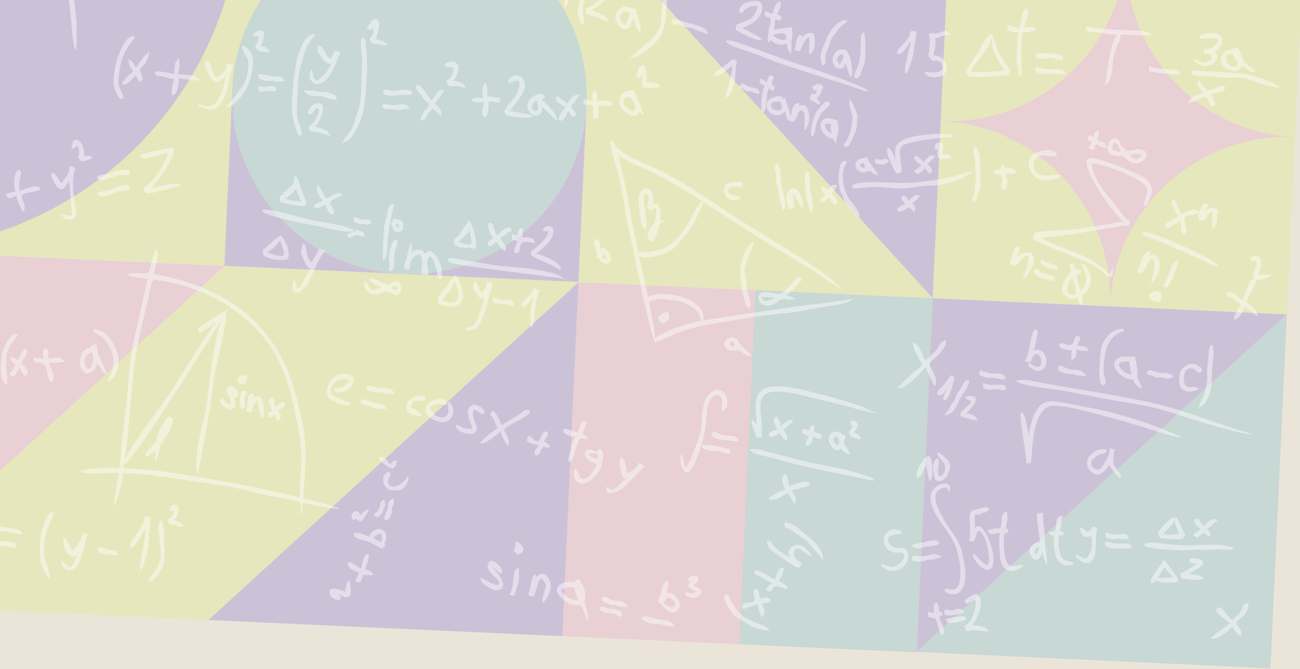

Math has a Problem

4 Lessons Learned

from educators turned would–be entrepeneurs

Guidance and support for founders, funders, & those determined to find a solution

Prepared for NewSchools

MATH HAS A PROBLEM
4 LESSONS LEARNED

EXECUTIVE SUMMARY

Math education has a problem. While initiatives are underway to improve the marketplace to make learning more engaging, accessible, and effective, those efforts stop short of being inclusive, particularly for students with recognized learning differences, such as dyscalculia. The absence of experimental research-backed solutions for dyscalculia exacerbates educational inequities. Our attempt to develop an intervention highlighted four key components for a solution, including explicit instruction, active piloting with students with learning disabilities, professional development, and informed market approaches. Individually, each one may seem obvious, but together they can provide a math solution that is transformative.

Lessons Learned:

1. **Explicit Instruction:** Research underscores the importance of explicit instruction for students with dyscalculia. This involves using clear, consistent vocabulary and incorporating scaffolded CRA practice to improve foundational math fluency. However, many teachers lack the necessary math background and require scripted lessons to facilitate the implementation of effective instruction.
2. **Active Piloting and Co-Creation:** Engaging teachers and students with learning disabilities through active piloting ensures an educational product meets the actual needs of those with learning differences. This collaborative approach leads to more effective and user-friendly solutions.
3. **Professional Development:** Teachers are integral to the success of any math intervention. The impact on students will be diminished without prioritizing high-quality professional development for teachers *and* other stakeholders to understand dyscalculia and implement evidence-based intervention techniques.
4. **Informed Market Strategy:** Navigating the complex State, Local, and Education (SLED) market requires an informed approach. Innovators must articulate clear impact goals and value propositions with a focus on states with numeracy and math legislation to improve math education.

An Opportunity:

Addressing dyscalculia is crucial for creating an inclusive and effective math education landscape within the complexity of schools. Coordinated funding of targeted interventions, improved teacher professional learning, and aligned math research on the implementation of interventions will improve instructional practices and ultimately **lead to research-backed intervention solutions for dyscalculia.** By funding both interventions and research that prioritizes inclusivity and evidence-based effectiveness, NSVF and others can play a pivotal role in transforming math education for all students, particularly those with dyscalculia, who have been historically underserved.

THERE'S A PROBLEM WITH AMERICAN MATH EDUCATION

Math has a problem. A statement widely recognized yet rarely agreed upon. Not only has it been lately relegated to second place standing in our schools, but it gets a bad reputation for being challenging, abstract, and terribly exclusive. We allow students and adults alike to write it off colloquially by proclaiming to be "bad at math" or "not a math person." While initiatives are underway to improve the marketplace and therefore the perception of math to make learning more engaging, accessible, and effective, those efforts stop short of being inclusive, particularly for students with recognized learning differences.[1] It's even more pronounced for marginalized students, exacerbating educational inequities.[2] Our current math landscape (Figure 1) does not serve students with math-centric learning differences like dyscalculia...nicknamed "math dyslexia."

Formally, **dyscalculia** is an umbrella term for intense difficulty or learning disability in mathematics that affects mathematics computation and numerical processing, typically in areas of number sense.

(Emerson & Babtie, 2010)

There is no experimental research-backed intervention solution for dyscalculia in our education landscape.

As two people who have been in the trenches as teachers, instructional leaders, and entrepreneurs, we saw success supporting students with dyscalculia in our classrooms and recognized a gap in the market. We set out to solve that problem (Appendix A - Case Study) and offer this reflection to convey our lessons learned. We share the elements of our solution so other EdTech innovators might consider the framework and improve upon it.

Our hope is that our experience will inform the support of future leaders and inspire new funding for interventions and research that champions inclusivity in math.

	CURRENT STATE	IDEAL STATE
TYPE OF INSTRUCTION	**INQUIRY** Conceptual understanding and collaborative soft-skills are emphasized, often creating confusion and frustration from an increased cognitive load.	**EXPLICIT** Direct, CRA-based instruction will scaffold and more fully impact learners, especially those with learning differences/disabilities.
INTERVENTION DEVELOPMENT	**DIRECTIVE** Interventions are developed for the learner, with rare cases of user input in the creation or launch of products or services.	**COLLABORATIVE** Learners, even young students, are given opportunities for input in the developmental launch of a product built to help them.
PROFESSIONAL TRAINING	**INCONSISTENT** Educators constantly receive updated curricula, but there is little time to implement more than one-off trainings for the fidelity & integrity of a product or intervention.	**PRIORITIZED** Training is prioritized, not just for instructive practices, but for foundational knowledge, ongoing coaching and peer support.
PROGRESS MONITORING	**RANKING** Students are formally monitored 1-2/year, with emphasis placed on specific grade levels & assessment of practice rather than a diagnostic tool for future intervention need.	**DIAGNOSTIC** Progress is monitored in real time using modern technological tools to diagnose and prescribe the most effective intervention instruction.

Figure 1

AN "ETHAN" IN EVERY ROOM

Without a solution...

Ethan's* experience in 4th grade math class was overwhelming. Simple arithmetic felt like deciphering a foreign language, and multi-step word problems seemed like navigating a maze. He watched his peers breeze through assignments that left him feeling stuck, frustrated, and, quite frankly, mad at them and the teacher. The teacher's instructions, though clear to others, sounded like a jumble of words to Ethan, who struggled to keep up with the pace of the lesson. When asked to solve a problem at the board, Ethan would rather cause a commotion in the room or hurt himself with scissors than look like a "dumb fool in front of everybody." His low scores bought him extra time with his teacher whose confidence was low and whose patience was understandably shot ... His parents wanted answers and sought out an educational psychologist who diagnosed Ethan with dyscalculia. It wasn't something any school could diagnose and it wouldn't show up on an IEP[3], but his frustration and low scores now had a cause.

As a result of his classroom frustrations, poor scores, and ultimate dyscalculia diagnosis, we paired Ethan with a veteran math teacher in place of his general math class. We provided the teacher with additional training in multisensory math and presented him with many more opportunities to practice with concrete aids. After 18 months, Ethan returned to his general math class with the foundational skills, the confidence, the voice, and the tools to attack the math content that had eluded him.

From this we wondered if those same efforts could be codified and scaled to other students who had similar challenges to Ethan. While we correctly assumed there would be individual and systemic challenges to overcome, our intent was to scale that solution (see case study) so any "Ethan" could get the intervention he required. Therefore, we piloted a solution with the key elements Ethan needed: explicit instruction from a product built alongside teachers, valuing their classroom experiences while providing them with quality professional development. To reach other students like Ethan we needed to capture the opportunity to get the intervention in all classrooms.

An Intervention Solution Best Serves Ethan When It Includes...

** "Ethan" is a composite character based on real students served at our independent school.*

LESSON 1

EXPLICIT INSTRUCTION

An intervention product for students with dyscalculia must be built on explicit instruction. There is little doubt in the research (Appendix B) that students with math difficulties need explicit instruction, an array of models taught with clear and consistent vocabulary followed by scaffolded Concrete/Representational/Abstract (CRA) practice to improve foundational math fluency.[4] Neuroscience indicates that children with dyscalculia may have impairments in both numerical and verbal processing areas of the brain.[5] Encouraging verbalization bridges these gaps by engaging verbal mechanisms that support mathematical problem-solving.[6] While other math learners may not be dependent on human interaction and dialogue to retain skills, those with severe needs are.

Explicit instruction is complicated for three reasons.

1. Unfortunately, teachers (and especially paraprofessionals) have little to no math background and struggle with the knowledge and confidence to converse in the think-aloud stage of explicit instruction.
2. There is no consensus on math pedagogy (and widespread misuse of math vocabulary even in core textbooks) with the popular media often favoring discovery learning in inquiry-based models.
3. Finally, children with dyscalculia need as many as 30 more models and/or practice problems to build the necessary neural pathways that few solutions currently provide and few school schedules have time allocated.

Since teachers may not be experts at underlying mathematical concepts with many having no more than one math class in their higher ed preparation, our solution (Appendix A - Case Study) offered direct scripted lessons with a template loaded with correct (defined) vocabulary for implementation. Prompts for teacher demonstration (modeling) and verbalization (think aloud), bridge the gap in Ethan's numerical and verbal processing, making math more accessible and less intimidating. The structured, predictable and repetitive nature of the lessons provided a sense of security, allowing Ethan to engage more fully with the material.

The repetitive format and scripted lessons were scalable solutions in a subscription software product. As we learned, however, teachers also need the autonomy (and permission) to pivot away from the script when diagnostic data and/or human intuition tells them a child's needs require it. We were only beginning to explore the balance between scripted lessons and the nuance of teacher instinct by researching the error analysis that AI technologies could run, translating student errors into patterns and a sub-script of fundamental skills which needed to be retaught or generating additional practice problems teachers could provide. Could AI supplement the teacher's response to errors by offering diagnostic data such as the mistakes on multiplication problems illustrate a gap in fact fluency for addition? Could AI supplement personalized learning by finding patterns of mistakes so teachers more easily (and with more confidence) know where to focus additional practice?

Insights for Funders

- Invest in products built on explicit instruction and CRA scaffolding.
- Ensure the intervention also supports the development of fact fluency.[8]
- Encourage development of scripted templates for instruction with prompts for think-alouds, feedback and other opportunities for verbalization of models and learning.
- Fund research in AI technologies for error analysis to transform student mistakes into a pattern of errors so a teacher has a diagnostic script for verbalization, additional practice problems, or other instructional models.
- Prioritize innovators who show evidence of a literary review of research.

Insights for Early Stage Innovators

- Prioritize explicit learning.
- Include scripted lessons.
- Embed verbalization of learning and feedback.
- Track the types and frequency of errors made by students during mathematical tasks to identify specific areas of difficulty and guide targeted interventions.
- Consider that teachers may need data-driven indicators or guardrails to determine when they need to deviate from a scripted lesson to meet a student's needs. Allow analysis of student input to determine additional verbalization, practice problems, or other instructional models.
- Refer to the Evidence for ESSA. They have included a subsection for struggling students with a filter for Special Education. It identifies a program's level of evidence under ESSA and the identifiers in the evaluation. It does not allow for a filter for explicit instruction. https://www.evidenceforessa.org/programs/math/

ACTIVE PILOTING FOR CO-CREATION

LESSON 2

While explicit instruction is key to student success in math, involving students and teachers in design is key to product improvement. **Since there is a need for experimental research-backed intervention for dyscalculia, active piloting and co-creation with stakeholders improves product iteration and offers some of the much-needed evidence to ultimately improve student impact.** Making a difference in student learning means engaging the many stakeholders who influence a child's education. The varied perspectives of stakeholders will have to be addressed for a true solution. (Figure 2) Allowing all of them to play a part in pilot testing can lead to a more effective and user-friendly product, as it incorporates diverse perspectives and expertise.[9]

Active piloting gives developers authentic feedback in real-world settings. It ensures that the product meets the actual needs of students with learning differences. As school leaders, we had access to students and teachers who guided our thinking around product development to understand the needs, challenges, and preferences of students with dyscalculia-effects. We included students who fell in the high-risk (red) category of Pearson's aimswebPlus math test. In a public school setting, these would be students in Tier 3 of the MTSS.[10] We also included students in the yellow risk group (Tier 2) whom teachers identified as struggling with math, acknowledging the value of this nuance of an educator's lived experience. With those students, we could test the intervention's presentation tool in real classrooms to observe student learning and make changes where lessons fell flat. The product improved when we shifted our thinking to develop it *with* students and teachers and not *for* them. Such co-design elevated and championed their lived experience with dyscalculia.

The problem is that active piloting with students with disabilities is somewhat uncommon. We were naively surprised to learn how many other solutions stood on statistics without controls, some containing no students with learning differences at all. Piloting with students with disabilities can have a very small N size leaving it statistically insignificant. What it doesn't afford in sample size, it provides in outcome measurement. There is value to being able to provide evidence that a child with a math learning difference has an improved educational experience because of the product. This will require leaders to think about their pilots as experimental research designed with data-sharing agreements with the school and potential parent permissions. Certainly, data access issues and privacy concerns are challenges to overcome, which imposes added work on the pilot classrooms and leaders alike, but schools and innovators would be offering a much-needed bridge between research and practice (not to mention the data to attract customers and investors) by collecting necessary data on students. Not only would such active pilots leverage evidenced-based results for student impact on the intended population, but also illustrate implications for scheduling, training, and administrative supports as feedback from those pilots would show how such structures affected results. Active piloting also allows innovators to ascertain the multiple personas of its users given that there is wide diversity in the types of disabilities that might affect learning math. Early-stage innovators need to be able to provide evidence as to whom their programs impact.

As leaders in a private school of 230 students, with roughly 20% presenting learning differences of some kind and 10% identifying as racially/ethnically diverse students, we knew our educational ecosystem was limited and wanted to pilot the solution in other school settings more representative of the larger market. We wanted the product to be inclusive and respectful of the diversity of possible users with various backgrounds, abilities, and experiences that our small subset of socio-economically homogeneous students in Wheeling, WV could not provide. We actively tested our lessons in three usability studies in other classrooms with more diversity in the student body. All were taught by a single educator. All but one was taught in a self-contained setting.

	The Problem with Dyscalculia	Evidence
Student	Math in inaccessible, frustrating and unnecessary. An obstacle to confidence throughout one's life.	NAEP scores, classroom behavior problems
Math Teacher	Students are mimicking not learning. In a subject that is built sequentially, they are not retaining foundational skills.	Short term success but can't succeed on review sections in subsequent lessons
Special Education Teacher	"If I keep trying to work at grade level they make the foundational leaps - but need to do it 4000 times" Complexities of individual pacing Paraprofessionals assigned to intervention support have no math instruction background.	Co-morbidity with working memory issues. Minimum math requirements for school personnel.
Superintendent	With mandates for reading, there is no time, nor district focus, left for math intervention.	90 minutes dedicated reading time with 30 min intervention time
Higher Education	"Teacher discomfort harms math instruction."	A 2019 NCTQ report found that 1 in 4 teacher candidates failed the math portion of a common elementary licensing exam the first time they took it.

Figure 2

ACTIVE PILOTING FOR CO-CREATION

Piloting and conducting usability studies in sites with diverse learners allowed us to identify the impact on subgroups of students beyond what the classrooms in our school afforded us. We would have had the opportunity to show impact on students with an IEP standing, or controls based on race or socio-economic status. Remotely, we met Sasha*, a student in our feasibility study in Waterville, OH. Her classroom struggles mirrored Ethan's. While she did not have a formal diagnosis, she had an IEP that identified her as having a learning disability. For her, some demonstration slides in our solution were overly complex. No matter what the teacher was saying from the script, she was drowning in the words in front of her. Using the product with her and taking the time to listen to her frustrations and explorations yielded change. We made explanations even more explicit in the teacher's script and added more clarity to the text presented on the presentation slides. For example, in an auditory drill students recited "If 1+3=4, then 10+30=40." That leap from single-digit to multi-digit math was not explicitly explained. The transition from operating with units of 1 to units of 10 needed clear step-by-step instruction, otherwise Sasha was lost. It is important to note that her confusion was made evident because verbal questioning and thinking aloud were established as core components of the intervention.

A pilot study that includes clear metrics of student identity, math pedagogy, and environmental school or classroom situations, is essential to fully evaluate the efficacy of the intervention to improve its equity and validity. Collecting information on multiple identities, especially the IEP standing, of a user improves product iteration, and further informs much-needed intervention research. For us, it was best to be as explicit as we could be as to who was using our product. Since dyscalculia can be costly to diagnose, most of our pilot sites determined participation by student math scores. Those achieving scores in the lowest 25% on a standardized pre-test assessment were assigned to the pilot study. It wasn't an ideal identification, but it matched the determination for math difficulties (11th-25th percentile) and for math learning disabilities (below 10%) and was the easiest to ask of our pilot sites.[11] Improving the screenings and structures to identify students for interventions and collecting more robust individual/classroom data would improve student impact in the long run.

While we are not suggesting an early-stage funder become a researcher, we are suggesting that pilot usability or feasibility studies could provide important data from that site which could be used for research across multiple sites in the complex market of schools. This brings up a series of questions. Who are the right students (the experimental group and the control group) to include in a pilot study? What is the right set of data to ask founders to note? What guidelines need to be considered for IRB[12] approval for a larger research study? The answers to these questions highlight the tension between scientific research and school realities. NewSchools collects data on important metrics for five years. Some agreement on what additional data would be most informative (and *possible,* based on privacy concerns) would aid in understanding student impact. It might not ameliorate the tension between research and practice but it would give us additional data from multiple sites.

Had we been able to ascertain data from a control group against any metric, we could have provided the evidence from experimental research to show true causality. In our case study, we had baseline data of a proof of concept and scores from students in the same grade level not participating in our intervention, but still had a hard time managing the controls within our pilot sites to inform cause and effect and prove efficacy to scale. Was growth a result of implementing our product or just more times at bat practicing math skills? Was a decrease in spring scores the result of testing fatigue, or were students experiencing burnout?

** "Sasha" is a composite character based on collective feedback received from those outside of our independent elementary school.*

Insights for Funders

- Look for products with robust data collection that are conducting user research and pilot testing early and often.
- Identify organizations that actively pilot their solutions with students with dyscalculia–effects in the learning.
- Encourage leaders to draft multiple student and teacher personas as to who their end user will be.
- Fund studies with control groups to determine causal validity especially with subgroups of students to understand and improve overall equity of a program.
- Support leaders through the challenges of data-sharing agreements and parental permission to secure evidence.
- Identify or help develop successful structures for data collection on students with disabilities.
- Inform innovators at the onset of the data NewSchool collects. Consider including other markers that may lend to research.

Insights for Early Stage Innovators

- Pilot early and often including students who have an IEP and/or ideally a diagnosis of dyscalculia if available.
- Conduct robust data collection.
- Listen to the voices of students and teachers using the product in addition to recording feedback through surveys or forms.
- Create teacher and student personas to keep in mind the diversity of users.
- Identify data as to what foundational skills relate to what common errors in math.

LESSON 3

PROFESSIONAL DEVELOPMENT

Teachers are integral in any math intervention. As stated earlier, students with severe math challenges need human interaction to increase opportunities for verbal processing. **Professional development, then, is a critical element in improving math outcomes for students.** To address the diverse needs of the learner effectively, teachers need a basic understanding of the insights neuroscience offers to explain what is happening in Ethan's brain when he is trying to learn math. They need to understand the learning disability, the elements of explicit instruction, and the impact of their feedback to positively influence the process of learning and lead to a more successful intervention.[13]

The problem is that too few teachers, or the para-professionals who are assigned to offer support, have the math foundation on which to build new skills themselves.[14] Many may have had as few as one math class in their undergraduate experience. They also do not have compensated time to add another training to their overburdened teaching experience.[15]

Our scripted lessons provide scaffolding, but teachers still need to tailor instruction to meet the unique needs of individual students with dyscalculia. Given the lack of preparation for math education, teachers need wrap-around support in their training.

- They need a basic understanding of the neuroscience behind dyscalculia and its co-morbidity with other learning disabilities.
- Once that foundation is established, they need pre-implementation training on the specific intervention program.[16]
- The National Center on Intensive Intervention recommends that the application of new knowledge requires coaching as well. Teachers need one-on-one time to ask questions and get feedback.
- Finally, allowing teachers to learn from one another and validate their experiences in a Professional Learning Community (PLC) strengthens the lasting impact of the professional development.

Ethan's learning issues did not follow a step-by-step playbook, however. We knew his working memory issues would still present learning challenges and cause frustration, thus our intervention offered an office hour each week so a dyscalculia expert was available to offer support as an instructional coach. The fact that other teachers might also join the call created a PLC. It was our hope to afford teachers the opportunities to analyze the curriculum, ask questions, and practice instructional techniques together.

Clearly, teachers and paraprofessionals working with students with severe math learning needs require additional skills, knowledge and competencies, but **the administrators who support them need professional development as well**. School leaders play a critical role in fostering a culture of inclusion. Guided by Watershed Advisors, we understood that "change for students hinges on all actors in the school system adopting, integrating, and sustaining new behaviors." The state defines the vision, so districts plan accordingly and support school-based administrators. In each building, teachers need support from principals, coaches (and innovators) to adopt new instruction. Therefore, professional development needs to extend beyond the faculty and hopefully be scheduled on compensated time for everyone. Success in treating dyscalculia will require a better understanding for school administrators who need to know what to expect when observing a lesson, such as explicit instruction, increased verbalization, and data from progress monitoring. District leadership and other administrators who will determine the funding, the scheduling, and the instructional staff support require additional training, so a shared understanding is possible. If only teachers receive training, they will not have the support they need within their building. To shift the system, administrators need to be part of professional development.

Insights for Funders

- Look for leaders/organizations who have the expertise to guide professional development – not just initial training but ongoing support for teacher growth.
- Invest in the establishment of course requirements for mathematical intervention content knowledge for general and intervention classrooms.[17]
- Support the development of best practices in professional development around math intervention.
- Fund the creation of a national Professional Learning Community (PLC) for teachers using dyscalculia interventions.

Insights for Early Stage Innovators

- Prioritize professional development and ongoing support for teacher understanding and growth.
- Ensure professional development is aligned to the product but fills in gaps in a teacher's or paraprofessional's preparation.
- Create training for other stakeholders.
- Provide coaching and an opportunity for a PLC of teachers.
- Consider a pricing model that is inclusive of all necessary professional development to ensure its implementation.

INFORMED APPROACH TO THE MARKET

LESSON 4

For student learning to be impacted, it's not enough to build a great product with a priority on professional development, innovators have to be able to map its use to the classroom. That is not easy. The State, Local, and Education (SLED) market is challenging. Within any school, you will find the complexity of competing priorities, needs, and interests. Each school operates in a different context and has to respond to local student needs. Add to that thousands of independent government entities, each with its own procurement processes and ever-tightening budget cycles, and leaders need an informed approach to navigate the process. **Marketing with impact goals and customer value propositions to known entities, especially those empowered by state leadership to improve numeracy instruction, improves the strategy to impact student learning.**

Our background in school leadership gave us no expertise for a go-to-market strategy, but we knew to keep our focus on capturing an opportunity to improve learning. Our sights were set on getting the intervention to the students who, like Ethan, needed it. We had to learn an informed strategy for winning contracts. First, we articulated impact goals. We considered how Ethan's experience changed to ask, "How would our product cause another student's learning to change?" Put simply, with our scaled intervention, students would engage with concrete manipulatives during explicit instruction to improve their achievement and confidence in math. For teachers we defined impact as improving their ability and confidence to teach math to all students, but especially those struggling to overcome the effects of dyscalculia. Neither teacher nor student were our customer, but the innovation would only be successful if their experiences were positively impacted. We needed to tell a compelling story that would drive all stakeholders to action, especially the purchaser. For this intervention, the customer would most likely be Special Education Directors. How would our product make their job responsibilities lighter? Our product promised to empower Special Education Directors to meet IEP obligations and improve math achievement for students with dyscalculia through specialized math intervention and stakeholder training. The truth remains that school systems are complex. The decision maker could hold a different role in each district or school. This is problematic as different stakeholders have competing perspectives on the problem to be solved (Figure 2).

As quoted from Watershed Advisors previously, "change for students hinges on all actors in the school system adopting, integrating, and sustaining new behaviors." To best position ourselves in the market, we planned to begin in those states with mandates to improve math education. In the supplemental table (Appendix 3) Watershed Advisors identified states with numeracy or dyscalculia legislation. Research into which of these states are reviewing or adopting new curricula or are reacting to recent negative math achievement headlines moved a state or district to the forefront of our strategy. Our home state, West Virginia, met all the criteria to top the list. After a handful of positive conversations with the State Superintendent, who wanted an agreement executed to fund a two-year pilot, we were faced with unanswered emails from his senior staff and ultimately a lost contract when a new superintendent was appointed months later. From that, we also learned to diversify our pipeline of contacts at every level as part of a successful marketing plan. Given the complexity of the SLED market, we also saw an opportunity to position ourselves in the private school network, a community we knew well and had strong credibility. If we wanted to impact student learning, we had to narrow our initial position in the market.

Insights for Funders

- Listen for organizations with a compelling story for impacting learning.
- Think strategically to support leaders through market barriers.
- Leverage connections to make introductions for leaders.
- Continue the exceptional support for early-stage innovators, especially the K-12 education market support for former educators and school leaders who are deeply familiar with instruction but far less familiar with sales.

Insights for Early Stage Innovators

- Craft compelling impact goals for teachers and student users with a separate value proposition for district personnel.
- Use established networks for early marketing of the product and positioning in the market.
- Stay open and well-informed of multiple avenues for positioning within the market.
- Develop relationships with multiple stakeholders in the educational ecosystem.

THE COMPLEXITY OF SCHOOLS

There is an underlying theme to each of the lessons learned - context matters, especially in terms of the complex ecosystems in our schools and districts. We discuss "schools" and "classrooms" in educational research (and throughout this report) as if there is uniformity. In reality, schools are intersections of race, gender, learning disabilities, language, religion, sexual orientation, mental health, socioeconomic status, to say nothing of societal expectations and external influences. Student populations differ widely; instructional quality is inconsistent; school and district leadership is vastly diverse in scope, efficiency, and efficacy. The list could go on. **Just as there is no average student, there is no average school or average stakeholder.**

Kolbe and Steele created a matrix (Figure 3) to highlight the complexity of perspectives in a single district in Vermont.[18] Each one of those perspectives might have a different priority and a competing demand for limited time (and human) resources as it pertains to learning differences. Each has a vested interest and all have varying levels of authority and influence (real or perceived). It could easily be a cacophony of conflicting voices.

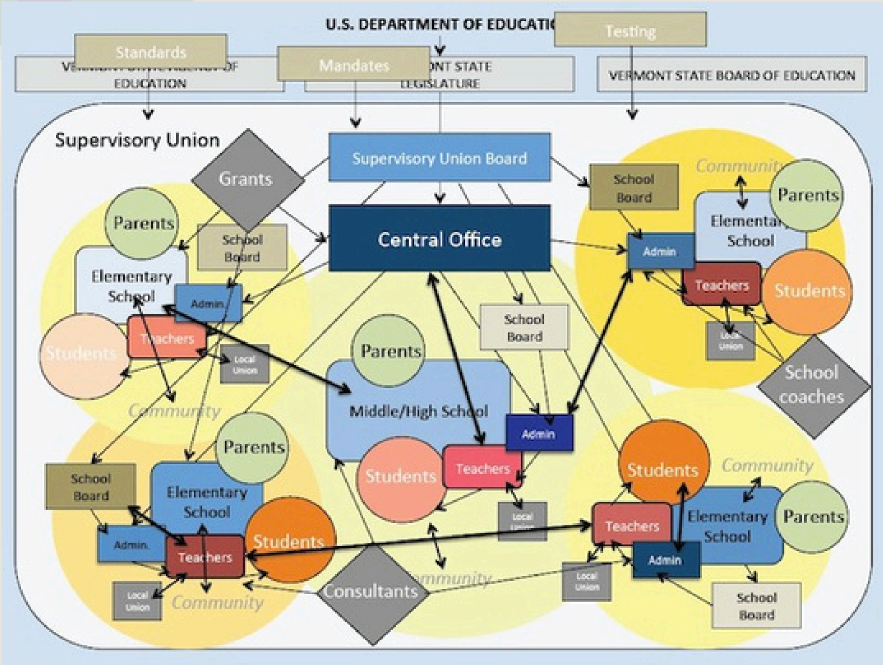

Figure 3

Add to this the perpetual turnover and leadership discontinuity and the complexity deepens. Just as there is a need for consistent vocabulary across mathematic instruction, effective communication across all stakeholders with a common vocabulary and a consensus on goals for student outcomes is essential. An intervention solution will have to navigate and negotiate this complexity. Balancing these diverse interests while maintaining focus on student learning and well-being is a significant challenge in schools, in policy-making and for leaders of educational innovations.

There is another critical factor affecting the complexity of schools: time. While the school system shapes how time is used, it is also dismantled by time limitations. Fixed academic calendars and daily schedules create rigid time constraints that clash with diverse learning speeds among students. Pressure to meet standardized testing schedules and grade-level deadlines requires a difficult balance in scheduling core subjects, interventions, and non-academic activities. Moreover, there is a need to provide adequate time for teacher planning and professional development in the midst of the ever-increasing requirements for instruction, feedback and administrative tasks.

While we recognize that addressing the "failure modes" where school systems get stuck[19] is beyond the scope of any funder or early-stage innovator, we felt the web of relationships among multiple stakeholders who remain prisoners of time needed to be highlighted in this report. It leaves us asking, is it possible? Can we really thread this needle and impact learning differences? Those are discouraging questions with a single answer. ***Yes.*** It is not the responsibility of the early-stage innovator or the funder to fix the school system, but it is imperative to understand and acknowledge the complexity of the problem that an intervention must anticipate and possibly accommodate.

OPPORTUNITIES

When he was in 7th grade, Ethan's math teacher asked him to show the class a different way to approach a problem. Now, as a college student, he remembers, "I was able to introduce a concrete approach as a way to tackle the problem. I ended up teaching the class. Me, the kid with dyscalculia. I understand the teacher continued to use the method in subsequent years. Call it a full circle moment, but that middle school teacher allowed me to feel triumph over dyscalculia. With intervention support, my obstacle became my opportunity and I have seen it that way ever since."

The challenges faced by students with dyscalculia highlight a critical gap in our current math education landscape: there is no experimental research-backed intervention for students with severe math learning needs. Our efforts to create an intervention tailored for students like Ethan underscore the necessity of four key elements: explicit instruction, active piloting with students with learning differences, professional development, and an informed (if not also narrowed) market approach. Individually, each one can make a positive impact and may seem obvious, but together they can provide a math solution that is transformative. Ethan's journey from frustrated to fluent exemplifies the profound impact that targeted interventions can have, transforming mathematical obstacles into opportunities for self-awareness, increased positive impressions of self, and ultimately, growth in his math achievements.

With policies in reading sweeping through the states, the structure is in place for math to follow suit. It may not be as easy as that seems. We often felt like we were building our product on quicksand, with systemic issues in math education and the school systems threatening to swallow our efforts whole. There are inherent problems in the foundation for math education, such as a lack of consensus on pedagogy, poor teacher preparation and training, and school schedule restrictions, to name only a few. The stakeholders we interviewed had varied responses to our question, "What's the problem with math, in particular with dyscalculia?" (Figure 2) While admittedly a small sample size, their responses illustrate the complexity of the educational landscape leaders will need to acknowledge.

While systemic challenges persist, our work represents a significant step toward addressing math's longstanding problem. In 2019, 16% of students with disabilities were performing at the NAEP Basic level in 4th-grade Math. **Only 1 in 5 students with disabilities could do basic grade-level math.** The lack of an experimental research-backed intervention solution for dyscalculia is a call to action for all stakeholders in the field of education.**

We urge all stakeholders to champion these much-needed interventions:

1. **Funders**: Fund a scoping review that compiles research, identifies gaps, and presents information in digestible formats to inform dyscalculia interventions and HQIM guidelines, including optimal delivery methods, dosage, and integration into school curricula.
2. **Innovators**: Continue to develop and refine interventions, prioritizing explicit instruction, active piloting with students with disabilities in a co-creative design process.
3. **Researchers**: Conduct longitudinal studies on the long-term effectiveness of dyscalculia interventions and explore the potential of AI in supplementing personalized math support.
4. **Policymakers**: Advocate for and implement policies that support early identification and intervention for students with dyscalculia, similar to existing dyslexia legislation.
5. **Educators and Administrators:** Embrace professional development opportunities to enhance your understanding of dyscalculia and implement evidence-based practices in your classrooms.
6. **Higher Education**: Design an optimal syllabus or course of classes for education majors to adequately prepare them to teach foundational math to all students especially those with dyscalculia.

Together, we can create a math education landscape that truly serves all students, ensuring that those with dyscalculia and other math difficulties have the tools and support they need to succeed.

***Upon completion of this report, we became aware of The National Math Improvement Project . Six of the largest urban school districts are collectively addressing the five core challenges in math education. Their challenges mirror our lessons learned.*

ABOUT US

LIZ HOFREUTER & LUKE HLADEK

After spending more than ten years choosing various programs to support students with dyslexia-effects in a PS-8 independent school in West Virginia, we recognized that no comparable math program existed in the market. For our small population on campus, we led a hands-on program for students with dyscalculia-effects and had pockets of anecdotal classroom success that ranged from increased math scores to improved classroom behaviors to greater self-confidence and self-awareness. The COVID pandemic acted as a catalyst to leverage technology to scale dyslexia and dyscalculia support for greater student impact. For two years, we led a dyslexia tutoring partnership with Boys & Girls Clubs in three states while we translated research into an early-stage EdTech startup and supported the development of an intervention program for dyscalculia. For the former, results were noteworthy. Students in the Boys & Girls Club program averaged 20% gains in literacy assessments and we hypothesized a similar increase in math.

Succeeding our own foundational educational experiences, Liz at Princeton University with a Masters from Harvard Graduate School of Education, and Luke at Bethany College with a Masters in Ed Tech Integration at West Liberty University, NewSchools' support and that from Watershed Advisors, Macon Street Ventures and EdTech Recharge allowed us to be students again. We were eager to learn from the wise advisors who guided us. Our intervention project was like a science experiment, each step a hypothesis tested, each failure a lesson learned.

In our combined 45+ years as teachers and 15 years in accomplished school leadership, growing a school from 80 to 240 students, an annual fund from $35,000 - $535,000, and maintaining a consistent student and teacher retention rate of more than 90%, with 100% graduation rate, we had a formula for school success, but no entrepreneurial roadmap for the complexities of spinning off an EdTech company from a school. We encourage other entry-level innovators to seek counsel early in the process for legal advice when incubating an innovation within a K-12 school. Nevertheless, we remain beyond grateful for this experience in uncharted territory.

Thank you.

Our thanks to the advisors and stakeholders who guided our thinking throughout this reflection:
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Lindsay Freeman, Director, Watershed Advisors
Mini Verna, CEO and Founder, Macon Street Ventures, LLC
Dr. Kripa Sundar, Founder and Lead Researcher, EdTech Recharge

and thanks to our colleague who guided our thinking throughout the process:
Margie Howells, Director of Math, Edge at Wheeling Country Day School

--- The stakeholders interviewed included:
Ashton Adams, college student and former student of Liz and Luke's triumphing over dyscalculia
Dr. Keely Baronak, Chair, Education Department, Carlow University
Cynthia Addison Brisky, Special Education and Mathematics Teacher, Weston, MA
Shelby Haines, Superintendent, Marshall County School, Moundsville WV
George Lammay, Superintendent, Washington School District, Washington PA
Liz Prather, Mathematics Instructor, Wheeling University, math tutor, Edge

ENDNOTES

4 Lessons Learned

1. CEMD sheds light on a math market that is changing.
    - **K-8 Math Curriculum Products and Publishers: The State of District-Led Selection**
    - Today's math market looks different than it did a generation ago. This quantitative report offers a glimpse of the change.
2. On average, only one in four kids are proficient in 8th grade math; the number hovering between 9-14% for Black, Native and Latino children.
    - **NAEP Report Card: 2022 NAEP Mathematics Assessment**
    - The 2022 National Assessment of Educational Progress (NAEP) Mathematics Report Card details declines in average mathematics scores for fourth and eighth graders compared to previous assessment years and highlights the impact of the COVID-19 pandemic on student performance.
3. In an Individualized Education Program (IEP), dyscalculia is often categorized under the broader term "Specific Learning Disability" (SLD).
    - "**The 13 disability categories under IDEA**" The Individuals with Disabilities Education Act (IDEA) is the nation's special education law.
4. **How to Teach Using Explicit Instruction**. Understood delineates this approach to teaching students.
5. Butterworth B, Varma S, Laurillard D. **Dyscalculia: from Brain to Education**. Science. 2011 helps to bridge neuroscience and teaching practices.
6. Faye A, Jacquin-Courtois S, Reynaud E, Lesourd M, Besnard J, Osiurak F. **Numerical Cognition: A Meta-analysis of Neuroimaging, Transcranial magnetic Stimulation and Brain-damaged Patients Studies.** Neuroimage Clin. 2019 look at nueral bases for numerical cognition.
7. Reference to Gersten et al., 2009 in **Making It Happen: What Does It Take to Implement Intensive Intervention?**
    - National Center on Intensive Intervention published this Q&A which discusses strategies for implementing intensive interventions in schools, highlighting factors such as scheduling, training, and fidelity to ensure effective support for students with intensive needs
8. Fact fluency is a precursor to generalization and maintenance of mathematical skills as Riccomini et. al articulate in **Implementing an Effective Mathematics Fact Fluency Practice Activity** TEACHING Exceptional Children, Vol. 49, No. 5, pp. 318 –327.
9. Processes for transformational co designing are available from **www.beyondstickynotes.com/what-is-codesign**.
10. **Multi-tiered System of Supports**, or MTSS, offers students who have learning, social, emotional, or behavioral difficulties in general classrooms personalized instruction or tiered support at the level of help they need to stay on pace with their peers. MTSS is usually divided into three tiers of support.
11. "Students who have developmental dyscalculia typically score at or below the 10th percentile on mathematics performance measures." (pp 5-6). The scoring difference between MD and MLD (developmental dyscalculia) is explained by Diane Pedrotty Bryant et. al. in "**Mathematics Interventions**," *Intensifying Mathematics Interventions for Struggling Students*. Guilford Publications, 19 May 2021.
12. An **institutional review board** (IRB) has the purpose to protect the rights and welfare of the potential research subjects by examining areas such as risks and benefits, informed consent, selection of subjects, privacy, confidentiality and anonymity.
13. Deans for Impact's **Lesson Internalization Protocol and Template** describes what teachers need to set students up for math success.
14. National Council of Teacher Quality regards factors of teacher preparation for **Elementary Mathematics**.
15. EducationWeek curated a five-week mini-course, **Teaching Math**. This special offering speaks to the need to support teachers in math fundamentals.
16. NCII **Coaching Resources** emphasizes the need for ongoing coaching for educators who are teaching interventions.
17. Deans for Impact's **Lesson Internalization Protocol and Template** describes what teachers need to set students up for success.
18. Kolbe, T. & Steele, C. (2015). **Wicked vs. Simple Problems: Implications for Education Policy.** Testimony on complexity theory and education policy presented to the Education Committee of the Vermont State Legislature. January 15, 2015.
19. Bryant, J. et al. (2024) **Spark & Sustain: How All of the World's School Systems Can Improve Learning at Scale**, McKinsey & Company.

Appendix B: Dyscalculia Intervention Research

20. Fuchs LS, Fuchs D, Powell SR, Seethaler PM, Cirino PT, Fletcher JM. **Intensive Intervention for Students with Mathematics Disabilities: Seven Principles of Effective Practice**. Learn Disabil Q. 2008;31(2):79-92.
21. **Assisting Students Struggling with Mathematics: Intervention in the Early Grades** This guide distills this contemporary mathematics intervention research into easily comprehensible and practical recommendations for teachers to use when teaching elementary students in intervention settings.
22. Baker, S., Gersten, R., & Lee, D. (2002). **A synthesis of empirical research on teaching mathematics to low-achieving students**. The Elementary School Journal, 103, 51–73.
23. Hattie, J., & Timperley, H. (2007). **The power of feedback**. Review of Educational Research, 77, 81–112.
24. Witzel, Bradley & Allsopp, David. (2007). **Dynamic Concrete Instruction in an Inclusive Classroom**. Mathematics Teaching in the Middle School. 13. 244-248. 10.5951/MTMS.13.4.0244.
25. Jones, J, Tiller, M. in **Using Concrete Manipulatives in Mathematical Instruction** discuss the benefits of using concrete manipulatives in math instruction.
26. **Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools** The Institute of Education Sciences (IES) practice guides provide evidence-based recommendations for educational challenges.
27. Representation of DBI from **https://intensiveintervention.org/data-based-individualization**
28. Gersten, R., Ferrini-Mundy, J., Benbow, C., et al. (2008). **Report of the task group on instructional practices** (National Mathematics Advisory Panel). Washington, DC: U.S. Department of Education.

FURTHER READING

Understanding Math Difficulties and Dyscalculia

- **Math Foundations For All: Clearing a Path**
    - This EdWeek Special Report focuses on how young students learn math fundamentals.
- **Math disabilities hold many students back. Schools often don't screen for them**
    - Jackie Mader discusses the need for screening and diverse, sensory-rich instructional methods to support students with difficulties.
- **The Language of Math with Paul Riccomini, PhD**
    - During an episode with READ Podcast, Dr. Paul Riccomini discusses the language of math and the challenges around its instruction.
- **What It's Like to Struggle With a Little-Known Math Disability**
    - EdWeek's Lydia McFarlane aims at helping people understand dyscalculia.

Policy and Legislation

- **It's time for math to have its 'Sold a Story' moment**
    - Math journalism needs deeper engagement with math content for educational reform to improve student outcomes.
- **7 States Now Require Math Support for Struggling Students. Here's What's in the New Laws**
    - A look at new laws that require schools to identify and support struggling students in math and mandate teacher training.
- **How a Debate Over the Science of Math Could Reignite the Math Wars: Special Education Researchers Copy the Science of Reading Playbook**
    - Jill Barshay explores the teaching of math in Special Education and related equity issues.
- **To Improve at Math, do Students, Teachers merely need more class time?**
    - How Piedmont City Schools landed the top spot among districts nationwide in a comparison of math scores in 2019 and 2022.
- **Focusing on evidence to improve learning**
    - The **Science of Math** is a movement focused on using evidence about how students learn math in order to make educational decisions and to inform policy and practice.

Effective Math Instruction and Interventions

- **Math Assessment and Intervention**
    - This EdWeek Spotlight evaluates recent trends in students' math scores; exploring growing investments in math education; learning how targeted support is essential for Algebra 1 students to progress to higher level math; examining the long-term benefits of early math supports and more.
- **Meeting the Needs of Students with Dyslexia and Dyscalculia**
    - Bradley Witzel and Minnie Mize highlight four empirically-validated teaching strategies necessary for improving literacy and math outcomes for diagnosed students.
- **Mathematics Sample Lessons to Support Intensifying Intervention**
    - Lessons to supplement mathematics interventions, programs, or curricula in schools.

FURTHER READING

Guides and Resources for Schools, Educators

- **Forward Together: A School Leader's Guide to Creating Inclusive Schools**
  - The School Leader's Guide to Creating Inclusive Schools provides actionable strategies and insights for school leaders to effectively support and improve outcomes for students with learning and attention issues.
- **Distance Learning Toolkit: Key Practices to Support Students Who Learn Differently**
  - This toolkit, created by Understood and the National Center for Learning Disabilities (NCLD), provides practical and necessary tips for making distance and hybrid learning more effective for students who learn differently.
- **The Pre-K to Grade 3 Essential Skills Inventories**
  - The Essential Skills Inventories (PreK-3) systematically track and develop critical core skills numeracy among other disciplines.
- **Marilyn Zecher's Multisensory Math Approach & More: Appropriate for All Essential for Some**
  - Marilyn Zecher provides instructional strategies and multisensory methods demonstrated meet the needs of all learners but are especially important for supporting those who learn differently.
- **Tools Chart Overview**
  - NCII's tools charts rate the technical rigor of academic and behavioral assessments and interventions but do not endorse or rank products.
- **Evaluate products with the Teacher Ready Evaluation Tool**
  - The Teacher Ready evaluation tool, which is grounded in research about the learning sciences and user experience design, helps standardize the way decision-makers evaluate EdTech products.
- **Intensive Interventions for Students Struggling in Reading and Math**
  - Center on Instruction provides a practical guide for instructional decision-makers on adapting and modifying instructional practices to deliver appropriate, responsive instruction for students with learning difficulties.
- **Evidence-Based Math Programs**
  - Evidence for ESSA provides a comprehensive list of evidence-based math programs including interventions for struggling students and specialized programs for different demographic groups.

Generative AI Technology

- **AI in Math: Improving Error Identification and Feedback**
  - The Learning Agency discusses the Math Errors, Interventions, and Opportunities for AI (MEIOAI) Workshop, which focused on leveraging AI to improve math education by enhancing error identification, feedback, and intervention strategies to address common math misconceptions and bolster student performance.
- **Research and Development Partnerships Using AI to Support Students with Disabilities**
  - NCSER stresses the importance of including special education experts in AI development.
- **Sal Khan Delivers the EdTech State of the Union Address**
  - Sal Khan acknowledged that generative AI's impact on education may be limited and stressed that EdTech must reset expectations by collaborating closely with educators and institutions.
- **The Kids That EdTech Writes Off: "EdTech can't fail kids. It can only be failed by kids."**
  - Dan Meyer critiques EdTech research for focusing primarily on the needs of a small percentage of students (less than 5%) and calls for a broader approach.

APPENDIX

CASE STUDY

An EdTech Pilot for Students with Dyscalculia

Background

As a small, dedicated startup within a PS-8 school, we embarked on a mission to address the challenges faced by students with dyscalculia, a math learning disability. Armed with decades of teaching experience and a passion for educational equity, we developed a Software as a Service (SaaS) intervention grounded in explicit instruction and designed initially for third-grade students struggling with dyscalculia-effects. The goal was to create an EdTech tool that not only supported students but also empowered teachers with effective instructional strategies.

Pilot Implementation

The Math intervention includes 62 research-aligned, multisensory lessons focused on specific math skills. The intervention includes support materials for teachers to best implement the program, including scripted teacher lesson plans, the scope and sequence of lessons, and teacher training on dyscalculia and the intervention itself. The usability pilot phase collected initial data in collaboration with several schools: our private school, a parochial school in Pittsburgh, PA, and a public elementary school in Waterville, OH. We collected baseline data through pre- and post-assessments. In a second year in Waterville, OH was conducted a feasibility study with the help of a third-party researcher from Michigan State University, who evaluated the efficacy and identify areas for improvement and iterate on the product design.

The intervention included multi-sensory materials for concrete and representational (CRA) scaffolding. Although the research did not show the need to follow a format similar to one used for dyslexia interventions, each lesson contained the following:

1. auditory drill,
2. visual drill,
3. visual/tactile activity,
4. incorporation of a new skill related to grade-level work,
5. followed by an interleaving review. *

This SaaS solution was intended for synchronous teacher-directed lessons to apply the learning through targeted instruction (I do), discussion and activities (we do), and checks for understanding (you do) for verbalizing thinking and feedback. Research does not yet identify the suggested dosage of math intervention, but our delivery was intended for

- 30 minutes baked into a bell schedule for intervention,
- four days per week
- in a self-contained classroom
- to small groups of four (but no more than six) students to attend to the responses and mistakes of the children.

The product included scripted lessons so teachers had the exact vocabulary to keep math language consistent and to build support and confidence for teachers. The pilot prioritized professional learning, providing teachers with the necessary training to implement the intervention effectively. In order to implement the intervention solution, a school or district would have to train teachers and other stakeholders who would use it. The asynchronous training began with an overview of dyscalculia and offered evidence-based math intervention techniques. The intent was to guide teachers in practically applying this instruction to the classroom as well as offering the curriculum-specific use of the intervention followed by individual coaching and peer support.

** Interleaving is an alternating review of multiple concepts at the same time. There were not yet 10 - 30 extra practice problems embedded into each lesson or suggested in teacher materials YET but that was a priority in the next iteration.*

CASE STUDY

An EdTech Pilot for Students with Dyscalculia

Challenges and Adaptations

We faced several challenges. The product was without embedded assessments for progress monitoring. Data from such assessments could have been analyzed through AI technologies to offer a diagnostic response to supplement teacher deviation from the scripted lessons. These two challenges were acknowledged as priorities in future iterations.

We also wanted to further adapt the product to allow teachers to be co-creators. We had a vision for a dashboard where teachers could post playlists of a new order of lessons they used to work with a student experiencing a particular problem. We wanted to create a virtual group community - a Reddit for math issues - where questions could be asked and answered by teachers using the product and monitored by our staff to improve the experience and the product... and, ultimately, the impact. Teachers could share supplemental activities and resources to enhance a lesson curating a clearinghouse of dyscalculia resources. By leveraging teacher experience to shape design, the product would only be that much more improved. In fostering teacher collaboration we would also be multiplying the influence of teachers on the market.

Perhaps our greatest challenge was being new to the SLED market. We knew teaching, learning, and school leadership, but not public school bureaucracy. We used our network to secure an introduction to the West Virginia State Superintendent. He praised our larger concept as one of the best he had heard and wanted to fund a state-wide pilot. Then came months of red tape, introductions to new stakeholders, and unanswered emails. By the end of summer there was a new superintendent who pulled all possibilities of funding for our project. Although we thought we were building the necessary strong relationships with stakeholders, a new hire at the top completely changed the playing field. We had not diversified our pipeline as we needed to.

Outcomes

The pilot yielded promising results. Students using the intervention showed improvement in their math concepts and applications, and administrators reported the ease with which any teacher or paraprofessional could use the product. Through third-party evaluation conducted at Michigan State University, the product's success was attributed to

- its foundation in explicit instruction,
- the emphasis on professional development for teachers
- and the feedback loop that allowed stakeholders a voice in product iteration.

DYSCALCULIA INTERVENTION RESEARCH

An effective program for dyscalculia includes four key aspects: explicit instruction, concrete and visual aids, increased practice, & embedded progress monitoring.

1 Provide Explicit Instruction

Similar to the pedagogy of "I Do, We Do, You Do," explicit instruction breaks down mathematical concepts into clear, step-by-step directions with direct teacher "think-aloud" explanations.[20] Students are offered many clear models of easy and difficult problems, using an array of examples.[21] They are then assigned scaffolded (CRA) group[22] and independent practice tasks followed by teacher (and peer) feedback.[23] Learners who require intensive intervention require 10 – 30 more practice opportunities than their peers.

2 Use the Scaffolded CRA Framework

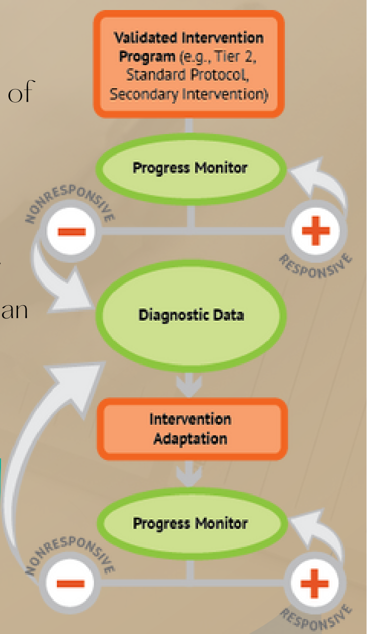
Concrete manipulatives (blocks, counters, rekenreks, etc.) make numbers and operations tactile to enhance understanding.[24] Visual aids such as number lines, charts, graphs, diagrams, etc. simplify complex mathematical ideas and make abstract math concepts and procedures more accessible for students with dyscalculia. The concrete-representational-abstract framework[25] is the step-by-step scaffolding needed to apply skills in extensive practice.

3 Include Repetition & Practice

Cumulative daily practice and repetition reinforces learning.[26] It's important for teachers to provide extensive (10-30) opportunities for students to practice skills with interleaving review until they become automatic. The amount of practice differs by student which can be correlated to working memory issues.

4 Monitor Student Progress

Progress monitoring is essential in developing new skills as well as diagnosing the next phase of instruction. Using curriculum-embedded assessments allows for the greatest student impact. The Data-Based Individuation (DBI) process developed by the National Center of Intentional Intervention (NCII) is a framework[27] upon which diagnostic data can be integral in an intervention product.



from IntensiveInvervention.org

The National Mathematics Advisory Panel (2008)[28] includes in explicit instruction the opportunity for students to be provided with:

- extensive practice in use of newly learned strategies and skills.
- opportunities to think aloud (i.e, talk through the decisions they make and the steps they take).
- extensive feedback.

NUMERACY LEGISLATION

State	Year	Description
AL	2022	Requires all K-2 students to be assessed using an early numeracy screener; 4-5 students must be assessed by a fractional reading screener at least two times a year. Allocates one mathematics coach for every public K-5 school with a student population of less than 800, and two coaches for a school with a student population of 800 or more.
AR	2023	Requires each public school district and open enrollment charter school to develop a math intervention plan for students in grades 3-8 who do not perform at or above grade level on the state assessment.
CO	2023	Requires training on evidence-informed practices* in mathematics for candidates for an elementary education, middle school mathematics, or secondary mathematics endorsement. Creates a grant program for interventions to help students who are below grade level or struggling in mathematics. Requires the state department of education to offer optional trainings in evidence-informed practices* in mathematics for all teachers. **Evidence-informed practice is defined in the law as: "a program or practice in mathematics that relies on peer-reviewed evidence to establish a basis for accelerating learning. 'Evidence-informed' includes evidence-informed curricula, interventions, acceleration strategies, and assessment options."*
FL	2023	Requires students in grades K-4 who show a "substantial deficiency in mathematics or dyscalculia" to receive supports and for parents to be notified, and requires districts to monitor these students' performance. Requires the department of education to provide a list of approved mathematics intervention programs, curricula, and supplemental materials. Requires that the department of education provide recommendations to the legislature for preparing teacher candidates and identifying math professional development for K-4 teachers and administrators.
LA	2023	Requires math teachers who teach grades 4-8 to take additional professional development related to numeracy.
WV	2023	Requires the state board to develop an "appropriate list of literacy and numeracy screening tools," and directs the state board to develop rules to: maximize family engagement in development of a culture of literacy and numeracy; provide professional development for administrators and K-3 teachers; ensure that early numeracy teachers and support staff are qualified; create a formula or grant-based program to distribute funds for these purposes; and provide support for numeracy programs and supervision at school sites.
TX	2023	Requires each 6th grade student who performs in the top 40% on their 5th grade state math assessment or other local measures (as defined) to be automatically enrolled in an advanced math course unless the parent or guardian objects.
TN	2024*	Would require TDOE to approve and make available a PD course on math instruction at no cost to K-8 educators. The department would also have to revise standards for students in a teaching-as-a-profession career pathway to align with the professional development course on math instruction. In addition, the bill would require an analysis of current math proficiency.
IN	2024*	Would require the IDOE to develop guidelines for mathematics instructional materials and provide optional screening and interventions for struggling students.
KY	2024*	Would require school districts to select a universal mathematics screener and administer it to all students in grades 4-8 within the first 30 days of the school year. Would also provide math improvement plans for students.

*Introduced in the 2024 session, not passed into law yet.

Compiled by Watershed Advisors

GLOSSARY
OF TERMS

active piloting
The iterative process of testing and refining new ideas or products in real-world settings.

co-design
brings together lived experience, lived expertise and professional experience to learn from each other and make things better – by design. More information available from Beyond Sticky Notes.

CRA Framework
The Concrete, Representational, Abstract is an educational framework used in math classes to help students understand concepts and learn procedures.

data sharing agreements
These allow researchers to access data to examine trends, determine the effectiveness of interventions, and support agencies in their efforts to use research-based evidence in decision-making.

dyscalculia
umbrella term for intense difficulty or learning disability in mathematics that affects mathematics computation and numerical processing, typically in areas of number sense. Also known as developmental dyscalculia.

experimental research
This type of research design examines whether change in an independent variable causes change in a dependent variable. Research Design for Special Education Research explain other design which include: descriptive, relative, and qualitative.

explicit instruction
involves direct explanation. Concepts are clearly explained and skills are clearly modeled, without vagueness or ambiguity. Language is concise, specific, and related to the objective.

feasibility study
A feasibility study helps you understand whether and how your product can be used by your users in the environment in which they would typically use the product. From edtechrecharge.org/newschools.

Interleaving
or interleaved practice format (IPF) mixes up at least three different problem types in review, i.e. a session may involve solving a rounding problem, followed by a subtraction problem, and then a multiplication problem.

interventionist
In addition to other responsibilities, the educator provides individual or small-group instruction to students who are struggling academically.

inquiry-based models
Teachers use questions, problems, and scenarios to help students learn through individual thought and investigation. It is a math pedagogy often set at odds with explicit instruction.

IRB
An institutional review board (IRB) is the institutional group charged with providing ethical and regulatory oversight of research involving human subjects. IRB approval requires appropriate consent, i.e. data sharing agreements.

mathematic difficulties (MD)
refers to those children and adolescents who have learning problems that make it challenging for them to understand mathematics instruction usually identified as scoring between the 11th and 25th percentiles on mathematics assessments.

GLOSSARY
OF TERMS

mathematics learning disabilities (MLD)
umbrella term for intense difficulty or learning disability in mathematics that affects mathematics computation and numerical processing, typically in areas of number sense

MTSS tiers
MTSS stands for multi-tiered system of supports. It's a framework designed to offer students personalized instruction or support that matches the level of help they need to stay on pace with their peers.

numerical processing
The cognitive function for mental manipulation of numbers and quantities. It occurs in both hemispheres in the brain.

pedagogy
A method of teaching that encompasses the strategies, techniques, and approaches used by educators to facilitate learning.

prisoner of time
A reference to the 1994 Report of the National Education Commission in Time and Learning and the 2005 reprinted to refocus attention on the critical issue of using time as a resource for teaching and learning.

Professional Learning Community (PLC)
A PLC is an approach in education where groups of educators work collaboratively to improve their teaching practices and student learning outcomes.

RTI
Response to intervention (RTI) aims to identify struggling students early on and give them the support they need to thrive in school as a component of IDEA.

scaffolding
Temporary support to help students learn a skill or concept. Can be gradually removed when these supports are no longer needed. Examples include breaking a task into steps and showing how to do each step. understood.org

Science of Math
a movement focused on using objective evidence about how students learn math to make educational decisions and to inform policy and practice. https://www.thescienceofmath.com/

scripted lessons
a highly structured and detailed instructional plan that provides teachers with specific wording, steps, and activities to follow during instruction.

usability study
A usability study helps you understand whether users are able to use your solution in ways that address their needs and/or, as you intend them to use it. From edtechrecharge.org/newschools.

verbalization
The practice of having students and/or teachers explain their mathematical thinking and problem-solving processes out loud.

verbal processing
The cognitive function to understand, interpret, and produce language in both spoken and written forms primarily occurring in the left hemisphere of the brain.