S8E106: Using Math Journals and Games

Intro quote: School and society teach us to view mathematics as a race. You run as fast as you can from one topic to the next. But let me give you a new vision of mathematics. I want you to think of math as a nature walk. There's a whole wide, wild world of interesting things — more ideas, more patterns, more concepts than you and your children would ever have time to study. And everywhere you look, there's something cool to discover.

----Denise Gaskins, from *312 Things To Do with a Math Journal*

Outro quote: This is how mathematics works. Mathematicians notice something interesting about certain numbers, shapes, or ideas. They play around and explore how those relate to other ideas. After collecting a set of interesting things, they think about ways to organize them. They wonder about patterns and connections. They make conjectures and try to imagine ways to test them. And mathematicians talk with one another and compare their ideas. In real life, math is a very social game.

----Denise Gaskins, from *Prealgebra & Geometry: Math Games for Middle School*

Can you tell us what a math journal is? And also explain why children should write about math?

Just as a nature journal records our children's explorations and discoveries in nature, so a math journal tracks our children's explorations in the world of mathematics.

In a math journal, children record their experiences with numbers, shapes, and patterns through drawing or writing. Journaling teaches them to see with mathematical eyes — not just to remember what we adults tell them, but to create their own math.

The process of writing forces children to pin down their thoughts, to transform nebulous concepts into firm ideas, to struggle with vagueness and build understanding.

As William Zinsser says in his book *Writing to Learn*: "Writing is how we think our way into a subject and make it our own. Writing enables us to find out what we know, and what we don't know."

Through journaling, children develop a richer mathematical mindset. They begin to see connections and grow confident in their ability to think through new problems.

What makes a good journaling prompt?

A good journaling prompt invites children to take any rabbit trail that interests them and discover whatever they will, without worrying about grades, testing, or state standards.

A typical school math book asks questions where the teacher always knows the answer. But journaling prompts ask questions for which we adults do not know the answer because the topic gets filtered through each child's own mind.

For example, one of the prompts in *Logbook Alpha* asks students to explore triangular numbers. Just as square numbers are the numbers of blocks that can make a square shape, triangular numbers show up when we arrange bowling pins in a triangle. Which numbers can make triangles, and which cannot? What patterns can you discover in the triangular numbers?

The journal prompt is not a lesson to be learned. Even with research prompts that require a student to seek out historical information, there is no specific thing we want them to see. It's more like a directed nature exploration: "What can we find hiding under this log?"

We're building awareness, helping children see that there's more to mathematics than they realized.

Can you give us some (more) examples?

Math prompts may include number play, math art, story problems, mini-essays, geometry investigations, brain-teasers, number patterns, research projects, and much more — even poetry.

For example, an essay prompt may ask students to explain how they solve math problems. A number play prompt might pose a puzzle for investigating number relationships.

Or a math art prompt may draw attention to the shapes and angles within a certain pattern, and then ask students to create a related design of their own.

One of the prompts in *Logbook Delta* asks students to create an octagon by connecting any 8 dots on grid paper. Most of us think of octagons as the stop-sign shape, but ANY closed shape with 8 straight sides is an octagon. The lengths of the sides or sizes of the angles may vary. The shapes may be convex or concave. Some octagons will tessellate, while others will not.

Children of different ages come to the task at their own level and explore their own ideas. Everyone may learn something different, but they all grow as mathematicians.

[Interior angle sum = 1080.]

As you know, our focus for this podcast is the educational philosophy of Charlotte Mason. To that end, would Charlotte Mason play math games?

Mason encouraged oral work over written assignments in the early years. Games are oral math for all ages, not just young children.

Games build mental math skills and develop a different, more flexible approach to math reasoning compared to workbook assignments.

Games are fun, building a positive attitude toward math. They give students a refreshing break from textbook work and make kids willing to practice their math.

But more importantly, math games push children to THINK about the relationships between numbers, shapes, or patterns — to reason about what math means and how it works.

What makes a good math game, and why should we play them?

Just as we avoid twaddle in our children's reading, we need to recognize and avoid twaddle in math. Games that emphasize speed and rote memory are twaddle.

A good math game offers children choices and makes them think. It reinforces the idea that math is about reasoning, using the things you know to figure out what you need.

For example, one of the games in *Logbook Delta* is called Pig. Some of your listeners may know the game. Players take turns with a die, rolling it to add to their score.

You can roll as many times as you like in each turn, but beware that if you roll a 1, you lose all the points you added during that turn. The first player to reach 100 points wins.

Playing the game will give children practice with addition, and it encourages them to think about probability. They have to make decisions based on their own risk tolerance, which is an important life skill.

How can games drive deeper learning?

Math gaming has a cyclic rhythm, as students dig more deeply into the ideas.

Level 1: Play a game for fun.

Level 2: As the game becomes more familiar, play it for strategy, and write in your journal. What moves increase your chances of winning?

Level 3: Notice things about the game, patterns or relationships that appear repeatedly. Wonder about extensions of the game, or of your strategies.

Level 4: Create a math game of your own by modifying the rules to see what happens. Mathematicians love to tweak games (or other math problems) just to see what changes. This is how the world of math grows, constantly building new ideas that branch off older concepts.

Level 5: Share your new game by playing it with friends. This brings you back around to Level 1, playing just for fun.

This cycle usually runs for several days or longer. Be sure to give students plenty of time to enjoy the game, before analysis ruins the fun of playing. Never rush that first stage.

Now let's talk about the math our kids really need. What's wrong with traditional math as primarily approached taught today?

We tend to give children rules to solve math problems. We suppose that if they follow our rules, they'll be fine. But think about the math you learned in school. Did all those rules get jumbled in your mind?

We stack "Do this" on top of "Do that" — higher and higher until the whole system comes crashing down — and then we say, "Oh, I'm just not a math person."

What students REALLY need are a few basic principles and the ability to reason, to draw their own conclusions about how math works.

Children don't need to know how to solve 3,762 ÷ 58 without a calculator. But they DO need to understand how to make sense of 36 divided by 6, and how to use that relationship to reason about related problems like 36 ÷ 12 or 3600 ÷ 60.

Children don't need a method for calculating $^{89}/_{315}$ of 72 by hand. But they DO need to understand one-half of 72, and to know how that connects to one-fourth, one-eighth, and other fractions, so they can use such relationships to make sense of something like 75% of 720.

The math that matters today is our ability to recognize and reason about numbers, shapes, and patterns, and to use the relationships we know to figure out something new.

Do we need to change our curriculum?

No, we don't need to change our math curriculum. We just need to change the way we use our textbooks, and the way we see math itself.

We talked about this a bit in our last podcast chat. If we change our own attitude towards math, that sets the right atmosphere for our homeschooling. And then we can use any math curriculum the Charlotte Mason way.

Human minds are not computers. We can't give our children a program to store and expect them to recall it on demand. Human minds only remember what they think about. And the deeper we think, the stronger we learn.

If we want children to understand math, to build true fluency, then we need to get them thinking deeply and making sense of the subject. We need to start where they are and help them learn to reason about the numbers.

The problem with giving our students rules and procedures is that we are giving them permission NOT to think. All they have to do is follow instructions.

I've posted a series of blog posts called "If Not Methods" about how we can get children to reason about tough math topics without just handing out rules. For example,…

$2\ ^{5}/_{12} + 1\ ^{3}/_{4}$

Suppose our children got stumped on a mixed-number calculation like $2\ ^{5}/_{12} + 1\ ^{3}/_{4}$.

We might begin by asking them to look more closely at the puzzle. Pretend this is a new plant we just discovered. What could we write in our journal?

As we take turns noticing details and wondering about this problem, we might say things like…

- I notice addition, so the answer will be greater than either of the original numbers. I wonder, does addition always make numbers bigger?
- I notice the sum has to be more than the whole-number parts, $2 + 1 = 3$, so the answer must be more than 3.
- I notice that $^{5}/_{12}$ is almost a half, and $^{3}/_{4}$ is more than a half, so I predict the answer will be a bit more than 4.
- I notice that this would be easier if the fractions had the same size of pieces, the same denominator.
- I know that $^{3}/_{12}$ is the same as $^{1}/_{4}$. So $^{5}/_{12}$ is the same as $^{1}/_{4}$ plus two extra twelfths.
- I wonder, would drawing a picture help?

This process of working through the idea will lead to growth, building our children's thinking mindset that serves as a foundation for future learning.

What else would you like to share with our audience before we close this episode?

Once upon a time, mathematics was considered a liberal art — an important part of any well-rounded education. Artists painted images of the angelic ladies Arithmetica and Geometria sharing their wisdom with human scholars.

Somehow, over the centuries, math lost its connection both to wisdom and to art. Now, too often, the school math curriculum forces students on a relentless treadmill from kindergarten to calculus.

And far too many parents feel unable to help their children learn. They worry about their kids falling behind, which raises the stress level to the point of tears. Mom and Dad are frustrated. The child is discouraged. Doing math homework feels like stumbling through an emotional minefield.

How can we help our children step off this treadmill and rediscover the liberal art of mathematics? Math journaling lets us focus on creative thinking about numbers, shapes, and patterns.

Imagine the freedom of no longer worrying about speed and memory. Instead, our children can dive head-long into the deeply refreshing waters of reasoning and problem-solving.

If you add math journals to your homeschooling repertoire, I think you'll be surprised at how much fun thinking hard can be.