

# Tutoring Markus in Math

*External Executive Function Supports, ADHD, and Long Division*

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**MEET MARKUS.** He is a fourth-grade boy with ADHD who attends an elementary school in Colorado. He is athletic, enjoys trampoline time, and likes Harry Potter. He does not like math. Our tutoring time takes place on the floor, where he often rolls around and picks at the carpet. Sound familiar?

As an executive function tutor, I help students like Markus. The defining question of my work is: “How can I help students with ADHD manage school and learn in ways that work well for them?” Because I teach content, I often address self-regulation issues in real time on specific learning tasks. In what follows, I share Markus’s story and how I redesigned a learning aid to support his executive function problems in long division.

## **Executive function supports matter**

I work with students in the late elementary and middle school years. These are prime years to build the self-management skills that are foundational for future academic success. Students have

the chance to learn, practice, and refine skills before they get to high school. My ADHD student roster runs the gamut: from disorganized sixth graders to student athletes. A meaningful portion of my students have 504 and IEP accommodation as well as comorbidities, like dyslexia. They are a colorful bunch, to say the least.

Students with ADHD do not always respond well to traditional teaching methods, and they require tailored executive function support to help them complete tedious or highly detail-oriented, non-preferred tasks. For example, highly effective study strategies like spaced repetition require sustained effort over time—an Achilles heel for ADHD students. My approach is influenced by the external executive functions concept championed by Russell Barkley. I borrow from executive function coaching strategies and use planners, reminders, and daily to-do lists with my students.

External executive function supports can help students with a variety of self-regulation issues. Rather than remembering a procedure or giving up because of perceived effort barriers,

checklists break tasks into steps that reduce demands on memory, attention, and inhibition. By opening the external world to scaffolded and design interventions, Barkley's insight gives practitioners an arena in which to explore solutions. But not all external executive function supports are created equal.

We return now to Markus as he learns long division and how I innovated on external executive function supports that his teachers wisely introduced.

### Markus's long division challenge

One afternoon Markus brought home a worksheet with three- and four-digit division problems. He could solve one- or two-digit problems but would lose his place in three- and four-digit problems. He would forget where to put the division answer (at the top) and the result of the multiplication (below). He was adept at the subtraction and bring-down steps.

In our next session, he proudly repeated a catchy mnemonic device that his teachers gave him: Dead Mice Smell Bad. It stood for division, multiplication, subtraction, and bring down—which is a common set of arithmetic procedures that chunk long division into discrete steps. Catchy mnemonic devices simplify the amount of things to remember and may reduce working memory demands, which is a core challenge for ADHD students.

While useful, the mnemonic device fell short of expectations. When Markus showed me how he used it, he wrote D M S B in block letters on a separate section of the paper. As he worked on the math problem, he would look at the letters and place a dot below the letter that corresponded to the step he was on. Then he would go back to the division problem, try to remember his location in the problem, and then complete the step. He would shift his attention and his body position as he moved between the division problem and the mnemonic device. Not only was this slow, but he would still lose his place and show uncertainty about where to write numbers.

## Quick Tips

- Mnemonic devices help students remember information and steps.
- Mnemonic devices are steppingstones to internalizing procedures.
- When introducing mnemonic devices or other external supports, note the gaps in the procedure that the mnemonic device omits.
- Observe students as they use the external aids.
- Redesign external supports to minimize executive function problems like task switching and working memory demands.
- Carefully fade the supports to help students internalize the procedure.

### A mnemonic device misfire

As I observed him, the problems became clearer. First, he was splitting his effort between the math problem and the mnemonic device, essentially juggling two problems at once. Second, he flipped between reading his mnemonic device horizontally and doing the math problem vertically. Third, he often forgot where to put the answers to the multiplication and division steps, an aspect that the mnemonic device did not cover. Fourth, he had become heavily reliant on the dot system to remember his place.

I had to build a learning bridge for Markus. I can often just drill long division with students, but Markus's executive function issues required more. This is what I did.

### Building a bridge to learning

I set up our workspace differently. Instead of writing out D M S B on a distant corner of the paper, I used four notecards. On each card I put the corresponding bolded letter D, S, M, or B and a diagram of that part of the procedure. I placed these next to the division problems in a vertical orientation.

I instructed Markus to write the part of the mnemonic next to the section of the problem he was working on so that when he finished looking at the notecard, he could use this letter as a memory cue. Next, we practiced about two to three problems between movement breaks. Lastly, I scaled back the length of the problems to two- and three-digit long division problems. After several one-hour sessions, he became more skilled at long division.

### Fading support

As Markus progresses, it will become important to reduce the scaffolding and support without jeopardizing his ability to complete long division. Furthermore, at some point, it will be valuable for him to learn about the conceptual benefits of long division so that he can use long division to solve challenging word problems with tricky remainder interpretations in fifth grade.

The goal of my work was humble: to redesign the mnemonic device to reduce executive function interference and get it to a place where parts of it can be removed incrementally. One day, Markus should be able to complete long division problems quickly from memory. Long division word problems with tricky interpretations of the remainders await him next year. **A**



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### RESOURCES AND ADDITIONAL READING

Henning C, Summerfeldt LJ & Parker JD. (2022). ADHD and academic success in university students: the important role of impaired attention. *Journal of Attention Disorders*, 26(6), 893-901.

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Colzato LS & Arntz FE. (2017). Ritalin. In LS Colzato (Ed.), *Theory-Driven Approaches to Cognitive Enhancement*. New York: Springer.