a website, and is unable to track identifying information of respondents."

	<p>The researcher plans to send out the email through principals. School principals can either send the online link and/or print out the recruitment letter which identifies a TinyURL link. This link can be typed in by participants which will lead participants to the Qualtrics survey link. *At principal request, the researcher can also email printed copies of the recruitment letter.</p> <p>All data will initially be compiled through the Qualtrics program so the research will not have access to any teacher names, email addresses, or other identifying information.</p>
<p>How will parent permission be obtained? If parent permission is not required, specify N/A</p>	<p>Participants will not be asked to sign a consent form in order to protect their privacy and ensure confidentiality. In the cover letter email, participants will be told that by submitting the survey, they are providing consent to participate in the study. The statement that participants will read states:</p> <p>“By clicking the link below, I confirm that I have read this letter and have decided that I will participate in the research described. Its general purposes, the particulars of involvement, and possible risks and inconveniences have been explained to my satisfaction. I understand that I can discontinue participation at any time. My consent also indicates that I am at least 18 years of age. [Please feel free to print a copy of this consent form.]”</p>
<p>What are potential benefits to students, teachers, staff, parents, and the district as a result of this study?</p>	<p>There are no inherent benefits in participating in this study beyond the contribution that teachers will be making to cumulative mathematical research.</p>
<p>What are potential risks to students, teachers, staff, or parents through participation in this study?</p>	<p>There is minimal risk involved for all participants in this research study. The minimal risks may include the inconvenience that it takes to complete the survey or the discomfort that participants may feel when sharing about their understanding or lack of understanding</p>

	related to mathematical learning disabilities and/or the math disability dyscalculia.
Will subjects be paid? (Yes/No) If yes, specify payment: (Please note: LCSD#1 staff cannot be paid for tasks that occur during the instructional day.)	No
Will a pilot study be necessary? (Yes/No) If yes, please explain.	No
Date by which ALL original data forms will be destroyed (e.g., questionnaires, video files):	August 31, 2018
When will a report of the project's results be available? Specify the month and year.	Between May 15, 2018 and August 1, 2018

Abstract for LCSD1 Research Proposal

The inclusion of students with mathematics disabilities in the general education mathematics classroom has become increasingly prevalent. It is now the role of general education mathematics teachers to ensure that all students work toward grade-level mathematics standards. However, it is assumed that many general education mathematics teachers including middle-level, Wyoming general education mathematics teachers do not feel that they have the required knowledge or resources to provide effective instruction to all students identified with mathematical learning disabilities. The purpose of this research will be to collect information from current Wyoming middle-level, general education math teachers in order to: (i) determine the extent of their understanding/knowledge about mathematic learning disabilities and the mathematics disability dyscalculia; (ii) examine the nature of their attitudes about mathematics learning disabilities including dyscalculia; (iii) identify what supports and/or interventions are utilized within the general education math classroom to support learners with mathematics disabilities; and (iv) explore what they see as the perceived barriers to providing supports and/or interventions to students with mathematics learning disabilities. To gain insight into current perceptions and understandings, a survey questionnaire will be sent via email to regular education, middle-level mathematics teachers across the state of Wyoming. Descriptive statistics, including means and frequencies, will be used to summarize information. An analysis of variance may also be conducted comparing teacher scores based on years of experience and educational background. The study outcomes are anticipated to make a significant contribution to the field of mathematics education by providing an indication of teacher understanding and perceptions of the math disabilities including the mathematics disability dyscalculia. This research study was initiated March 1, 2018 and should conclude no later than August 31, 2018. The teacher survey opened on March 1, 2018 and is scheduled to close on March 31, 2018.

Contact Information:

Theresa Graves

UW Lab School, Dept. 3374, 1000 E. University Avenue, Laramie, WY 82072

Phone number: (307)399-3623 / (307)721-2155 Email: tgraves@uwyo.edu

Advisor: Dr. Jacqueline Leonard

Department: University of Wyoming School of Teacher Education

Phone number: (307)766-3106 Email: jleona12@uwyo.edu

This study has been approved by the IRB, protocol #20180227TG01907

Trevor Swarm <trevor.swarm@laramie1.org>

Thu 3/29/2018 12:25 PM

To:

Theresa Louise Graves

Inbox

You forwarded this message on 3/29/2018 2:59 PM

Good afternoon Theresa,

I have an update on your LCSD #1 research request. Overall, we think that this research would be aligned with our mission and is in the spirit of what we consider to be in our student's best interest. We have approved this request.

Please remember to contact me when you have completed your research. We are looking forward to learning from your findings!

Good luck with your project. Please do let me know if you have any questions.

Trev Swarm

Program Administrator – Instructional Data Analysis

Laramie County School District #1

(307) 771-2118 trevor.swarm@laramie1.org

Extension 10408

Appendix I

CITI Completion Report

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)
COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Theresa Graves (ID: 6841954)
 - **Institution Affiliation:** University of Wyoming (ID: 1296)
 - **Institution Email:** tgraves@uwyo.edu
 - **Institution Unit:** SMTC
 - **Phone:** 307.766.6381
-
- **Curriculum Group:** Basic/Refresher Course - Human Subjects Research
 - **Course Learner Group:** Students - Class projects
 - **Stage:** Stage 1 - Basic Course
-
- **Record ID:** 25855895
 - **Completion Date:** 02-Jan-2018
 - **Expiration Date:** N/A
 - **Minimum Passing:** 75
 - **Reported Score*:** 100

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Students in Research (ID: 1321)	01-Jan-2018	5/5 (100%)
History and Ethical Principles - SBE (ID: 490)	02-Jan-2018	5/5 (100%)
Defining Research with Human Subjects - SBE (ID: 491)	02-Jan-2018	5/5 (100%)
The Federal Regulations - SBE (ID: 502)	02-Jan-2018	5/5 (100%)
Assessing Risk - SBE (ID: 503)	02-Jan-2018	5/5 (100%)
Informed Consent - SBE (ID: 504)	02-Jan-2018	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	02-Jan-2018	5/5 (100%)
Research with Prisoners - SBE (ID: 506)	02-Jan-2018	5/5 (100%)
Research with Children - SBE (ID: 507)	02-Jan-2018	5/5 (100%)
Research in Public Elementary and Secondary Schools - SBE (ID: 508)	02-Jan-2018	5/5 (100%)
International Research - SBE (ID: 509)	02-Jan-2018	5/5 (100%)
Internet-Based Research - SBE (ID: 510)	02-Jan-2018	5/5 (100%)
Vulnerable Subjects - Research Involving Workers/Employees (ID: 483)	02-Jan-2018	4/4 (100%)
Conflicts of Interest in Human Subjects Research (ID: 17464)	02-Jan-2018	5/5 (100%)
University of Wyoming (ID: 12732)	02-Jan-2018	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?ka11c79da-4293-4c7f-a146-fb8c3a33f70a-25855895

Collaborative Institutional Training Initiative (CITI Program)
Email: support@citiprogram.org
Phone: 888-529-5929
Web: <https://www.citiprogram.org>

Appendix J

IRB Approval Letter

UNIVERSITY OF WYOMING

Vice President for Research & Economic Development
1000 E. University Avenue, Department 3355 • Room 305/308, Old Main • Laramie, WY 82071
(307) 766-5353 • (307) 766-5320 • fax (307) 766-2608 • www.uwyo.edu/research

February 27, 2018

Theresa Graves
Graduate Student
SMTC
University of Wyoming

Jacqueline Leonard
Professor
School of Teacher Education
University of Wyoming

Protocol #20180227TG01907

Re: IRB Proposal "*Teacher Knowledge & Perceptions of Mathematical Learning Disabilities and Dyscalculia*"

Dear Theresa:

The proposal referenced above qualifies for exempt review and is approved as one that would not involve more than minimal risk to participants. Our exempt review and approval will be reported to the IRB at their next convened meeting on March 22, 2018.

Any significant change(s) in the research/project protocol(s) from what was approved should be submitted to the IRB (Protocol Update Form) for review and approval prior to initiating any change. Further information and the forms referenced above may be accessed at the "Human Subjects" link on the Office of Research and Economic Development website: <http://www.uwyo.edu/research/human-subjects/index.html>.

You may proceed with the project/research and we wish you luck in the endeavor. Please feel free to call me if you have any questions.

Sincerely,

Nichole Person

Nichole Person
Staff Assistant, Research Office
On behalf of the Chairman,
Institutional Review Board

Appendix K

Teacher Comments on Defining Dyscalculia

- How would you define/describe the mathematical learning disability dyscalculia?
- No idea what it is
- A student who struggles to hold information in their working memory long enough to complete a problem.
- I have no training in dyscalculia
- Dyscalculia is a disability that makes it difficult to understand number concepts. I think of it as having difficulty understanding the "language" of mathematics.
- not understanding numbers and what symbols/variables mean or represent. not being able to apply the mechanics to everyday life
- I can't.
- Students have difficulty working with numbers. This includes fluency with math facts, addition, mult, division and subtraction. Students with dyscalculia have difficulty with mental math.
- specific disability in working with numbers and spatial calculations
- I define dyscalculia as a difficulty reading and understanding numbers. I think that it is similar to dyslexia where students often get letters mixed in their head and also have trouble relating those letters/numbers to their purpose in the world.
- The student has a really hard time with concepts such as basic facts or other types of calculations which is why visual aids and manipulatives help them so much.
- don't know but I believe it has to do with calculations and the ability to do this mentally
- Never heard of this until now. Just Googled the term. I believe that there are students with this disability but it doesn't disable them from being successful in math class.
- Like most other disabilities, there is an overlap of symptoms with other disabilities. However, if a student had difficulties learning, say, their basic math facts, I will try to help them in the same manner that I would help a student with a different disability that affected their ability to learn their math facts. Other problems I have seen include difficulties distinguishing between subscripts used for notation and exponents, which have a different meaning. Also, it is challenging to help them understand that same notation devices may mean something different mathematically when the context changes, like absolute value lines and matrix lines. They may look the same, but they mean something different based on context.
- I'm not sure.
- Not sure.
- The struggle/inability to read, understand, and calculate with numbers
- The inability to take numbers and perform mathematical functions with said numbers.

- I'm guessing it has to do with an inability to remember math facts.
- I would not define or describe it as I have not heard of this learning disability.
- I wouldn't as I do not know what it is. :(
- Students who have challenges with organizing numbers.
- Never heard of it, but guess it means a difficulty with making calculations.
- With spatial reasoning and short term memory of basic facts or inability to memorize.
- dyslexia with numbers
- I have never heard of it.
- I do not know anything about this disability.
- I think it is when you get numbers and/or variables mixed up; and I think I have a bit of dyscalculia. For example when I was learning Algebra, it was really hard for me to combine like terms because I got the exponents and letters mixed up. When I teach students, I keep this in mind and I think it makes me a better teacher.
- difficulty understanding numbers, operations with numbers, recalling math facts, interpreting story problems or applications of computational procedures
- I have no idea without looking it up!
- Dyscalculia is a student's difficulty to utilize mathematical processes that can include various co-morbid difficulties including working memory, fine motor skills, processing speed, dyslexia, dysgraphia, ...
- I have never heard of it.
- Dyscalculia can be anywhere from number reversals to switching operations to reading information incorrectly.
- No idea.
- ?????? I have never heard this term.
- Processing disorder, struggle with steps and organization and number sense, pattern difficulty, weak abstract thinking

Appendix L

Teacher Comments on Interventions & Supports

1. The students sit in the front row near me, my para sits within that group, I accommodate on length of assignments. They work in pairs when needed.

2. I have not had any students IDENTIFIED with mathematical learning disabilities.

3. I have used fraction magnets, online graphing technology, and not much else

4. Current text and supporting materials, additional hands-on manipulatives, calculators to aide in computations which helps student focus on concept, 1 para-educator who is helpful but not trained, In class note taking (with para-educator) for these students that they can use for lessons and tests

5. Chrome books and online resources, Special education inclusion teacher/aide help, algebra tiles, other manipulatives

6. online program called TenMarks

7. Chromebooks Smart Board manipulatives the special education teacher.

8. I use math manipulatives (algebra tiles, + and - tiles), multiplication tables, and calculators also for accommodations students go to a quiet place to take assessments. Small group interactions are used to identify and clarify concepts.

9. number talks, subtilizing resources, counting-on, math recovery,

10. Go Math book Khan Academy Google Classroom Kuta Software

11. starboard, visual aids, manipulatives, sometimes calculator

12. Special Education Teacher/Case Manager Math XL iPads - paperless classroom helps students who struggle to keep track of work

13. Ipad, computers, calculators, Web sites.....

14. Go Math, Compass Learning, modifying assignments

15. We don't use textbooks in our classroom for ANY student. Class lesson plans are created around what works for students. We use online videos, notes, games. We use interactive games in the classroom. We complete paper pencil practice papers. All depends on what works for the students while also trying to very lessons per learning styles. With this being said, resources that I have used to support students with disabilities include: online programs such as Khan Academy for independent work at the appropriate level, Chromebooks (1 to 1 devices) for students to watch, rewatch and practice skills in everyday class, and simply providing tools for each student that helps them be successful. Example: timer for students to track progress (not in a negative way), multiplication table for students who don't know their facts, visuals on walls or journals for students to refer to on frequent topics.

16. Physical activities can sometimes help. For instance, to help students understand graphing, I lay out a coordinate plane on the floor and have students graph themselves. When they begin working with linear equations, I give them string to make the lines.

The major devices I use as assistive technology are graphing calculators, GeoGebra app, and Desmos app. These can be used to fairly quickly demonstrate what happens to a figure or graph as one parameter changes. It also helps students understand why I am so "picky" when writing mathematically.

-
17. I don't have any classroom material or devices. Just an aide.
-
18. I use the standard curriculum, the differentiated instructional pieces, IXL accounts for additional practice, online fact practice pieces for additional practice enrichment.
-
19. TenMarks, Khan Academy, Desmos Calculators, CPM extra practice
-
20. I use Kuta software to supplement, calculators, one-on-one teaching, peer coaching. I also re-teach when necessary. I find that if they don't learn one way it is my obligation to find a mode of delivery that makes sense to their brain.
-
21. Support personnel in the classroom, students pulled out as needed
-
22. Some common accommodations that my students have are preferential seating, dimmed lights, extra time, educational support aids (such as calculators or multiplication tables). However, none of which include teacher directed strategies.
-
23. Graphic organizers, graph paper, access to calculator.
-
24. I currently have no students identified with mathematical learning disabilities. I use manipulatives and models with all of my students.
-
25. 27 years of teaching mathematics and the strong support from the Sp. Ed. Department
-
26. -individualized goal work once a week with Accelerated Math and teacher instruction - Math 180
-
27. We allow them up to 2 extra days for all work assigned. Calculators can be used for all assignments. (This is a terrible resource in my opinion. Each student is judged based on their state exam levels. On those tests they can't use calculators so we cripple their ability to perform well on state test) For those who are severely behind, they work on Aleks.com to do work closer to their level.
-
28. Hands on manipulatives to make abstract concepts concrete; IXL for individualized instruction and practice; use of calculators; extended teaching time through a flex class period; additional support through a 45 minute intervention class
-
29. I use a textbook, document camera, and Khan Academy. I also use some manipulatives. When I see a student struggling with a concept, I ask their parent(s) to help them with it at home.
-
30. consulting with special ed. teacher, small group or one on one instruction, Think Through Math reteach
-
31. I can't say I use anything extra.
-
32. District generated Foundations of Math courses that use multiple on-line and print copy resources.
-
33. IXL, Moby Max, and Sumdog are websites I use for all students as review and practice of math skills.
-
34. manipulatives, Big Ideas Math curriculum, iPads

35. Para, Smart Notebook, resource room. I did have a student use the program ALEKS last year.

36. CPM textbook resources, calculators, Desmos, IXL

37. The only material I really use to intervene I come with myself. I use an assistive technology program only because it is one I have become familiar with from my own intervention study. Seldom are accommodations clearly mathematically based. They are more general to all Learning disability.

Appendix M

Teacher Comments on Perceived Barriers

1. With varying abilities such a factor is difficult to assign work each day to their level without overwhelming them.

2. Lack of identification because I have not had any students IDENTIFIED with mathematical learning disabilities.

3. Spending the time to co-plan learning experiences that are appropriate.

4. The time to sit 1 to 1 with the students

5. 1. My lack of knowledge of how the disability is affecting my students learning. 2. Lack of time to spend with these students and also attend to my other students. 3. Lack of additional help from special education teachers and para-educators (Man-power).

6. The biggest barrier to teaching students with math learning disabilities is the time constraints that are present in a traditional middle school schedule. If a student doesn't get a concept in a 45 minute time period, oftentimes it has to be "tabled" until the next class period.

7. The special education system of public schools.

8. Not knowing how to help the students with certain disabilities.

9. Each disability looks a little different and identifying what works best is sometimes difficult.

10. Time to work 1:1 with the students.

11. I have not received specialized training to teach students with Math disabilities.

12. It is difficult to effectively work with these students when they are in a classroom with 20 peers with different needs. Another barrier is the lack of follow through outside of the classroom. A lot of times, these students struggle because they are taught differently by different teachers. For instance, if I teach a method differently than the special education teachers, the students have difficulty code switching and realizing that the two methods are accomplishing the same thing. Follow through at home can often be a barrier too. I hear a lot of parents say, "I was bad at math and turned out fine. So don't worry about it." Beliefs like that make teaching any student difficult, but it makes teaching students with disabilities even more difficult.

13. Time with each student.

14. Knowing how to motivate them when they just don't care.

15. Their ability to reason and work independently

16. Training-always can use a better understanding of students' disabilities and ways to help them be successful. The issue with training is that ALL students are different and there are no one-size fits all approaches. Training just helps increase the amount of tools I have in my toolbox to help our students.

17. First of all, they need to be properly identified. Most have not. Because they are not properly identified, then I do not have access to possible resources to aid their learning in a more effective manner.
18. Often then have gaps in learning so they are not prepared for the regular classroom.
19. A lack of confidence and the stigma of I am bad at math.
20. Not enough individual time with them. Lack of support outside the classroom.
21. I believe the biggest barriers are the attitudes that are ingrained in the students before I ever see them. Statements like "he has my math Brain." "He never has been able to do math."
22. I lack any formal training.
23. Lack of professional development, lack of understanding of mathematical learning disabilities, lack of support through SPED teachers.
24. I believe my lack of resources and training in the area of mathematical disabilities are my biggest barriers when it comes to working with students who are identified with mathematical learning disabilities. I do not feel that I am aware of best practices when it comes to effectively reaching students with mathematical disabilities nor do I have an understanding of how the disability impacts the students' ability to gain and retain information.
25. Time and quantity of students.
26. Time
27. Time and behavior management
28. The pressure to have them in a general education classroom. When a student is a few grades below their peers, asking them to complete work along with their peers, even when given extra time and resources, can be unrealistic. I have 3 students in my 8th-grade class that score in the 3rd, 4th, and 5th, grade level on placement tests. I can't hold them accountable for knowledge at an 8th-grade level if they are capable of work 3-5 grades lower.
29. My own knowledge about types of mathematical disabilities and specific strategies to work with specific disabilities; time to work with students individually to drill down to specifics of confusion or misunderstanding
30. I have not been trained in my UW classes or in professional development to help students with mathematical learning disabilities. If had some training, it would at least be a starting place.
31. Lack of knowledge and not having the time to be able to work with them one on one or in a small group
32. Ignorance, resources and time.
33. Their belief that they can learn.
34. Time
35. The biggest barrier is time, students with mathematical learning disabilities need to wait time to process what is happening and why.

36. Time. Having the time it takes for them. I am fortunate to have a para to help out in my classroom.

37. For a lot of students, the biggest barrier for me is the students' own negative attitude. So many think they can't do math.

38. Not having the specific understanding through the special education department or the families. These disabilities are MUCH less clear than 'reading' disabilities are.

Appendix N

Teacher Comments on Teacher Effectiveness

1. I believe I am effective with identified students as I build relationships with my students to make sure they are comfortable and safe within my room. I try not to treat them like any of my regular ed. students.

2. I have not had any students IDENTIFIED with mathematical learning disabilities.

3. Somedays yes and some days no. I feel like I enjoy the challenge of helping students understand complex material.

4. It depends on what they are struggling with as some material and some concepts I can come at from different directions and this increases the understanding of the concept.

5. I believe that over several years of teaching I have gotten better at helping these students. But I know that I am not as effective as I could be.

6. I do think I am effective when working with students with math learning disabilities. I have a degree in special education and taught middle school special education for 4 years in an inclusionary setting before moving to general education.

7. To some degree, yes. Students with a math learning disability should be given the opportunity to find what works for them. They may never know the math facts but can process through algebra.

8. Somewhat. I have learned strategies from the special education teacher that I co-teach with but have not had any formal training.

9. I wish I was better and more effective. However, the students I have worked with have shown growth.

10. Yes, especially if I am given the opportunity to work 1:1 with the student.

11. I am successful with any student who has a desire to learn.

12. When I have the opportunity to work one on one with the student I feel like I can teach them math effectively because I am able to decode their mistakes and work to correct them.

13. Yes, because they move from one level to the next.

14. Yes, I feel that I have the patience and understanding to work with students who struggle in math. I believe I can teach the math at a level and in a way that they understand

15. I believe that I can be, given the proper support

16. I have 6 IEP kids out of 25 that are mainstreamed into my classroom. All are in class for instruction then 4 are pulled and worked with in small groups with Paras.

17. Overall, I feel very effective with students on IEPs in the general education classroom. I do have to say that my caseload is pretty minimal with 10 or less students on IEPs per year. We also co-teach with the special education teacher. I LOVE have IEP students in my classroom under this model. We can help each other out as team teachers. The special education teacher helps with how to assist students with disabilities while I help teach different ways to approach the concept so all learners can understand. With many of these questions, it was hard to give a strongly agree or strongly disagree. What I can say

is that I believe ALL students, even students with a mathematical learning disability, can learn math! Everyone is just a little differently on how they get from point A to point B.

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18. Yes. I break down for the students repeatedly how to read an expression or equation. If they have issues recognizing, say exponents, I include color coding as well as other activities to try to help them recognize differences. I have extensive experience working with students placed in "remedial" classes. Even though only a few of the students in those classes were considered to have learning disabilities, I know many other students also had learning disabilities or major gaps in their mathematical learning. Major gaps in mathematical learning often need to be treated the same as learning disabilities.
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19. No not really. Lots of time they have memory issues or don't know basic facts well- so I teach way too quickly for them.
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20. Not as much as I would like to be. There is always room for improvement and I am not perfect.
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21. Yes. I have a strong foundation in math and understand scope and sequence well. It is important to know which skills are needed to understand new concepts.
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22. I do believe that I am effective when working with identified students with mathematical learning disabilities. I choose to look at them as challenges rather than disabilities. I have been teaching students with challenges in math for several years and simply find other methods to teach them and the rest of the students. Because of this I have seen students go from no understanding to explaining to others. I believe a lot of it is the teacher attitude and approach. Not every brain learns the same and we cannot teach as if every brain is the same.
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23. I don't have much experience teaching math to students with a disability.
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24. No I am not an effective teacher when working with students who are identified with mathematical learning disabilities. I have not been given the resources to help students with mathematical disabilities. In the past I have tried to differentiate by making assignments smaller or giving extra time, however, I do not feel that offers students the working knowledge required to learn math concepts.
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25. I feel that I could benefit from additional training and professional development regarding mathematical learning disabilities. I feel that many of my strategies and interactions could further be fine-tuned once equipped with the knowledge and deepened understanding of mathematical learning disabilities and how to better address them in the general education classroom.
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26. I feel like I need additional PD around ways to identify student's mathematical learning disabilities so that I can adjust the way that I teach. I also feel I need additional supports around what those techniques may be.
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27. I am effective when teaching math to students.
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28. Yes, given time and individual instruction with an IEP student and with help from the Spec. Ed instructor, I have had success, quantified as knowledge gained in mathematics.
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29. I don't agree, mainly because of time. If I could have extra time just for those students and to slow down at work at their pace, I would be fine, but the demands of district and state don't allow me to spend enough time with those students. Most math disability students are pulled out for instruction for this reason.

30. I think that we have developed some interventions that have worked but in many ways, I feel unprepared to teach students with math learning disabilities. In addition, I think that although sometimes being in a general education classroom is beneficial. I also think it can be overwhelming to the student and can also be unfair to them.

31. Yes - however I am most effective when I have time to ask the student one-on-one questions about where the misunderstanding is taking place, listen to the student talk about his or her thinking, or observe the student work.

32. All students have different learning styles, and I try to teach so all students can learn. However, I do not specifically and explicitly teach for students who have mathematics learning disabilities.

33. No. Despite having a minor in SpEd, I have never had explicit instruction in how to help students with a math learning disability. The coursework that I had focused on reading and writing, and I don't remember ever being taught how to support math students with a disability.

34. Somewhat, but there are so many factors and excuses made for kids in education that success in math is often seen as unimportant.

35. I have been effective with some students, and not so effective with others. My instruction is focused on a constructive, behaviorist approach that attempts to identify specific student learning styles and needs. Part of that instruction may include teaching students how to accommodate for their difficulty and advocate for their needs. This instruction and learning occurs within the arena of student disposition and motivation, which can be fragile, and have a particular impact on our success. We try to include grit, growth mindset, and executive function skills training for all of our students with learning difficulties.

36. Not really due to training.

37. Yes, students with a learning disabilities need different learning approaches and given more opportunities to practice the concept and skills that are being taught.

38. Depending on the student and their disability--all the kids are different in how their brains process everything--not just math. Non-disability kids process math concepts differently also. As a math teacher, I just have to have a wide variety of methods available for all kids to be sure they are learning the math concepts. I believe I am effective to an extent--with kids with disabilities. I have seen kids "hit their ceiling" in math education sooner than others, but I look for other branches of math in which they can still learn.

39. I sometimes get frustrated with "time" issues. In order to keep all of my classes at the same pacing, I sometimes feel like I short my team-taught class of some opportunities. Sometimes, I go at different pacing for my team-taught group so I make sure they get what they need. This creates its own issue; instead of having to prep for 2 different lessons (math and algebra), I end up with a 3rd and sometimes 4th lesson prep and not a lot of prep time for all of it.

40. It has seldom been addressed what exactly a mathematical learning disability is. We get a general 'learning disability understanding but I can't remember when I have had a special education Teacher of Record address the terms 'mathematical learning disability' or especially dyscalculia. I only know of this term through my own research.