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The Most Effective Teaching Strategies for at Risk Students With Mathematical Learning Disabilities

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THE MOST EFFECTIVE TEACHING STRATEGIES FOR AT RISK STUDENTS WITH MATHEMATICAL LEARNING DISABILITIES

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Honors in Education Research Project

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Abstract

What are the most effective teaching strategies and assistive technology to support at risk students who have mathematical learning disabilities? This was the question my thesis revolved around. The problems relating to this question are the lack in definitions for at risk as well as mathematical learning disabilities and that there is no research of the overlap of these two populations. To find this overlap, I researched the best strategies for at risk students and the best for students with mathematical disabilities, and I compiled the strategies that overlapped. I thought that since they are effective for both populations, these strategies would be the best for the overlap in populations. My project design is to create a website titled *Teaching the 'Unteachable:' Tips and Tricks to Best Support and Teach At Risk Students with a Mathematical Learning Disability*. My website will educate teachers in each of these populations and the most effective strategies and assistive technology for them.

Introduction

Increasingly, teachers are required to work with students of varying degrees of abilities and disabilities. One group of students that teachers need to work with are at risk students. In general, "The term at risk is used frequently to describe children and youth that have a strong intuitive meaning. However, the term has no consistent definition and can be viewed as stigmatizing certain groups" (Moore, 2016, para.1). Basically, at risk students face multifarious roadblocks that create complications in getting an education (DeAngelis, 2012). The lack of a concrete definition causes conflict in the education community due to a multitude of disagreements. Despite the difficulty in defining the term, at risk is widely used by educators. An advantage to this ambiguity is that program providers—ones which aid at risk students with any help necessary—have a flexibility in how they define at risk students for their own program. This allows more students get the assistance they need (Moore, 2006).

The statistics relating to at risk students has been, and still is, alarming. According to Donmoyer and Kos (1993), "each year 700,000 students drop out of high school" and "a third of high school graduates cannot order two items from a lunch menu and the calculate how much change they are owed after paying a cashier three dollars" (p. 7). Additionally, "every year nearly half a million teenagers give birth; half of these teenagers never complete high school; many end up on welfare" (p. 8). Since then, the statistics has not improved. According to Kominski, Jamieson, and Martinez (2001), the statistics for at risk students are as follows:

- 7.6% have at least one disability
- 8.1% were held back at least once
- 4.9% speak English less than 'very well'
- 30.8% do not live with both parents

- 8.5% have a family income level of below $10,000
- 10.5% have parents or guardians that both are unemployed.

Currently, there are still many unaddressed problems for at risk students. According to DeSilver (2016), the statistics are still staggering. DeSilver reported that about 25% of teenagers have experience some sort of anxiety disorder at some point in their lives. Those anxiety disorders could include phobias, panic disorders, or post-traumatic stress disorders. The percentage of students being bullied has also increased—both online (14.8% reported being bullied electronically) and in person (19.6% reported being bullied on school property). Similarly, 24.7% of high school students reported being in a physical fight at least once in the past year.

Special education expert, Marilyn Friend (2005), defines at-risk as students that "may be homeless, abuse drugs or other substances, live in poverty, or have any of hundreds of characteristics that can negatively affect their learning" (p. 21). Other common risk factors include being abused sexually, physically, or emotionally, having a mental illness, lacking social or emotional supports, being neglected at home or living in a stressful family environment, and involvement with delinquent peers (National Center for School Engagement, n.d.).

The list of characteristics for at risk students are as long and varied as the definitions for the term. However, "at-risk youth are often identified after running away, skipping school, drinking under age, engaging in sexual behavior, displaying disruptive behavior, bullying/harassment, fighting, and committing acts of vandalism. These behaviors can be precursors to dropping out of school, acquiring low paying jobs and/or unemployment, and adult criminal behavior" (National Center for School Engagement, n.d.).

Being at risk does not equate students with having any kind of learning disability—although an overlap does occur and will be discussed in this thesis. Likewise, having a learning

disability does not mean a student is automatically at risk. As a result, at risk "students probably need many types of supports and services" but they do not always have disabilities that would require an individualized education program (IEP) and are thus not eligible for special education (Friend, 2005, p.21). According to Friend (2005), an IEP "summarizes all the information gathered concerning the student, it sets the expectations of what the student will learn over the next year, and it prescribes the types and amount of special services the student will receive" (p. 59). The lack in support and services for at risk students enhances the importance in knowing the proper teaching strategies for them. These students arguably require the most "attention of caring and skillful teachers who can set high expectations, teach in a way that maximizes student potential, and instill in students the love of learning" (Friend, 2005, p. 21).

At risk students also tend to have difficulties in school; mathematical difficulties are common for many students. According to Hersh and John-Steiner (2011), graduate students are avoiding and rejecting math due to struggling in the subject. The term, mathematical difficulties, has no biological basis and has been defined as "referring to children whose poor mathematics achievement results from any one of a number of potential causes" (Berch & Mazzocco, 2007, p. 30). Having mathematical difficulties does not necessarily mean a student is failing calculus, not understanding a geometry lesson, struggling in linear algebra, or thinking math is hard. To be declared as having mathematical difficulties, one must have "the presence of relatively poor mathematics achievement" (p. 31). Mathematical difficulties start at different stages of math for everyone—for some it starts with fractions, for others it starts with algebra, and for the rest it's in an upper level college course like calculus (Hersh & John-Steiner, 2011). Although there is some overlap of students with mathematical difficulties and mathematical learning disability, one does

not imply the other and vice versa (p. 32). Mathematical learning disabilities and mathematical difficulties are separate terms that describe two different groups of students.

Many individuals can be described as "not very good at math," but when does not being skilled at math become a math disability? As explained by Voice of America (2008), parents and teachers may discover if a child has a math learning disability if she/ he is well developed in all academic areas except math. According to Berch and Mazzocco (2007), defining mathematical learning disabilities (MLD) is not an easy task. The main difficulty in defining MLD is "the lack of a more rigorous standardization of criteria" (p. 30). The difficulty in defining MLD contributes to estimating the number of people who are affected by it. According to the National Institute of Child Health and Human Development (2016), some studies reported approximately 5% while others found 15%-20% of people in the United States are diagnosed with a learning disability. However, "the task of defining MLD begins with resolving the differences reflected by terms used to refer to it or to related constructs" (p. 30). Such terms are mathematical disabilities, MLD, mathematical difficulties (as discussed previously), arithmetic disabilities, math anxiety (See Appendix A), and dyscalculia.

It is almost universally agreed that MLD and mathematics disabilities are synonymous, thus it is not important to differentiate these definitions. In scientific terms, MLD is "related to a combination of disrupted functions of the central executive, including attentional control and poor inhibitions of irrelevant associations or difficulties with information representation and manipulation in the language system" (Berch & Mazzocco, 2007, p. 42). In other words, MLD affects basic cognitive abilities like semantics and working memories as well as spatial and linguistic abilities. In terms of the classroom, "MLD would likely affect not only the level of higher mathematics proficiency but also opportunities, desire, or encouragement to pursue higher

mathematics courses" (Berch & Mazzocco, 2007, p. 39). Swanson, Harris, and Graham (2003) found that children with arithmetic disabilities only differed from their "academically normal peers […] in the percentage of retrieval and counting errors" (p. 7) Thus, it is not beneficial to further define arithmetic disabilities. This leaves defining dyscalculia.

One of the most common mathematical learning disabilities is dyscalculia. Typically, both MLD and dyscalculia "refer to the same intended population, as both imply an inherent disability rather than one caused predominantly by environmental factors" (Berch and Mazzocco, 2007, p. 30). Like MLD, dyscalculia is difficult to define due to the term "referring to a wide range of life-long learning disabilities involving math" in addition to the difficulties affecting and varying for each individual (National Center for Learning Disabilities, 2007). In the most basic terms, dyscalculia "affects a person's ability to understand numbers and learn math facts" ("Dyscalculia," n.d.). According to Berch and Mazzocco (2007), the *Diagnostic and Statistical Manual of Mental Disorders-IV*-TR defined dyscalculia as "a condition when arithmetic performance is substantially below that expected for age, intelligence, and education" (p. 50). Those with dyscalculia commonly struggle with comprehending math symbols, memorizing numbers, organizing numbers, telling time, and counting (See Appendix B).

Despite the fact that definitions for at risk and MLD are not clearly defined in the field of education, students experiencing both of these obstacles still need academic support in order to be successful in the classroom. There are multifarious studies and reports that explain the best teaching strategies for students of different populations, so what about at risk students with a MLD? There are many studies that explore the myriad strategies for assisting students with MLD and those that investigate the best support to give at risk children and adults. However, there is

very little research about the most effective strategies for the specific population of at risk students who have a mathematical learning disability.

Literature Review

There are many resources that explain the most effective teaching strategies for at risk students. According to Beach (2013), it is crucial to have challenging, but achievable work—if the work is too difficult, students tend to give up. At the same time, people get bored and lose interest if the material is too easy. Teachers must also be excited about the material that is being taught, even when it is mundane, challenging, or hated (Mierzwik, 2013, p. 61). Students pick up on their teacher's attitude, so if she/he has negative feelings towards the material, the students will, too. One way to keep students and teachers actively engaged in class is to incorporate movement when possible. This is a simple way to keep students motivated in class due to the reduction of stress and the increase in neuronal metabolism (Mierzwik, 2013, p. 64). According to Mierzwik (2013) and Snow, Barley, and Mid-Continent Research for Education and Learning (2005), keeping students motivated is crucial, especially for at risk students. When any student gets unmotivated, it is difficult to get students to participate or care about the class. Mierzwik (2013) astutely stated, "…The ultimate goal for a teacher: to motivate students to do their best" (p. 60).

One way to keep students motivated is through School-to-Work programs that help students learn about the working world by getting first-hand experience (Beach, 2013, p. 71). This program gives at risk students a clear, definite purpose of attending school, because they can see where graduating high school can lead them to. Experiencing the working world can also give students a goal to work towards. The desire to work at an organization or business will motivate students to do better in school, more so than wanting good grades or trying to please

parents/ teachers. Assistive technology is also a great resource to motivate at risk students. Students love technology so giving them the opportunity to use it in school can help them stay interested and excited with class material. According to Beach (2013), teachers should try to incorporate word processing, database, design, and graphing softwares in their classrooms. Additionally, Mierzwik (2013) discussed using smartphones in the classroom since many students use them for daily planners, calendars, calculators, fact checkers, and so much more (p. 64).

Additionally, these students "…thrive in a learning environment that is risk free and filled with authentic communication between the teacher and students and among students" (Mierzwik, 2013, p. 57). It is crucial to have an open classroom where students are comfortable with talking to their teacher and classmates. Students learn best when they are able to communicate their struggles and what they need help with. Teachers need to encourage students to not only communicate with him/her, but also their classmates. Being able to talk with classmates results in students relying and leaning on each other when they need help. One way students can help each other is through peer tutoring (Mierzwik, 2013; Snow, Barley, & Mid-Continent Research for Education and Learning, 2005). According to Snow, Barley, & Mid-Continent Research for Education and Learning (2005), peer tutoring is when one student teaches a topic or concept he or she has a strong understanding of to a peer that is struggling with the material. Peer tutoring is beneficial for the 'tutor' because the material is further engraved in a his/her brain, due to needing a strong understanding of the material and having to explain it as well. Peer tutoring also helps the student being 'tutored.' Students often struggle to understand teachers because they are unable to relate to each other or the student gives up due to feeling defeated. When a student teaches a peer, they can better connect since they are on similar levels of understanding. Thus,

peers can better explain the concept to students struggling because they are able to do so in a different way than the teacher.

Not only are there numerous strategies for the at risk population in schools, but also for students who have a mathematical learning disability. Teachers of these students must remember to refrain from moving on until students have mastered the basic understanding of the material (Berch & Mazzocco, 2007; Witzel, Ferguson, & Brown, 2007). In other words, do not move on until the students are ready. Sometimes, teachers are forced to continue moving ahead in order to stick to the curriculum or Common Core State Standards. If this is the case, the teacher must use effective teaching strategies to help students be as successful as possible. One way to help students that may be falling behind is to involve parents (Bryant, 2008; Berninger & Wolf, 2016). While it is important for teachers to know their students' home life, it is also important for parents to know their child's school life. Bryant (2008) suggested that teachers and parents share information and observations from school and home and encouraged both to ask each other questions. This way students are constantly getting the support that they need and that it is consistent at home and school.

Berch and Mazzocco (2007) discussed the importance of letting students use strategies they are comfortable with while exposing them to other problem-solving strategies. As a result, students are pushed outside their comfort zone, but not to the point where they would feel distressed. One way to introduce students to different strategies is to emphasize multi-sensory aspects such as auditory, verbal, visual, and kinesthetic (Berch & Mazzocco, 2007; Berninger & Wolf, 2016; Witzel, Ferguson, & Brown, 2007; Zorfass, Gray, & PowerUp What Works, 2015a). Teachers should utilize hands-on activities, virtual field trips, and outdoor education to engage students, especially those who learn best with nontraditional forms of instruction (Berninger &

Wolf, 2016). This is because every learner is unique and thus learns best in different ways. It is important to use different teaching techniques, so students can discover what works best for them. Incorporating the four traditional language skills—speaking, writing, oral, and reading—is important for all students, especially those with a mathematical learning disability (Berch & Mazzocco, 2007; Berninger & Wolf, 2016). Witzel, Ferguson, and Berch (2007) furthered this thought by telling teachers to instruct students to talk, write, and then understand the words relating to math. Just because a student can write a word, does not mean they can speak it and understand it. That's why it's important to emphasize all four traditional learning skills. If students are struggling with one of these areas, encourage partner work by having one student explain the steps to solving a word problem while another student listens and then have the roles switched. This helps students work on listening and speaking while they review class material with each other (Zorfass, Gray, & PowerUp What Works, 2015a).

Having students explain their work, answer specific questions, and summarize the material is beneficial for students with a MLD (Zorfass, Brann, & PowerUp What Works, 2014b; Zorfass, Gray, & PowerUp What Works, 2014; Zorfass, Gray, & PowerUp What Works, 2015a; Zorfass, Han, & PowerUp What Works, 2014; Zorfass, Gray, & PowerUp What Works, 2015b). Students need to be able to explain their choices and thought processes, so teachers know if students really understand the material or if they are just guessing. Comparing and contrasting material, giving prompts, and justifying answers are three different ways to check students' understanding.

Students with MLD also benefit from using technology. Berninger and Wolf (2016) suggested using computer games in class to try to enhance motivation in learning and language skills. Using calculators for complex computations is also beneficial for students—it is important

to first make sure students master basic calculation skills without the calculator before they are allowed to use it (Berninger & Wolf, 2016). Zorfass, Brann, and PowerUp What Works (2014a) as well as Zorfass, Gray, and PowerUp What Works (2015a) both suggested using class websites, podcasts, blogs, or wikis. This encourages students' creativity and is a way for students to easily access the class information. Zorfass, Gray, and PowerUp What Works (2014) reported that digital organizers such as PowerPoint, Prezi, Keynote, and SlideShare are great for personal notes and referencing class materials. Web-based applets, virtual manipulatives, graphing software, drawing tools, dynamic geometry software, and spreadsheets are also tools that help students with a MLD succeed (Zorfass, Brann, and PowerUp What Works, 2014b).

These are not the only strategies for effectively instructing at risk students or those with MLD. In fact, there were many that overlapped for both populations. The first thing teachers should do with their at risk students with a MLD is assess their initial understanding of material (Berninger & Wolf, 2016; Zorfass, Brann, & PowerUp What Works, 2014b; Mierzwik, 2013; Snow, Barley, & Mid-Continent Research for Education and Learning, 2005). It is important to identify students' strengths and needs in the beginning of the year, so you know how to best instruct and assist them (Zorfass, Brann, & PowerUp What Words, 2014b). Mierzwik (2013) suggested using a K-W-L chart or a self-assessment to test students' initial knowledge, because it is informal and clearly shows what students know and understand. Teachers must also be explicit with their directions and give concrete examples for abstract concepts (Berch & Mazzocco, 2007; Zorfass, Gray, & PowerUp What Works; 2015a; Beach, 2013; Mierzwik, 2013). At risk students and those with a MLD need a thorough explanation of the process their teacher used, why he/she was able to do it, and have several specific examples of how to solve the problem. Teachers cannot skip steps, assume students know terms, or understand concepts because these

students need multiple examples for reference and extra support to better understand the material.

One of the easiest and most crucial strategies for this population of students is focusing on vocabulary (Berninger & Wolf, 2016; Witzel, Ferguson, & Brown, 2007; The Access Center, 2006; Mierzwik, 2013). This is especially important for teaching math-specific vocabulary since math can be confusing to those who are unfamiliar with the subject and struggle in school in general. Witzel, Ferguson, and Brown (2007) also emphasized the necessity of repeating terms to students. Many teachers tell students a term and then never review it again, expecting students to have mastered the concept or understand the meaning of the word immediately. At risk students with MLD struggle with remembering definitions due to challenges they face in the classroom. Thus, is it important for teachers to repeatedly remind students of the vocabulary terms and their definitions. Word walls, glossaries, toolkits, or classroom math dictionaries are simple and convenient resources to remind students of vocabulary. These resources are also constantly available whenever they need them. Not only should teachers review the vocabulary, but also concepts and skills (Mierzwik, 2013). Students often forget topics that do not build on newer topics, so it is important to keep the older concepts fresh in students' minds. One way to do this is to have a quiz at the beginning or end of class once a week. The quiz would consist of everything that the class has learned so far that year. When grading the exams, correct what students got wrong, but grade it using check, check minus, or check plus. This is so that if students do not remember the material their grades will not suffer. The use of mnemonic devices is also exceedingly useful for this population of students. According to The Access Center (2006), mnemonic instruction is "a set of strategies designed to help students improve their

memory of new information." Keywords, pegwords, acronyms and acrostics are common examples of mnemonic devices.

Using various forms of visual aids is also effective for at risk students with a MLD (Zorfass, Gray, & PowerUp What Works, 2014; Zorfass, Gray, & PowerUp What Works, 2015a; Mierzwik, 2013). Examples of visual aids include but are not limited to the following: process charts, pictures, diagrams, expressions, equations, posters, and hands-on manipulations. Teachers should encourage their students to use one of these forms of visualizations to try help them better understand the big idea of the lesson. In addition to using visualizations, "thinking aloud" has also been shown to work for at risk students and those with a MLD (Zorfass, Gray, & PowerUp What Works, 2015a; Mierzwik, 2013). "Thinking aloud" forces students to slow down and articulate the process they are using. By slowing down and articulating what they are doing, students must focus their work which helps them learn the material faster and easier.

Another effective strategy to keep in mind is to individualize and adapt material whenever possible (Berninger & Wolf, 2016; Zorfass, Brann, & PowerUp What Works, 2014b; Beach, 2013; Mierzwik, 2013; Snow, Barley, & Mid-Continent Research for Education and Learning, 2005). When both teachers and students have an organizational system, it is easier to adapt lessons to students' individual needs because it is then simple finding additional worksheets or lesson plans that would benefit the child's understanding of a difficult concept. Having predictable routines also assists with making adaptions because it allows the teacher to create more involvement, a less distracting classroom, and helps students who have individualized projects. Two important aspects to remember is to be positive and to have an inclusive learning environment (Berninger & Wolf, 2016). When all students feel welcomed and included, they are more likely to contribute and answer/ ask questions, which is how students

learn best. It is also crucial to tailor the math instruction to each learner's developmental and individual differences, since every student is unique and learns best in a variety of ways. One way to adapt and individualize lessons is to have students create their own models and projects. This allows students to have some control of their education and how they learn the lessons. Along with making adaptations, teachers must try different combinations of strategies since every student learns differently (Snow, Barley, & Mid-Continent Research for Education and Learning, 2005). Some students may struggle if only one strategy is used, which means teachers need to use a variety of techniques to help as many students as possible be successful. Teachers cannot be afraid to experiment with different techniques to see what works best for his/her individual students and classroom.

Group or partner work has also proved to be beneficial for at risk students with and those with a MLD (Zorfass, Brann, & PowerUp What Works, 2014a; Beach, 2013; Mierzwik, 2013; Snow, Barley, & Mid-Continent Research for Education and Learning, 2005). According to Mierzwik (2013) and Snow, Barley, and Mid-Continent Research for Education and Learning (2005), working in pairs or groups helps students better understand mathematical concepts and processes. When making groups, it is necessary to be strategic (Beach, 2013; Snow, Barley, & Mid-Continent Research for Education and Learning, 2005). Teachers should try to get mixed-ability groups rather than like-ability groups, because the students can use each other's strengths to help each other. Like-ability groups tend to isolate those who are lower-achievers from the rest of the class. Being segregated from one's peers is demoralizing to students of this population who already face many challenges. However, sometimes teachers have no choice and are forced to have a like-ability group due to having a class of all "low-achieving students" (Snow, Barley, & Mid-Continent Research for Education and Learning, 2005). When this happens, teachers can

try to individualize the material for each group and try to teach to each student's abilities (Snow, Barley, & Mid-Continent Research for Education and Learning, 2005).

Another effective strategy for instructing at risk students with a MLD is to relate the material to something they can connect with (Berninger & Wolf, 2016; Beach, 2013; Mierzwik, 2013; Snow, Barley, & Mid-Continent Research for Education and Learning, 2005; Reading Rockets, 2011). Teachers must tie the material being taught into student's prior knowledge. Doing so makes the information more applicable and relevant to students' lives (Mierzwik, 2013). Students need to know why they should care about the material and how it can improve their lives (Zorfass, Gray, & PowerUp What Works, 2015b; Mierzwik, 2013). To do this, try using similes, metaphors, and analogies as well as providing context to each lesson. When students know the context of when the concept in used in real life, they are more likely to remember it. Patterns are also helpful for at risk students with a MLD, because they make understanding math concepts much easier and attainable (Reading Rockets, 2011; Snow, Barley, & Mid-Continent Research for Education and Learning, 2015; Zorfass, Gray, & PowerUp What Works, 2015b). The patterns students find in solving problems help them better understand how to solve other math problems. The more patterns students can find in the steps of solving problems, the more they understand about the process of doing so and the concept being taught. (Snow, Barley, Mid-Continent Research for Education and Learning, 2005). As Beach (2013) pointed out, this usually requires a lot of creativity and using technology. It can be hard to find ways to connect math to something students connect with, so teachers need to think outside the box. Students also love using technology in school, so adding a technological aspect to the lesson can help engage students and help them better understand the material.

One assistive technology that is especially beneficial for at risk students with a MLD is anything that helps with notes such as dictation and speech recognition applications, speech synthesizers, scanners, text-to-speech programs, and SmartPens or other audio recording devices (Berninger & Wolf, 2016; Mierzwik, 2013). These assistive technologies allow students to replay the recorded lecture, so they can add the information they missed from the oral lecture to their written notes. This helps to alleviate some of the stress students get when they miss important information during the lecture due to struggling to keep up with the speaker. This is especially a problem for this population of students due to having the learning disability and the factors of being at risk. There are also hundreds of websites that give students the opportunity to practice what is taught in class. Any one of these websites can be found by quickly using a search engine or asking other teachers for resources. These websites are effective to all students, but can especially assist at risk students with a MLD because of the extra practice, the fun gaming aspect, and the motivation it gives for student to learn the material. When using technology in the classroom, it is important to remember that "one size does not fit all when it comes to AT [assistive technology] tools or apps" (Berninger & Wolf, 2016, p.227). As a result, teachers must constantly be looking for different technological resources to help students be successful in the classroom.

Methodology

For my project design, I will be constructing a website titled, *Teaching the 'Unteachable:' Tips and Tricks to Best Support and Teach At Risk Students with a Mathematical Learning Disability*. My website will contain information about at risk students, mathematical learning disability, and the best strategies as well as assistive technologies for students who are

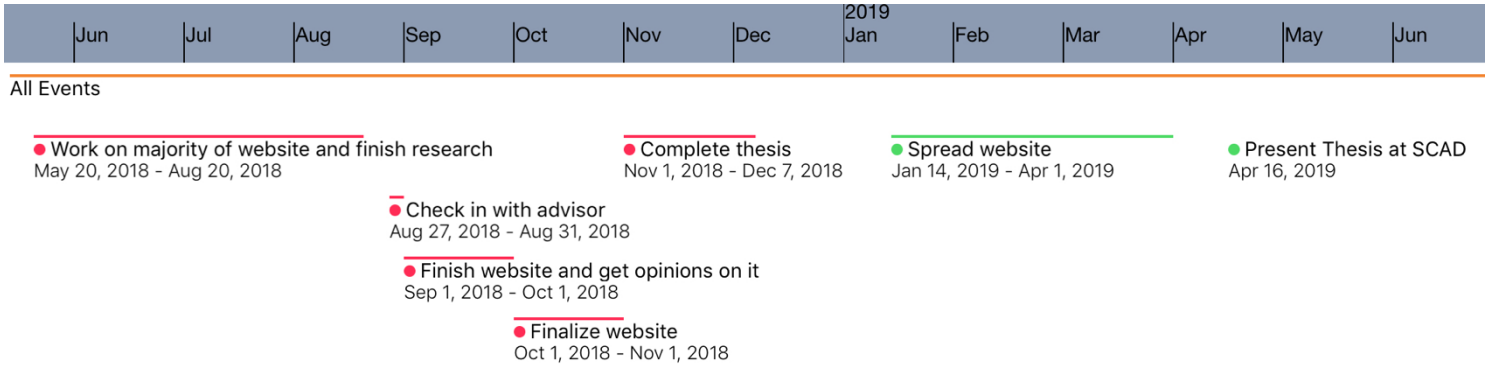
both at risk and have a MLD. I will be using Wix to create my website, because I have used it in the past and believe it is easy to navigate and professional looking.

My website will have a home page that explains who I am, why I am passionate about this topic, and my thesis. The website will have the following five tabs: Who is at risk?, What is a MLD?, Most effective teaching strategies, What does the literature say?, and Links to resources. In the "Who is at risk?" tab, I will include the general definition of at risk as well as traits, factors, and characteristics of those who are identified as at risk. This tab can help teachers identify at risk students in his/her classroom if the student is not classified and the teacher is unsure. Similarity, in the "What is a MLD?" tab, I will lists the different terms used, the general definition, and characteristics/ traits of those who have a math learning disability. This will help teachers identify students with a MLD if they are not already, or if it is instead math anxiety or mathematical difficulties. The "Most effective teaching strategies" tab, will include adaptions/ modifications, assistive technologies, and teaching techniques that would best benefit at risk students with a MLD and how to help them be as successful as they can be. The "What does the literature say?" tab will include articles, journals, or magazines that discusses at risk students, MLD, a teaching strategy discussed in the website, technology I suggested, or any other academic literature that I think teachers would want to learn more about relating to my thesis. My final tab, "Link to resources," will have links to websites, apps, and programs I found to be helpful to students. This way teachers have easy access to the resources I am giving them.

I will try to send my website to teachers, so they can benefit from the information and the resources it provides. To do so, I will start with emailing the website's link to my current professors, previous teachers, and teachers I have worked with. I will also tweet my website on my professional twitter and tag math education organizations. My hope is that they will see it

and share it to all their followers as well. Finally, I hope to submit my website to blogs for educators because I want to see if they will post it on their page to spread the information.

This is the timeline I intend to follow:



While I stated that I will only check in with my advisor at the beginning of the school year, I intend on checking in with Dr. Soltys throughout the summer to see if he has any suggestions and his opinions on my website while I build it.

Process

I decided to use Wix for my website because I liked how user-friendly it is and the format I was able to use. I felt as though Wix had the most professional-looking templates and allowed me more creative freedoms when it came to designing my site—it also helped that Wix was free. My original outline of how my website would look stayed pretty consistent with having the following tabs: HOME, Who is at risk?, What is a MLD?, Most effective teaching strategies, What does the literature say?, Additional resources, and CONTACT. With that being said, it was slightly different than what I had originally imagined. Although I wasn't exactly sure how the website would turn out, I was very impressed with the finished product.

Figure 1: QR code of website (URL: https://kateymowery.wixsite.com/unteachable)

I first started with the general design of the website which included the theme and template. I decided on this once because I thought it looked professional yet not intimidating as well as organized and colorful (but not overwhelming). I tried to include visuals and quotes to break up the information without being too distracting. The first page I started with was the "HOME" page since it's was the easiest and most obvious page (other than the contact page which has areas for people to leave their name, email, and a message if they have any questions, comments or additional resources for me to include). As seen from Figure 2, my home page has a general introduction and then a button to take viewers to another page. This page explains who I am, why I created the website, and also includes a copy of my thesis (for those that wanted more of the in-depth information that I discovered).

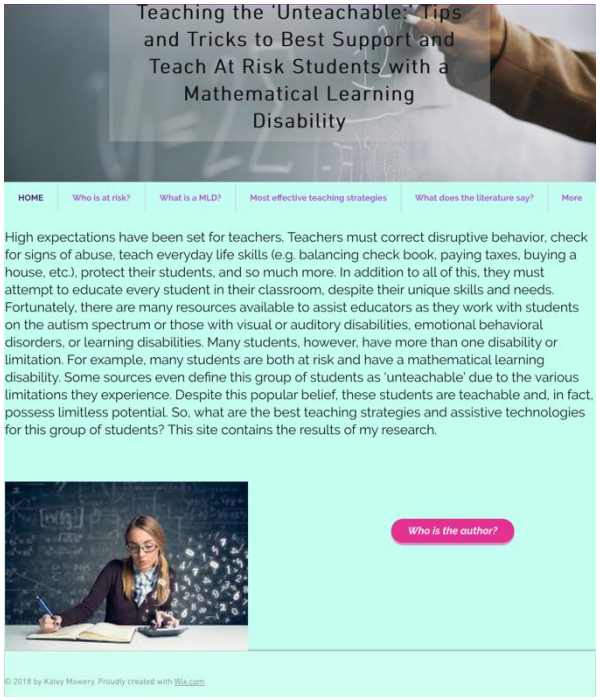


Figure 2: Home page of "Unteachable"

The next page I worked on was the "Who is at risk?" tab. As seen in Figure 3, I included the general definition as well as statistics for this population of students. I also had a quote from Marilyn Friend, an expert in special education, that perfectly depicted this group of students. I felt as though it was vital to have the long list of factors and characteristics of at risk students

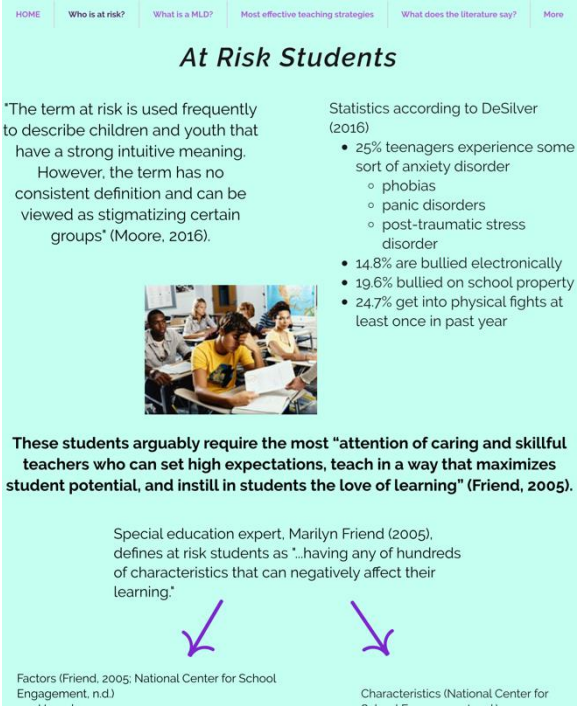


Figure 3: At risk page of "Unteachable"

because many times at risk students are not identified in public schools. Teachers need to be able to spot out these students and know how to help their specific needs. Even if students are identified as being at risk, teachers should know and understand the different aspects that attribute to these students' daily lives and personalities. This helps teachers better prepare their lessons and various assessments.

The next page I focused on was the "What is a MLD?" tab. This page is probably one of the most confusing aspects of my website because of the material. As discussed earlier, MLD is difficult to define due to the multitude of definitions. As a result, I defined each individual MLD term and explain each one in detail. This way teachers have a better understanding of the Mathematical Learning Disability their student has and thus the best ways to help them. Additionally, once a student is identified as having a certain MLD, teachers can research that particular disability to better understand this specific student's needs and abilities. As seen from Figure 4, I have a button for Mathematical Anxiety. This is because, as explain in Appendix A, it is not technically

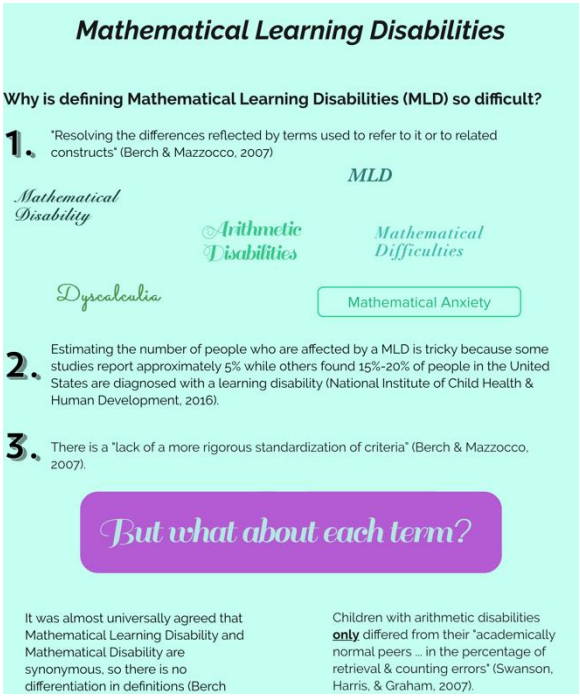


Figure 4: MLD page of "Unteachable"

defined a a MLD, but is commonly confused as such. However, I do explain what it is in detail so teachers know and recognize students with this challenge.

I worked on the next three tabs around the same time and switched back and forth between while working on them (it helped me stay interested while making my website). One of those tabs was, "Most effective teaching strategies," which has the most information, causing it to be very overwhelming for viewers. I carefully arranged this page to try to make it less intimidating and overwhelming. I have the most effective strategies for at risk students, students with a MLD, and—the most important demographic of students for this website—at risk students with a MLD.

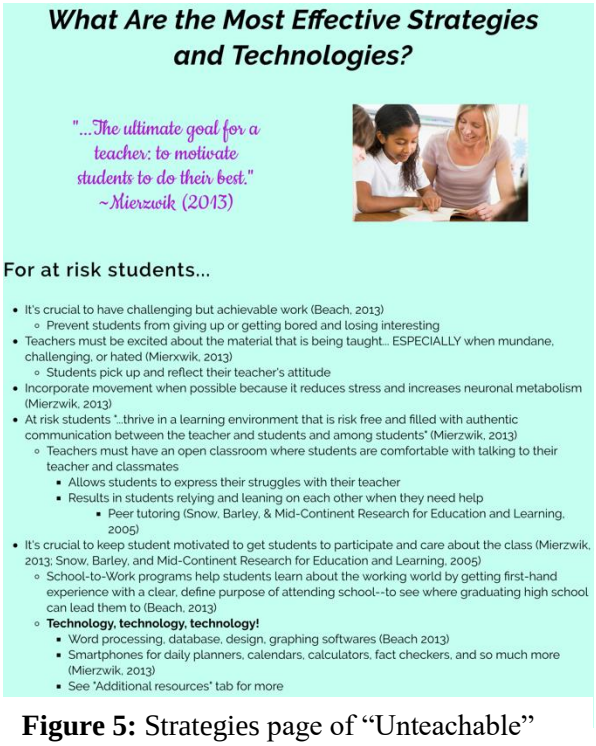


Figure 5: Strategies page of "Unteachable"

In between all the sections I have an inspiring education quote as well as a picture of teachers assisting students (see Figure 5 for one example). I wanted to break up all the information with something light and uplifting. Despite the mind-boggling amount of information on this specific page, it is one of the most useful pages on my website. It gives over twenty different strategies to use for this demographic in addition to advice and supporting techniques for each one. While student teaching, I used many of the strategies I researched. Examples include relating the material to something students to connect with, utilizing partner work, using visual aids when applicable, and using multiple strategies to keep students engaged. I found all these strategies to work well with at risk students in a high school math classroom. Although I did not have any

students with a MLD, many students did have mathematical anxiety as well as an aversion to math. They all expressed interest and appreciation for these specific strategies.

My next tab, "What does the literature say?" has all the resources I used for my thesis in APA formatting at as well as two buttons that takes viewers to additional literature. The first

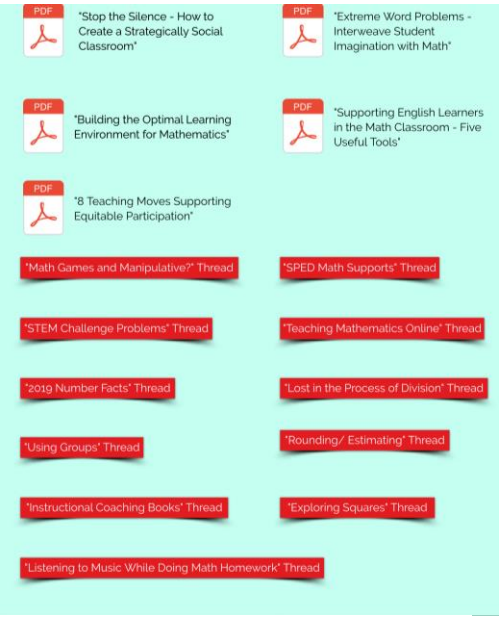


Figure 6: Literature page of "Unteachable" focusing on NCTM

Figure 7: Literature page of "Unteachable" focusing on articles from various sites

button takes viewers to a page full of articles, discussion boards, and videos posted by the National Council of Teachers of Mathematics, also known as NCTM. I decided to have a page with material from just this website because I felt they had copious resources relating to my topic. Moreover, I believe that this is an organization that all teachers of mathematics should invest in due to the multifarious resources it provides. The second button takes viewers to a page with various articles that focuses on the different topics discussed in my thesis. I felt as though they had great advice wanted to give viewers the opportunity to read it first hand.

The last tab I created, and my personal favorite, was "Additional resources." For this tab, I found over a hundred websites and apps that teachers can use in their classrooms. I separated

the resources into five separate pages which can be seen in Figure 8. Viewers can get to each page by clicking on the buttons found on the "Additional Resources" page. I got this idea from

Figure 8: Resources page of "Unteachable"

Figure 9: Resources page of "Unteachable" focusing on apps

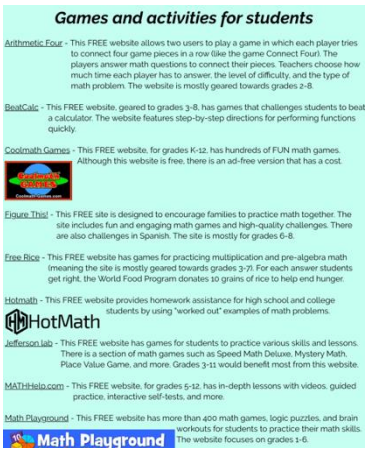


Figure 10: Resources subpage of "Unteachable"

We Are Teachers—a website that has resources and ideas for teachers. They had many of the resources I used in my website and separated them in the first four categories—the resources I found for the iPad and iPhone apps (see Figure 9) were mostly from "Pinterest." With that being said, there were many sites that were not included from the *We Are Teachers* page that I felt would be beneficial for teachers. Such sites include "Studygeek," "WolframAlpha," "YouTube," and more. Clearly this is not all the of the online resources available to teachers, but it is a good starting point for those needing a little extra guidance. I have tried out many of the sources I posted on my website and my top five favorites are "Quizizz" (great for reviews), "Pinterest" (unlimited classroom design ideas and activities), "GeoGebra" (allows hands-on experiences and visuals for many math topics), "Desmos" (the best online graphing calculator AND awesome activities for students), and "Kuta Software" (makes creating worksheets and quizzes easy).

Conclusion

During my entire thesis process, the most difficult task was picking a topic to write about due to my passion for many areas of education. That being said, deciding to research the best

strategies for at risk students with a MLD proved to be the best choice for me. I loved researching about this demographic of kids and learning about the best kinds of teaching strategies for them. I never thought that I would like research, but I enjoyed every part of my thesis. Furthermore, when I first started making my website, I felt overwhelmed with all that I had to do. However, once I started working on it, I found it hard to pull myself away. I loved researching websites, apps, and material for my website as well as designing the actual site.

The other difficult step was deciding the project I would use to test my thesis. Since having this specific group of students is difficult to accomplish, it was unreliable to do a case study due to having no guarantee of getting an at risk student with a MLD in my student teaching placement. I didn't want to write curriculum because I wanted my project to be generalized for any aged student studying any math class. As a result, I decided on making a website that encapsulated the various strategies and resources. At first I wasn't a fan of the idea because I thought the website would be boring and unimportant. However, I realized that a resource like this would be useful for *all* teachers because of the multitude of strategies and resources that can be used for *all* student. Although the resources are directed towards at risk students with a MLD, all students can benefit from them.

My next steps will be to share my website with other educators to express the importance of using a variety of strategies and incorporating technology whenever applicable. Not only have numerous academic studies concurred with my findings, but I have seen this successfully done first-hand. My mentor teacher is constantly changing the strategies used in the classroom—while keeping a consistent routine—to keep students engaged, interested, and positive. When I took over the classes, I ran my classes in a similar fashion. I encouraged creativity when possible, changed the way students reviewed for tests, used various instructing techniques, and

incorporated multiple kinds of technology when applicable. In fact, when I told my students about my thesis, one girl said, “ohhh, is that why you always teach us differently? And why we try different things in the classroom?” When I said yes she responded with, “well that actually makes a lot of sense because I kinda like math class this year. Every other year we do the same thing everyday and I find it hard to stay awake. But not in here!” It was encouraging to hear my at risk students validate my research and express that they learn best in this way. It is my hope that other teachers develop various teaching strategies and resources to use with their at risk students with a mathematical learning disability.

Appendix A: Mathematics Anxiety

The concept of mathematics anxiety being a mathematical learning disability is an unresolved controversy. It is agreed that it is plausible for students to acquire a phobia to math due getting left behind in the subject early on in life (Hersh & John-Steiner, 2011). In fact, Hersh and John-Steiner (2011) stated that 40% of people in the United Stated reported that they hated math, making "mathematics the school subject that provokes the strongest reactions" (p. 303). But what is mathematical anxiety? According to Berch and Mazzocco (2007), "math anxiety is typically defined as a negative emotional reaction to math and to situations in which math reasonings or problem solving must be performed" (p. 329). In some severe cases, it is categorized as a phobia. It is thought that "in some functional ways, math anxiety does seem to

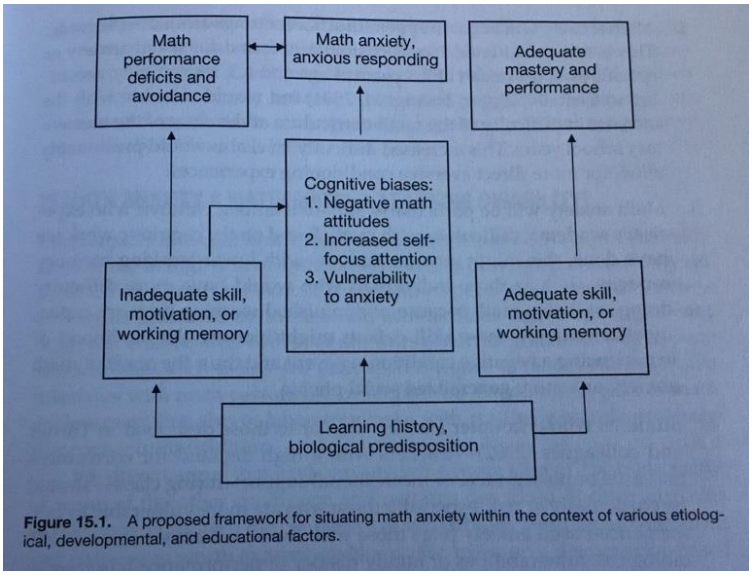


Figure A1: A visual representation for understanding math anxiety. Retrieved from *Why is Math So Hard for Some Children? The Nature and Origins of Mathematical Learning Difficulties and Disabilities* by Berch & Mazzocco, 2007, p. 343

operate like a genuine math learning disability, insofar as the outward manifestation includes poor math achieve under certain circumstances" (Berch & Mazzocco, 2007, p. 345). However,

tat is not always the case. Many experts believe that poor math achievement is a result of have mathematical difficulties, not a math disability.

Many experts believe mathematics anxiety is not a MLD because of "medical and environmental conditions that may masquerade as learning disabilities or exacerbate the difficult season of a child who is considered academically weak who does not have a learning disability" (Berch & Mazzocco, 2007, p. 51). Similar medical and environmental conditions include but are not limited to ADHD, overcrowded classes, mainstreaming of children of different capabilities, inadequate teaching methods, untested curricula, emotional issues, family adversity, and environmental deprivation. Furthermore, the attitudes and feelings about math can also impede on a students' mathematical performance, leading to mathematical difficulties. As stated by Berch and Mazzocco (2007),

> Because MLD is a biologically based condition, attitudes about mathematics are unlikely to constitute a predominant causal factor of this disability; nevertheless, attitudes may exacerbate the cognitive characteristics associated with MLD. Anxiety about math may result from one's awareness that mathematics is an area of pronounced difficulty, yet math anxiety in an otherwise cognitively capable individuals may still decrease performance accuracy (p. 44).

In other words, having a negative attitude towards math will probably cause poor math skills; however, it will not result in being declared as having a MLD due to having the cognitive capability to achieve in math.

Appendix B: Signs, Symptoms, and diagnosing of Dyscalculia

Signs and symptoms of dyscalculia include but are not limited to:

- Difficulty in understanding concepts of place value, quantity, number lines, positive and negative values, and carrying and borrowing
- Difficulty understanding and doing word problems
- Difficulty sequencing information or events
- Difficulty using steps involved in math operations
- Difficulty understanding fractions, making change, and handling money
- Difficulty recognizing patterns when adding, subtracting, multiplying, or dividing
- Difficulty putting language to math processes
- Difficulty understanding concepts relating to time such as days, weeks, months, seasons, quarts, etc.
- Difficulty organizing problems on the page, keeping numbers lined up, and following through on long division problems
- Good at speaking, reading, and writing, but slow to develop counting and math problem-solving skills
- Good memory for printed words, but difficulty reading numbers, or recalling numbers in sequence
- Good with general math concepts, but frustrated when specific computation and organization skills need to be used
- Chronically late, difficulty remembering schedules, trouble with approximating how long something will take
- Poor sense of direction, easily disoriented and easily confused by changes in routine

- Poor long-term memory of concepts—can do math functions one day, but is unable to repeat them the next day
- Poor mental math ability—trouble estimating grocery costs or counting days until vacation
- Difficulty playing strategy games like chess, bridge or role-playing video games
- Difficulty keeping score when playing board and card games. ("Dyscalculia," n.d., para. 3; National Center for Learning Disabilities, 2007, para. 9)

Students with dyscalculia are identified when a teacher or trained professional evaluates the students by testing his/her full range of math-related skills and behaviors. This evaluation compares the student's expected and actual levels of skill and understanding as well and his/her strengths and weaknesses. The student with dyscalculia is tested on their ability to use basic math skills, predict appropriate procedures based on understanding patterns, organize objects in a logical way, tell time, use money, estimate, self-check work, and find alternate ways to solve problems (National Center for Learning Disabilities, 2007). Determining how many students have dyscalculia is imperative. Knowing how prevalent the disability is can "aid in assessing the efficacy of education programs and instructional methods" (Berch & Mazzocco, 2007, p.49)

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