Interventions for Students With Developmental Dyscalculia: A Systematic Literature Review

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Developmental dyscalculia (DD) affects 2-6% of the population. Yet, a readily accessible list of potential interventions for DD is not available or can be easily found by educators. With a large percentage of the population afflicted with DD, educators should be made aware of what supportive approaches are available. The purpose of this study was to construct a literature review to locate and identify strategies tailored for this particular learning disability that can be used in the classroom. Results indicated that a total of seven evidence-based interventions are available for DD. Of the seven available options, all reported evidence of effectiveness in terms of helping to improve mathematical learning abilities for individuals. The need for future research into interventions for DD will assist students in improving their understanding of how they can handle mathematical tasks.

Keywords: **developmental dyscalculia, dyscalculia, intervention, mathematics difficulty, mathematics learning disability**

Introduction

Developmental Dyscalculia: Origins, Prevalence, and Impact

Developmental Dyscalculia (DD) is defined as "persistently weak mathematical performance of developmental origin, related to the weakness of some kind(s) of cognitive function(s) and/or representation(s); appearing when the concurrent motivation to study mathematics and access to appropriate mathematics education is normal" (Szűcs, & Goswami, 2013, p.33). As this field progresses, it is crucial to emphasize harnessing students' strengths rather than merely concentrating on their shortcomings.

DD is estimated to be present in 2%-6% of the total population (Kosc, 1974; Shalev et. al, 1998; Von Aster & Shalev, 2007). This specific kind of learning disability has been identified in various forms over time, including but not limited to Gerstmann's syndrome (Nielsen, 1938), finger agnosia (Gerstmann, 1927), acalculia (Singer & Low, 1933), dyscalculia (Stanton, 1954), and now is known as DD (Cohn, 1968). Initially, researchers proposed traumatic brain injury as the culprit for DD (Ardila & Rosselli, 2002). However, today, brain

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scientists and researchers note that the underlying causes can be linked to spatial ability (Geary, 2022), variability in working memory (Cárdenas et al., 2021), lower numerical and finger-related skills (Cohen et al., 2019), and representation impairments and disrupted access to representations (Bulthé et al., 2019). As of Fall 2020, the number of K-12 students in the United States with DD is estimated at a minimum 464,000 (NAEP, 2020). Individuals with DD often experience inaccessibility in terms of high-quality school learning environments (Xu, 2003), which leads to an increased risk of lack of employability, lower working salaries, and a higher-than-average unemployment rate as future working adults (Cortiella & Horowitz, 2014). A need to better understand the landscape of literature directly and indirectly related to DD exists.

Prior Literature Reviews on Interventions for DD

Two prior reviews of the literature were found with "interventions" and "dyscalculia" in their title. These were the only ones the author could locate that specifically addressed strategies for individuals with DD. Both will be briefly discussed below.

Monai and Pedro (2017) published a paper titled *A systematic review of interventions for children presenting with dyscalculia in primary schools*. The overarching goal of their literature review was to examine the currently available interventions for primary students with dyscalculia. However, the review focused broadly on students with mathematical learning disabilities, with just one study that focused specifically on girls with dyscalculia. To define what studies met the criteria for inclusion in the literature review, the author created a quality appraisal tool to assess the quality of articles. Of a total of 1551 potential articles, the quality criteria were met on 11 articles. The author determined "interventions that directly address the knowledge of mathematical facts, the ability to carry out mathematical procedures, understanding and using mathematical principles and so forth are ideal in helping to support children with dyscalculia" (Monai & Pedro, 2017, p. 290). While this paper title would suggest that it relates to primary students, specifically with dyscalculia, it was mainly focused on those with mathematical learning disabilities broadly.

Santos (2020) wrote a chapter titled *Interventions for children with developmental dyscalculia*. Santos incorporated Devine and colleagues (2013)'s work that cited sources to identify the prevalence of DD. While explaining different perspectives from the literature, the author states, "developmental dyscalculia and low attainment in mathematics, as interchangeable" (Santos, 2020, p. 71), which does not clearly define the discrepancies between the two. Potentially, there are other contributing factors, such as teacher performance, curriculum, peers, and familial influences that are also present relating to low attainment in mathematics (Abd Algani & Eshan, 2019; Chand et al., 2021) as opposed to DD being associated with a neurological condition. Continuing to refer to

studies, the author states, "Persistent does not mean immutable" (Santos, 2020, p. 70), which implies mathematical difficulties interventions can be used to increase understanding. Numeracy interventions are identified by Santos as the most effective interventions for those with DD. While examining the meta-analysis of studies for students with mathematics disabilities and DD, the aim was not to comprehensively examine studies with DD but to give an overview more broadly across mathematics disabilities.

Limitations of Prior Research

Analyzing the previous two literature reviews uncovers several research gaps. Firstly, there remains a lack of a standardized definition for DD agreed upon by researchers and practitioners. As a result, there are discrepancies in identifying students with DD and variations in the selection of appropriate interventions. Secondly, despite the mention of dyscalculia in the titles of these literature reviews, the primary focus of the papers does not revolve around DD, indicating a need for more focused and dedicated research in this specific area. The most recent literature review's main goal was not to systematically analyze the current literature on interventions but give an overview with a brief synopsis and the nuances of DD. The 2017 literature review focused on interventions and the 2020 review focused on many aspects of DD, including parents and neuropsychologists, which was not specific to mathematics interventions for DD. Including viewpoints from different stakeholders is an important aspect of research that is helpful for revealing different perspectives of individuals with DD and how they interact with others. The author of the 2017 literature review does not focus exclusively on DD but instead states that Mathematical Learning Difficulties (MLD) and DD are interchangeable terms. DD and MLD are intertwined; however, they are not identical. Using these terms interchangeably leads to including literature that is not specific to interventions for DD. The author of the second literature review only provides a brief synopsis of the nuances associated with DD and not specific interventions. A review of few interventions is included; however, it is not a systematic approach to finding all literature associated with interventions and DD. The 2020 literature review, while a book chapter, could cause a bit of confusion with readers specifically seeking interventions for students with DD due to the titling of the chapter.

With so little literature and research available related to DD and associated interventions, there is an opportunity and need for this literature review to share the overall landscape of what is available. The author of this literature review intends to explore all available interventions in the literature for those identified with DD as well as including interventions that would be able to be used in classrooms. Narrowing what interventions are specifically available for students with DD will allow both researchers and teachers to more appropriately support their students.

The Need for Evidence-Based Mathematical Interventions for Students with DD

Furthering research on what interventions are effective for students with DD is twofold. First, the author intends to show the lack of currently available literature on effective interventions for DD. The lack of interventions available creates a justification to increase efforts to expand the dedication of research being conducted directly related to DD. Secondly, the author intends to promote successful interventions from this literature review to mathematics educators in the classroom to further equity and inclusion for students with DD. There is a need to identify and bring awareness to successful interventions for those with DD so that teachers and interventionists can employ these interventions with students that could greatly benefit. Teachers with access to effective interventions can create a more equitable student environment allowing them to level the playing field (Schechter, 2018).

Lacking sufficient knowledge of successful interventions available to students with DD severely limits the impact teachers and researchers can have on helping those students. Currently, there are only two prior systematic literature reviews that do not directly investigate interventions for the student population with DD. These two literature reviews were published in 2017 and 2020 (Monei & Pedro, 2017; Santos, 2020) which suggest a need for additional research due to the limited information available on specific interventions for those with DD. Through an extensive search of the literature, the author plans for the current literature review to locate and identify interventions specific to DD. Identifying specific interventions that are available for DD has the potential to expand the availability of said interventions to practitioners.

Equitable access to mathematics must start early in a child's school career by building strong mathematical identities while using research informed practices (NCTM, 2020). The author of this literature review intends to find effective evidence-based interventions that allow for this through the identification of what is currently available for our students with DD. The inclusion of effective mathematical interventions allows access for not only students with DD but all students. The earlier we can supply effective interventions in a child's mathematical experiences the more likely they are to build a strong mathematical identity.

Ensuring fair opportunities in mathematics provides individuals a level playing field in the classroom. This can be achieved by eliminating student and teacher tracking, fostering positive mathematical identities, and promoting effective teaching methods in mathematics (Graham et al., 2018). Relating mathematics to experiences they will face in post-secondary settings allows for students to have more success outside of the classroom both in the present and the future personal and professional lives. Creating a more equitable environ-

ment in mathematics to ensure current and post-secondary success is critical to improving the chances of those with DD to not be defined by their disability. Working with individuals' strengths while employing effective interventions for those with DD will ensure equitable access to mathematics for all students. Focusing on areas common once they leave the classroom is also important to address. "To leverage their mathematical content knowledge and mathematical reasoning skills to understand the effects of compound interest, weigh the risks of different investments, or determine whether payday loans are reasonable options" (NCTM, 2018, p.15), which shows the need for using research backed evidence-based interventions for our students in the classroom.

While many literature reviews in exceptional student education focus on both mathematics and learning disabilities, only two are available on dyscalculia but are broader and not specific to only dyscalculia. This paper is specifically and uniquely focused on literature specifically related to interventions focused on those with DD.

Purpose Statement and Research Questions

The purpose of this literature review is to build awareness to the research and professional community regarding the dearth of information available with relation to interventions for those with DD. The author intends to make known what interventions are currently available and how effective they are for students with DD.

This literature review focuses on two specific questions:

1. What are the characteristics of available interventions in the literature for those presenting with DD?
2. What is the effectiveness of these interventions for those with DD?

Method

Inclusion Criteria

The literature included in this review was selected because it specifically focused on interventions for those diagnosed with DD that have practical classroom application. Only peer-reviewed articles were selected for this literature review. Many interventions have been created for mathematics generally; however, there is a dearth of interventions created specifically for those diagnosed with DD. The author did accept those interventions for students with DD and dyscalculia due to the duality of those names in the literature. All date ranges are included due to the limited availability of interventions specifically aimed at those with DD. Other selection criteria were that the literature be in English and fully accessible electronically through the university's library services.

Search Strategy

The University of Central Florida library was used, targeting databases focused on special education, mathematics education, educational psychology,

and equity in education: PsycINFO (American Psychological Association), Education Source (EBSCOhost), ERIC (EBSCOhost), ERIC (ProQuest), LearnTechLib, and Science Direct. Search terms focused on the intervention of DD and included "dyscalculia" and "interventions". Phrases such as "mathematical disability" and "disabilities" were omitted from the query review due to their broad scope.

Results

Completing a search for "dyscalculia" and "interventions" fetched a total of 1041 results (see Table 1 for a detailed analysis).

Table 1. *Yielded results from the search of each database*

Databases	Search Terms	Yielded Results
APA Psychinfo	dyscalculia and intervention	146
Education Source (EBSCOhost)	dyscalculia and intervention	82
ERIC	dyscalculia and intervention	38
LearnTechLib	dyscalculia and intervention	19
Science Direct	dyscalculia and intervention	756

The intention was to identify all relevant articles; however, some constraints and justifications shaped the search: Peer-reviewed papers were exclusively selected to ensure a base level of quality. The decision to include full access online/free allows for continual access and does not limit any future search attempts without access to a university library search engine. Only articles written in English were considered to avoid any confusion during translation as well as the lack of access to translation. The sole term "dyscalculia" was used in the search as it would encompass articles referencing DD. Using this criterion combined with "interventions" produced 133 results. Abstracts of these results (which contained some repeated entries across databases) were reviewed to identify articles specifically discussing interventions for individuals with DD. The selection was further refined to spotlight strategies applicable directly within the classroom setting. After thoroughly evaluating the article abstracts of the 133 results, it was determined that seven articles met the criteria of interventions specifically for students identified as having DD. The articles selected meeting the criteria from the narrowed search are found in Table 2 (the one piece of seminal work related to dyscalculia is also included).

Table 2. ***Summary of Research Studies of Interventions for DD***

Published Year	Title and Author(s)	Population	Selection Criteria	Intervention	Comparison	Outcome
2022	Effectiveness of a process-based executive function intervention on arithmetic knowledge of children with developmental dyscalculia (Nazari et al., 2022)	30 male students with mean age of 9.5 years	Participants included in study were referred by school principal and chosen based on WISC-IV and Key-Math (Persian) test performance	Executive Function Intervention	Students with DD received intervention while control group received standard instruction	Intervention benefited factual and procedural arithmetic but not conceptual knowledge for students.
2021	Can abacus course eradicate developmental dyscalculia (Lu et al., 2020)	128 males and 117 females randomly chosen 8.8 years of age +/- 0.6 years	Participants selected based on previous studies by Barner et al. and Wang et al.	Students placed in abacus class	A total of twelve classes were included in the study.	Participants in the abacus course demonstrated better performance
2020	Persistent effects of musical training on mathematical skills of children with developmental dyscalculia. (Ribeiro & Santos, 2020)	44 total students. 17 males and 5 females with DD mean age of 8.27, control group consisted of 22 students who were typically developing	Participants chosen with teacher's recommendation based on mathematics grades	A 14-week musical training program	A total of 22 students were identified as having DD by researchers and 22 students were typically developing peers	All students showed improvement in number production, number comprehension, and calculation.

Table 2. ***Summary of Research Studies of Interventions for DD (continued)***

2020	Substantiating synesthesia: A novel aid in a case of grapheme-colour synesthesia and concomitant dyscalculia (Berger et al., 2020)	21-year-old female with lifelong DD	Chosen by researchers due to early childhood experience and difficulty with mathematics	The participant used the digit-color calculator (DCC).	N/A	The aid of the DCC helped participant with mathematical computations.
2018	Functional hyperconnectivity vanishes in children with developmental dyscalculia after numerical intervention (Michels et al., 2018)	31 children, 15 with developmental dyscalculia and 16 typically developing ages 7.8 to 11.8 years of age	Participants selected from a prior study by Kucian in 2011, with a total of 32, one was excluded because prior data was not readable	Participants received intensive computer-based training	N/A	The training intervention led to increased hyperconnectivity in the brain
2017	Effectiveness of working memory training among children with dyscalculia: Evidence for transfer effects on mathematical achievement—a pilot study (Layes et al., 2017)	16 males and 12 females with developmental dyscalculia with mean age 9.68 years	Participants selected based on academic achievement and teacher's opinion, screening included mathematics and Raven (human intelligence) test	Participants were placed in an eight-week training program	Participants for the study were equally assigned randomly to both the control and experimental groups	After the training program participants working memory

Table 2. ***Summary of Research Studies of Interventions for DD (continued)***

2011	Mental number line training in children with developmental dyscalculia (Kucian et al., 2011)	32 total students. 16 students with DD, 10 males and 4 females with mean age of 9.5 and control group of 9 males and 7 females with mean age of 9.5	Participants chosen by using comparison scores in mathematics sections and overall scores from the WISC-III and ZAREKI-R	A mental number line training computer game was used for 5 weeks for 15 minutes a day.	A total of 16 students were identified as having DD by researchers and 16 students were typically developing peers	Students with and without DD benefited
1974	Developmental dyscalculia. Journal of learning disabilities. (Kosc, 1974)	199 males and 176 females randomly chosen 10.2 to 11.8 years of age	Participants were chosen based on teacher's recommendation,	N/A	Two different sets of group tests were utilized to measure the participants mathematical abilities.	The testing identified 24 of the 375 children to have dyscalculia.

Note. This table includes the seminal piece for the identification of DD (Kosc, 1974

Summary of Findings

The reviewed literature reveals noteworthy findings regarding interventions for DD. The studies demonstrated that an executive function intervention positively influenced factual and procedural arithmetic in children with DD but had limited impact on conceptual knowledge. The abacus courses were found to enhance arithmetic computation and spatial short-term memory in DD individuals. Similarly, musical training exhibited persistent positive effects on number production, comprehension, and calculation skills among children with DD. Moreover, the use of a digit-color calculator (DCC) as an aid significantly alleviated basic calculation difficulties in an individual with grapheme-color synesthesia and DD. Intensive numerical training led to a reduction in functional hyperconnectivity in the brains of children with DD, making them less distinguishable from typically developing children. Additionally, working memory training showed transfer effects on mathematical achievement in DD children. Lastly, a mental number line training computer game benefited both DD and typically developing children, improving spatial representation of numbers and mathematical problem-solving skills.

Interventions

Executive Function Intervention

The study by Nazari et al. (2022) examined the effectiveness of a process-based executive function intervention on arithmetic knowledge in children with DD. The intervention focused on enhancing three key executive function components: working memory, inhibition, and switching. Thirty male students diagnosed with DD and no comorbidities, with a mean age of 9.5 years, participated in the study. Participants were referred by the school principal and selected based on performance in WISC-IV and Key-Math (Persian) tests. The intervention involved 30-minute sessions, twice a week, for 17 weeks. Results showed significant improvements in factual and procedural arithmetic among the intervention group. However, there was limited progress in conceptual knowledge. These findings highlight the potential of executive function training in enhancing specific arithmetic skills in children with DD.

Abacus Course for DD

Lu et al. (2021) investigated the effectiveness of an abacus course in eradicating DD in children. The study included 245 participants randomly chosen, with a mean age of 8.8 years +/- 0.6 years. The selection criteria were based on previous studies by Barner et al. and Wang et al., comparing abacus and control classes. After recruiting several natural classes, 126 students were chosen for the study. The abacus course consisted of daily sessions lasting 10 to 20 minutes, incorporating both physical and virtual abacus practice. Results demonstrated that children who underwent the abacus intervention showed significant improvements in arithmetic computation and spatial short-term memory.

This highlights the potential of abacus training as an effective intervention for enhancing mathematical abilities in children with DD.

Musical Training and Mathematical Skills

Ribeiro and Santos (2020) explored the persistent effects of musical training on the mathematical skills of children with DD. The study involved 44 total students, including 17 males and 5 females with DD (mean age of 8.27), and a control group of 22 typically developing students. Participants were chosen based on teacher's recommendation and mathematics grades. The musical training program lasted 14 weeks and involved assessments at baseline, 7 weeks, 14 weeks, and a 10-week follow-up. The results indicated that all students, including those with DD, demonstrated improvements in number production, comprehension, and calculation. Moreover, these benefits remained evident even during the 10-week follow-up period. This suggests that musical training can lead to long-lasting enhancements in mathematical abilities for children with DD.

Synesthesia Aid for DD

Berger et al. (2020) presented a case study involving a 21-year-old female with lifelong DD and grapheme-color synesthesia. The participant had experienced difficulties with mathematics since childhood and received a diagnosis of "cognitive learning difficulties" for mathematics. In this unique intervention, the digit-color calculator (DCC) was used as an aid. The DCC substantially improved the participant's basic calculation difficulties, providing visual color cues to enhance mathematical computations. The findings showcase the potential of leveraging synesthetic abilities, like the DCC, as supportive tools to ameliorate difficulties faced by individuals with DD in mathematical tasks.

Numerical Intervention and Brain Connectivity

Michels et al. (2018) conducted a study on the impact of numerical intervention on brain connectivity in children with DD. The study included 31 children, 15 with DD and 16 typically developing, aged 7.8 to 11.8 years. The participants were selected from a prior study by Kucian in 2011, with one excluded due to unreadable data. The numerical intervention comprised intensive computer-based training on number lines for five weeks, five days a week, and fifteen minutes a day. Surprisingly, the training led to the vanishing of functional hyperconnectivity in the brains of children with DD, making them less distinguishable from typically developing children. This intriguing finding highlights the potential of numerical interventions in reshaping neural connectivity patterns in individuals with DD.

Working Memory Training

Layes et al. (2017) investigated the effectiveness of working memory training among children with DD. The study involved 16 males and 12 females with DD, with a mean age of 9.68 years. Participants were selected based

on academic achievement and teacher's opinion, using mathematics and Raven (human intelligence) tests for screening. The eight-week training program consisted of three weekly 45-minute sessions with an adaptive training component. Results indicated that the working memory training had positive transfer effects on mathematical achievement in children with DD. There were improvements in working memory skills, as well as slight enhancements in progressive metrics and reading number tasks.

Mental Number Line Training

Kucian et al. (2011) conducted a study on mental number line training in children with DD. The study included 32 total students, 16 with DD (10 males and 4 females) and 16 typically developing peers (9 males and 7 females), all with a mean age of 9.5 years. Participants were chosen using comparison scores in mathematics sections and overall scores from the WISC-III and ZARE-KI-R. The intervention involved a mental number line training computer game for 5 weeks, 15 minutes a day. Results demonstrated that both children with and without DD benefited from the training, showing improved spatial representation of numbers and enhanced mathematical problem-solving skills.

Similarities of Each Study

Several similarities were found in the research studies. The interventions were implemented with elementary aged children with six of the seven studies focused on students younger than 12 years old with a typical mean age of around 9.5 years with only one study focusing on an adult that was 21 years of age (Berger et al., 2020). Technology-based interventions were used in the studies with most implementations using either a computer or iPad with the majority focusing mainly on computer-based training. The participant populations remained small for the studies at around 30 students, with one having markedly more at 245 participants (Lu et al., 2020) and studies were completed in classrooms. The researchers who created the studies implemented and maintained all the studies which limited classroom teacher involvement. The studies were short in duration, ranging anywhere from 10 to 50 minutes per day. All the research studies reviewed were created to help students with DD increase their abilities in mathematics, and they were all successful in some capacity. Many of the studies helped students with mathematical computations and numerical recognition. The proposed interventions were all employed multiple times weekly until completion of the intervention.

Differences of Each Study

The studies used multiple methods and selection criteria to identify participants with DD. The methods include teachers and principals identifying students currently struggling in mathematics, implementing the use of multiple assessments (e.g. Keynote, WISC) or using previous research criteria. While the researchers chose the participants based on a specific criterion individually,

overall, there was no standard by which researchers chose the participants. The elapsed duration of the studies varied widely from five weeks (Michels et al., 2018) to fourteen weeks (Ribeiro & Santos, 2020). Interventions could be as little as twice per week (Nazari et al., 2022) versus implementing daily at five times a week (Kucian et al., 2011). While the author generally used computerized methods for testing of interventions the methods which they completed the task differed. For example, Kucian (2011) used a game-based approach with rocket ships to engage the students while Lu et al. (2021) chose to use a computerized cognitive task such as standardized testing.

Effectiveness of Interventions

The interventions all showed gains in part, or on all the mathematical areas examined for students with DD. An example of this success would be an 85% gain in number comprehension with Riberio & Santos (2020) to functional hyperconnectivity disappearing completely with Michels et al. (2018) intensive number line training. In some instances, the gains from the interventions were as small as 10%, but a gain, nonetheless. Several studies showed retention from the interventions utilizing follow-up studies ten weeks after the intervention was completed (Ribeiro & Santos, 2020).

Limitations of Interventions

One of the limitations of the studies is a need for more cohesion among the selection criteria for the participants. Two of the studies used standardized assessments, including Keymath and the WISC, while others use either principal or teacher input for selection criteria. While teacher selection should be included in studies, other specific selection criteria should be used to avoid teacher biases. Participants' teachers should also be trained in the implementation of the intervention to allow for the future ability to implement the intervention in their own classroom if successful. While treatment fidelity is higher when researchers implement their own interventions teacher training would also allow for a broader use of interventions.

Discussion

Main Findings

The purpose of this literature review was to provide an overview over interventions specifically for students with DD. From an initial pool of 1,041 search results, only seven articles met the stringent criteria of emphasizing strategies that could be used in the classroom. According to the results of this review, interventions targeting DD in students have shown varying degrees of success. An executive function approach that focused on components such as working memory, inhibition, and switching significantly improved factual and procedural arithmetic, although its effect on conceptual knowledge was minimal. Abacus training produced significant improvements in arithmetic and spatial short-term

memory. Musical training produced sustained positive effects on number production, comprehension, and arithmetic skills. In addition, the use of a digit-color calculator (DCC) significantly improved arithmetic tasks, especially for an individual with DD and grapheme-color synesthesia. Another compelling finding was that intensive numerical training could reduce functional hyperconnectivity in the brains of children with DD, bringing them closer to typically developing children. Meanwhile, working memory training showed promising transfer effects on math performance. A mental number line training game also proved beneficial for children with DD, improving spatial number representation and mathematical problem solving skills. In general, these studies shared similarities, such as targeting elementary-age children and using technology-based interventions, and they all aimed to improve the mathematical skills of students with DD. Despite the successes, the varied selection criteria for participants and the lack of standardization in intervention duration and frequency are limitations. It's clear that while no single intervention offers a complete solution, a combination of strategies can significantly support students with DD.

Limitations

The author realized that while they did an exhaustive search of literature some literature could have been missing. By reading abstracts, it is possible that an abstract did not clearly define what the study was about, or the author misinterpreted, and in these cases the author would have missed the inclusion of that literature. The idea of what interventions could be used in the classroom could be interpreted differently based on location. Being from North America the author's perspectives are shaped by his experiences as a student, teacher, and researcher. Although he searched the common databases, additional library searches could have been used which could have expanded the available literature. The author's implicit biases (e.g., history of teaching, preconceived notions of what interventions will and won't work) also could be considered as a limitation to this review.

Implications for Practice

The author intends to provide this paper as a resource regarding what available interventions are available that potentially could help students both with and without DD in mathematics classrooms. While if even one of the interventions is used in classrooms and helps even one student then the author will consider the field moving in the right direction. Even so, the goal in practice is for effective interventions for DD to be available and for use in all K-12 mathematics classrooms. Identifying what interventions are currently available also allows teachers the options to use them in their classrooms. The use of effective interventions of mathematics for those with DD in the classroom lends itself to help set up students for future success.

Implications for Research

The author reveals the lack of research that has been done on interventions for those with DD. The paucity of research should dictate the need to expand what is currently being done in the field to increase the overall understanding of what interventions would be successful in classrooms. Undertaking and completing more research on interventions available to those with DD will not only benefit those with DD but any students currently struggling in mathematics as well. Along these lines research needs to be conducted to ensure interventions that are available for students with DD as effective and appropriate.

Directions for Future Research

The author intends to continue the search and develop effective interventions for DD. The need for evidence-based research backed identification tool for those with DD is needed to create a starting point with which researchers can identify what is needed for specific interventions. Once a screener has been created that is considered the gold standard for DD identification, the author plans to create a database of open-source effective interventions for those with DD for K-12 classrooms. The creation of a screener and effective interventions for those with DD will allow greater accessibility providing more students opportunities for success in both the classroom and in their future professional goals.

Concluding Thoughts

The research conducted on interventions for those with DD includes several common concepts. Researchers universally aimed to enhance the acquisition and retention of mathematical knowledge in their student subjects. The studies all showed growth in some capacity which shows that research needs to be continued to increase growth. They also indicated that the interventions will work on most if not all students as well. The author is hopeful that with the continued investment into research of interventions for DD that the gap that currently applies to students and adults will be able to narrow and close over time.

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