Ed Tech for Teachers
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Dysgraphia, Math, and Remote Learning: Part 2

When Part 1 of this 2-part column was written and went to press, the world was in the throes of a massive pandemic. Schools were shut down and one could say that students and teachers were learning at the same time, albeit different topics. As this column goes to press, the world hopefully is edging towards a (1) more controllable and understandable endemic and (2) an educational world that is evolving in different and improved directions. There are still many students learning remotely and/or in hybrid situations. With that scenario as background, this column will still focus primarily on addressing ways for students who are working in either type of setting to progress in math in spite of dysgraphia. As Part 1 discussed, there is more research going on in math in particular but also related to dysgraphia and technology. As a result, educators should be aware of three other important points to consider.

1. Pandemic or not, remote teaching and learning or not, more and better technology is available to help these students.

2. There is an increased emphasis on the language component of math. This emphasis can positively or negatively impact the student with dysgraphia depending on whether there is a co-existence of the two.

3. In many situations after learning various approaches to solving problems, students are now more frequently encouraged to use the method that works best for them.

When planning a program for a student with dysgraphia, understanding how the dysgraphia manifests itself can be very important. Research has shown that there are several categories of dysgraphia (Frye, 2022).

1. Motor dysgraphia, which involves difficulty with fine-motor coordination and visual perception

2. Spatial dysgraphia, which involves difficulty with number/letter spacing and drawing

3. Linguistic dysgraphia, which impacts written expression, especially spontaneous written text

A key part of using apps and websites often involves setting up the tools and providing instructional time on using the tools prior to assigning tasks. This may be a relatively new part of instruction for a classroom math teacher and/or an educational therapist, but it is just as important as the actual assignment. For many students today, figuring out technology is relatively easy, but knowing how and when to adapt technology and using it wisely is often another story. Even these students, and especially those with dysgraphia, will benefit from initial instruction on how/when to use a tool along with time to explore before being expected/allowed to use it. They will learn (1) that there may be several different ways to adapt the technology so it best meets their needs and (2) when and what type of technology is best used in a specific situation.

One advantage to taking class time to help students learn about the tools and set up templates is that this can be a good source of review at the start of the year (semester) and even at the start of new topic. Rather than singling students out who specifically benefit from these tools, make this a class activity. The more tech savvy/able students will enjoy setting up templates that work for them and will be able to share these with their peers. This also provides for interaction between all the students.

For purposes of this column, the author is going to focus primarily on tools/websites that are easily accessible, free, or cost very little to educators and schools. Many apps are available for school purchase only. Experience has shown that if an ed therapist working individually with a student or a few students contacts the app publisher for an individual subscription, many are willing to provide one free or at a reduced cost. Providing the publisher with a clear description of why this is being requested and how the app will be used is important. Two such tools which are extremely worthwhile but also come with a cost are EquatIO and OneNote, which is part of the Office 365 suite.

Before looking at specific ideas, let’s look briefly at some of the ways teachers already are helping students with dysgraphia and see how these might be adapted remotely. Some concrete options that can transfer to online teaching and learning include pencil grips (also for stylis), slant boards, softer lead pencils (thicker online pens/pencils), erasable pens, dictation/scribe, and graph paper. Classroom accommodations might also include (1) providing handouts (preferably) prior to or as a lesson begins, (2) pairing a student up with a peer to get copies of notes, (3) requiring fewer problems without changing task expectations, (4) allowing two days to complete an assignment, (5) spatially organized and/or highlighted paper, (6) posting notes and videos online, and so on. With increased use of smart phones, it is the author’s belief that learning to use these tools responsibly is important. One use that students already know is how to take a screenshot. Allowing students to take a screenshot during class can be helpful for all students and especially for those who are dysgraphic.

These and many other accommodations can be used or adjusted for remote learning as well as for classroom instruction involving whiteboards or even textbook work. Online material is more and more available. Along with physical textbooks and workbooks, some publishers are starting to make digital materials available. Two sites in particular, Internet Archive and Scribd, have a large number of math books available. Internet Archive is free. Most books can be borrowed by the hour and renewed each hour depending on whether or not someone else is requesting it at the same time. Other books can be borrowed for two weeks.
As of this publication date, Scribd costs about $10/month and can be paused when not needed without losing the subscription or incurring a price increase. Books are provided as e-books and, when available, as audible books. Figure 1 shows a picture of some of the more common math materials available at the Internet Archive site. By using these online texts side by side with a template, students can “read” from left to right and solve the problems on the screen.

![Figure 1: Math Books on Internet Archives](image1)

Using the XY Coordinate Board on the [Brainingcamp](https://www.brainingcamp.com) site, Figure 2 shows work completed by a 7th grade student who kept losing her place on both the handout (pictured) and on graph paper as she tried to plot the points and then label them. Before beginning, the author taught her how to set up a Zoom screen so she could use the laptop keyboard when doing homework at home independently. First, she plotted each coordinate pair so that all points were graphed. To keep her place, she kept her left hand on the coordinate pair she was trying to plot, e.g. (-7,6) while using her right hand to put the dot on the graph. Once all the points were plotted, she then again kept her place with her left hand while using the typing tool to type the label for each point. After the assignment was completed, she printed it out and uploaded the work to her school portal.

![Figure 2: Brainingcamp, Graphing](image2)

With the increased availability and format of online calculators as well as physical ones, it is hoped that teachers are judiciously incorporating these tools into the curriculum. Online calculators which do not automatically provide a solution or can be set not to do so can be a very valuable tool offline or online for a student with dysgraphia. Using a physical or online calculator with a tape readout allows even a young student to solve problems and simultaneously show understanding in class in a similar fashion to her/his peers. (See Figure 3). Two very good online calculators that are also available as apps are [CalTape Paper Tape Calculator](https://appstore.calculatoria.com) and [Soulver](https://www.soulver.com). As of this publication date, CalTape is $5.99 and Soulver is $34.95, and both are one-time prices. Soulver has more options, such as color coding. Depending on needs, they are both well worth the cost.

![Figure 3: CalTape Paper Tape Calculator](image3)

An additional free online calculator with a tape is [Calculatoria](https://www.calculatoria.com). It works well side by side with an online textbook or workbook as it can be sized accordingly. It can be used as a basic or scientific calculator and works on tablets as well. Each individual tape can be downloaded and/or printed and, since the student can easily show his/her name, page, date, and problem number, the pages can easily be organized to turn in if a paper assignment is needed. Figure 4 shows an example of how an elementary student might show understanding of two-digit multiplication using this calculator.
Question marks are included to remind students who are working independently on assignments of the steps needed when adding and subtracting fractions and mixed numbers. Each individual step in column one can be copied to column two as needed. In this example, the final answer is already in simplest form. Should the answer require more simplifying, the student can highlight and copy a step from column one. Using this template and adjusting the font size, students can type in problems without having to go back and forth to Equation Editor. With prior instruction, students can fill in the document on the right using the computer keyboard and then print out the work. Those students who do not have access to Office 365 can still complete the work on the whiteboard screen, and the ET can send the completed work to them.

This type of a setup works well when students are learning a new procedure which might otherwise involve listening and writing simultaneously. With the problems that are being used as examples already in view, the student is free to highlight information rather than trying to keep up by taking notes. Similarly, most students today know how to take screen shots. Before going over a sample problem, leave a minute or so for students to take screen shot and open it up on their monitors. This will avoid the need for students to copy the problem and allow them to highlight, an easier task for many students with dysgraphia. Many of today’s laptops and tablets use touch screens and/or stylus. In the author’s experience, students with dysgraphia sometimes have an easier time with these aids, especially the touch screen. A minor drawback is that since the size of a laptop/
tablet monitor is small, it probably means that only one or two problems can be solved on a screen. For those students who want to use a stylus, the additional aid of a pencil grip can help.

Another example using Equation Editor in Word is shown in Figure 6. By putting the “Type equation here” on the top right/left side of the page, the student can copy that box each time she/he wants to solve the problem, regardless of the length. In this example, the special character viewer was left on to help the student with alignment when copying. This figure was set up so a student could solve word problems from a classroom workbook found at Internet Archives.

Graphing is another area that can be very difficult for students with dysgraphia. Using customizable online graph paper or apps allows students to use more gross motor movements (arms instead of fingers) as well as a larger area within which to work. Two common online graphing sites are Desmos and GeoGebra. Both of these are free apps, provide a good deal of flexibility, and have activities included. Some other good sites to help make graphing easier include BrainingCamp: XY Coordinate Plane and pdfFiller. (Figure 7).

pdfFiller is an example of a nice online graphing site. In this case, the circles for A, B, and C had already been placed. Using the open type of circle helps a student focus more easily on the needed grid location. The student then used the app text tool and her laptop keyboard to label the coordinates. Next, the line tool was used to connect the points. A dotted line helps guide the student while drawing the straight line. Color-coding is also available, as are sticky notes for any questions or explanations the student may have.

Some other areas to think about when working with students with dysgraphia include using a protractor, a ruler, drawing/measuring shapes, and determining angles. There are a number of websites that can help in these areas. Two well-known sites are Desmos and GeoGebra. Both of these sites have a wealth of material, tutorials, and pre-made activities. Teachers can also create their own lessons and/or edit others that have been posted.

Some additional sites are:

**Mathswhiteboard** [https://mathswhiteboard.com/](https://mathswhiteboard.com/)

**Heyhi** [https://www.heyhi.sg/](https://www.heyhi.sg/)

Both Mathswhiteboard and Heyhi work well with Zoom, and Heyhi is also an option for Zoom as you can invite participants. I inserted my figures from Mathswhiteboard Blankpage into Heyhi and then shared that screen with a student on Zoom. By doing this, I can add pages and also annotate without having everything move around when I scroll the screen or resize it on Zoom.

**Graspable** [https://activities.graspablemath.com/](https://activities.graspablemath.com/)

This is a relatively new website and deserves watching. It is aimed at middle and high school algebra and can also work with GeoGebra. Once the developers include the ability to write mixed numbers and solve problems vertically, it might also be quite useful for younger students. There is a slight learning curve, but the video tutorials are very helpful and clear. Numbers are moved by dragging the digits and/or variables. Once a lesson has been created (See Figure 10a), a link is sent to students who then can log in with a code to access and solve the problems. (See Figure 10b.)
Video links for Graspable:
https://graspablemath.com/learn/gesture-library?page=0
https://www.youtube.com/watch?v=JfNkVG4WgYQ&t=206s
https://www.youtube.com/watch?v=ccqFVeRt2WI

Mathshare https://benetech.org/our-work/mathshare/
This site also is in process and requires a learning curve but not a steep one. It is one of my favorites as an ET and also for students. It has good tutorials and easily adaptable settings. It is especially helpful for students who have worksheet assignments as they can create their own problem set while doing their homework.

Mathshare for Students Webinar: https://www.youtube.com/watch?v=qUKDF2XcBk4. Figure 11a-e shows various examples of how the website works.

In closing, it is hoped that along with introducing readers to various ideas and tools, they are also sparked to think outside of the box as we all learn more about integrating technology into the math curriculum.

REFERENCES

Nancy Bley, MA, ET/P, is a special education consultant in the West LA area. Previously, she was Academic Dean at Park Century School, an independent school for students with learning disabilities. She works with Hayutin & Associates in Santa Monica as an educational therapist and does some curriculum training. She continues to maintain a small private educational therapy practice working with a variety of ages and grades from 1st grade through high school. Her areas of specialty are math, technology, reading, writing, study skills, and executive functioning. Nancy has presented at numerous conferences including IDA, LDAA, BDA and AET. The 5th edition of her book *Teaching Mathematics to Children with Learning Disabilities* was published in February 2019.