Demystifying Math Struggles & Identifying Strategies to Help

Introduction

Since the YCDC website began in 2007, we have received many requests about how best to help dyslexic students struggling with math. We reached out to Chris Woodin, the head of the Math Department at Landmark School, a respected school that specializes in teaching students with language-based learning issues, to help us find alternative methods for mitigating common math struggles that seem to accompany dyslexia. Woodin offered many helpful strategies to help address them, and we hope that it will help other teachers and parents who are looking for ways to support dyslexic children with math. We also hope that if you are a math specialist or a parent of a child who has struggled in math, you will share what has worked for you.

Breaking Down Math

Excelling at math, or just even being able to pass the requirements, draws on many different skills and ways of thinking—it calls on conceptual, logical, and spatial reasoning, but it also often requires neatness, exactness, and computational skills. There are many areas in which to shine in mathematics, but unfortunately, there are also many areas in which to struggle. These tasks change over time, demanding increased refinement or elaboration of skill sets, or the addition of new ones as a student progresses through school. Woodin encourages teachers to treat math problems with the same kind of thoughtful and targeted strategies that are applied to reading instruction.

In the classroom, we break down the complex processing tasks of reading and spelling into various subskills that can be tested and analyzed. As a result, students' strengths and weaknesses may be acknowledged and an effective course of action can be planned and implemented. Math skills, however, are not routinely evaluated in this manner. Math is usually assessed in terms of achievement: a student's ability to perform a set of increasingly sophisticated computations or word problems. Resulting scores define students as being "good, average, or bad" at math. The problem with these labels is that, much like reading and writing, math is made up of subskills, and it may be that a deficiency in just one of these subskills makes the student "bad" at math. A student who is a poor speller or has bad handwriting wouldn't necessarily be considered a poor writer. Specific weaknesses are not defined within the context of math, therefore specific therapies are not prescribed to treat them. In the math sphere, the "bad" math student who has been defined in very general terms is usually afforded an equally general course of remediation, and a repetition of previously introduced material ensues, or perhaps an enhanced sensory diet of "slower and louder" is dispensed.

The Relationship Between Math and Language Struggles

We often define dyslexia as an "unexpected difficulty in reading"; however, a dyslexic student may also have difficulty with math facts although they are often able to understand and do higher level math quite well. The specific skills that an educational evaluation measures to determine where language glitches, both written and verbal, occur can also be helpful in predicting where math breakdowns might occur. Using this knowledge, we can also develop strategies to address an individual student's struggles in math.

Math-specific skills, including the ability to recognize and relate quantities, should also be assessed and factored into the production of an effective program for students whose atypical learning profiles suggest the need for special attention.

Why and how should teachers use what they know about language remediation to address math problems?

Mutlistep tasks can be difficult for students who have trouble organizing, naming, or sequencing; however, experience has shown that these students can be helped by using instructional methods that forge meaning and context through physically organizing objects, naming the action, and writing the process down.

Students' learning styles must be acknowledged through the development of strategies that compensate for their individual difficulties. Woodin has found that using activities that involve visualizing, walking, and talking out problems are effective in developing vocabulary, organizational skills, and oral and written output.

Overview: Importance of Integrating Visual and Language Systems

Like reading, math involves many cognitive processes or systems. Ideally, teachers should diagnose and treat math breakdowns with the same specificity and strategies they apply to language-based instruction. When math remediation is most effective and efficient, it employs the same best practices that are used to address reading struggles. We know that using hand motions when teaching songs or poems may be helpful since it provides cues and context clues that reinforce learning of the content. Likewise, the best math instruction utilizes student strengths to mitigate weaknesses, and uses context and the integration of multisensory techniques to help the student create meaning and improve memory.

About Chris Woodin:

Christopher Woodin is a specialist in the field of mathematics and learning disabilities. A graduate of Middlebury College and Harvard Graduate School of Education, he has taught extensively at Landmark School in Massachusetts. At Landmark School's Elementary/Middle School Campus, he holds the Ammerman Chair of Mathematics. Christopher served on the Massachusetts Department of Education's Mathematics 2011 Curriculum Framework Panel, and teaches graduate-level professional development courses during the summer through Landmark's Outreach Program. Chris was the 1997 Massachusetts Learning Disabilities Association (LDA) Samuel Kirk Educator of the Year. He has presented at numerous international LDA and International Dyslexia Association (IDA) conferences, and has led math workshops to audiences across the country.

Christopher has published *The Landmark Method of Teaching Arithmetic* ©1995 and several journal articles. His latest project, *Multiplication and Division Facts for the Whole-to-Part, Visual Learner: An Activity-Based Guide to Developing Fluency with Math Facts,* is currently in press and due to be released in 2012. This comprehensive text features the methodologies and many of the activities that are described on The Yale Center for Dyslexia & Creativity's website. To learn more about Mr. Woodin and his work, please click here.

Processing Breakdowns

Students with slower processing speeds or executive-function problems are often no different from their peers in math proficiency in first and second grade; but as they confront multistep computations in upper elementary school tests, their scores tumble because they lack the skills necessary to produce organized, efficient output. These students aren't losing their earlier skill base. New tasks demand efficient processing in different domains. The mathematics problems they now encounter need organizational skills involving planning and sequencing, as well as skills like handwriting, copying text, note taking, and other outputs requiring accuracy and efficiency. These skills are often difficult for dyslexic students. Students who struggle with processing multistep problems can improve their accuracy by employing several strategies that involve "walking" and "talking" problems through.

Woodin: An individual student can process auditory, visual information, and produce verbal and motor output with varying degrees of accuracy and at different rates. This lack of integration across modalities can result in frustration. Imagine how frustrating it must be for a highly verbal student whose pencil cannot keep pace with his racing thoughts, or the less verbally gifted student who finds it difficult to explain his written solution to a math problem—he can see the problem, he knows how to solve it, but he can't present it orally. All these students benefit from teaching methods that provide organization and encourage the integration of information between visual images, language, and motor output. When students can process information across these three systems, they can access information across a variety of contexts.

Getting Math Concepts

Math-specific concepts seem to be particularly difficult to master. In addition to being abstract, these concepts contain terms that confound students with visual similarity (divisor vs. dividend) or auditory similarity between homophones (times: multiplication vs. times: hours and minutes, or times: "X" the 24th letter). The terms can become more accessible when presented through concrete demonstrations.

Download the Graphic Organizer for this Fractions Renaming Exercise. Click here. Chris Woodin has graciously allowed us to offer PDFs of some of the graphic organizers he uses in his classroom. To see more organizers and information, click here.

Difficulties in learning abstract mathematics terms or concepts can be mitigated by providing concrete visual examples that the student can commit to visual memory. Student-generated images of concrete visual examples can prompt a student to name the elements of a fact or procedure. For example, durable images like those of a dog, an ant, or a clock face can be used to concretize the process of renaming fractions. When provided with ample time to formulate responses, students can label information contained within these familiar concrete images and apply these labels to describe procedures.

In the following video, a struggling student is able to use concrete images to prompt himself to label, rename, and add fractions. Note the way that the images are processed more efficiently by the subject than the abstract number-based fractions as well as the positive effect related to the generous response time afforded the student.

Memory Challenges

Helping Students with Poor Working Memory

Often an educational evaluation will describe a dyslexic student as having "low working memory." Low working memory is indicated when someone cannot keep many things on their "screen." For example, think about when you first learned to drive. You had many steps to remember. You held those steps in your active working memory. Once you drove a lot, you didn't think about where the key went, where your feet should be positioned, when you needed to look in the mirrors (and know which ones to look at), where to put the shifter, which side the blinkers were on, etc. Multistep problems or directions pose the same challenge for students with low working memory. For instance, when they are borrowing in subtraction they have to hold onto numbers as they work through the problem. Students with low active-working memory usually have to write everything down. They also benefit from underlining/highlighting directions before they start.

Many struggling math students can enhance their memory of processing steps if they name each step of a math process as it is being performed. This strategy requires students (and teachers) to slow down, but the investment of time increases the student's ultimate grasp and retention of the mathematical concept.

Dyslexics often experience difficulty remembering directions and learning sequences that they hear. This hampers their ability to sequence and plan sequential steps as they may not be able to hold auditory information long enough to process it. In terms of math, a student may be unable to remember elements of word problems long enough to perform an operation. He may know that he needs to subtract one value from another, but he may not be able to keep those numbers in his head long enough to hear the whole word problem. This is not to imply that a low digit span correlates with being dyscalculic; however, auditory-memory limitations will make it difficult to utilize certain math strategies and related procedures.

Woodin uses a combination of logic and visualization strategies, including graphic organizers, to help students who have difficulty formulating and comparing multiplication facts and other mathematical processes. Once internalized, graphic organizers, like a clock face or familiar dot patterns, help students because they can "chunk" a great deal of information into an organized package that they can access and use to orient themselves. Without imposed organization, facts are learned as isolated sentences through rehearsal-like phone numbers. Dyslexics are big-picture thinkers, and being able to organize through context is a helpful strategy.

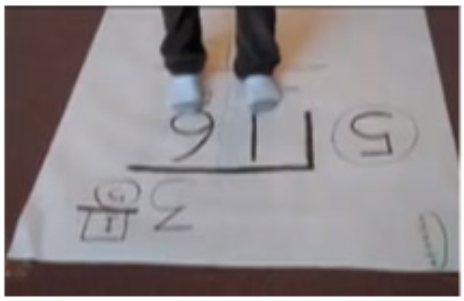
Counting and Comparing Difficulties

Subitizing is the ability to recognize a number of briefly presented items without actually counting.

A common response to students who are having counting problems is to simply have them do daily counting practice; however, students with counting and comparing difficulties also benefit from practice that utilizes patterns and relationships. These strategies improve their ability to conceptualize and compare numbers without counting. Data in a study of dyslexic students who had difficulty with basic arithmetic skills (Fischer B., Kongeter A., Hartnegg K., 2008) showed that dyslexic children could also improve subitizing and visual counting through daily practice. It is important to distinguish the whole-to part process involved with this training. Not all daily counting practice is created equal. These dyslexic students did not achieve their gains in arithmetic merely through the process of counting. They were taught counting strategies for many years to add and subtract numbers with little benefit to their overall concept of number. Students made their gains because they were supplied with a whole- or gestalt then they combined subordinate parts to reconstruct the image. Over time they improved their ability to match quantity with successively larger patterns.

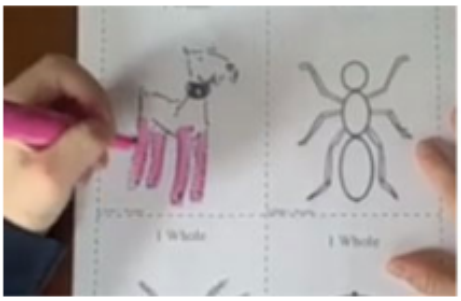
http://dyslexia.yale.edu/math.html

Processing Breakdowns



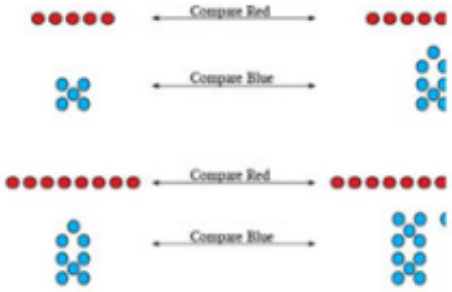
Help students who struggle with processing multistep problems improve with these strategies. Learn more.

Math Concepts



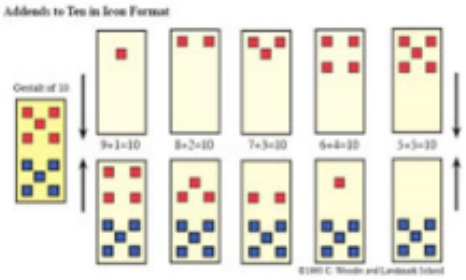
Learning math concepts involves interaction between the visual and auditory systems. Learn more.

Memory Challenges



Students with low active-working usually have trouble keeping multiple items on their "screen." Learn more.

Counting & Comparing



Students can benefit from counting practice that utilizes patterns and relationships. Learn more.