Review of Mathematical Imagining: A Routine for Secondary Classrooms by Christof Weber

Geoff Krall
University of Wyoming

BOOK REVIEW

Abstract: This book review of Christof Weber's *Mathematical Imagining* yields insight into the routine of mathematical imagining and offers practitioners advice on how to incorporate the routine in the classroom. A brief summary of the book is provided, followed by commentary on potential benefits of mathematical imagining, connection to other research, and suggestions for accommodating for emergent bilingual students. Readers are encouraged to follow up with a reading of the original book.

Keywords: mathematical imagining, problem solving, creativity, book review

> ***"Imagine a ladder*** *in a light and empty room…*
>
> *Take the ladder and lean it closely against a wall…*
>
> *A light bulb is attached to the middle of the side rail you are facing. Darken the room and turn on the light bulb. You see it shining as a point of light…*
>
> *The bottom end of the ladder continues to touch the wall and slides down it. When the top touches the floor, the ladder stops and comes to rest…*
>
> *What is the shape of the trace of light that the bulb 'draws' in the darkened room as a result of the ladder's sliding?*
>
> *What did you imagine during this exercise in Mathematical Imagining?" (p. 132-133)*

This is the script from a task from *Mathematical Imagining: A Routine for Secondary Classrooms* by Christof Weber (2020). Many recent

changes around mathematics instruction are geared toward technologizing the mathematics classroom: incorporating video, instant computer-aided feedback, using applications, and so forth. Weber provides a routine that relies on students' imaginations to construct mathematical meaning and knowhow. This book review provides a discussion of the routine itself and potential benefits and challenges to implementation in a secondary mathematics classroom.

DESCRIPTION OF ROUTINE AND BOOK

In a mathematical imagining routine, the teacher prompts students to imagine mathematical scenarios intentionally and carefully. Weber provides the following phases:

1) Imagining Phase
2) Journaling Phase
3) Discussion Phase

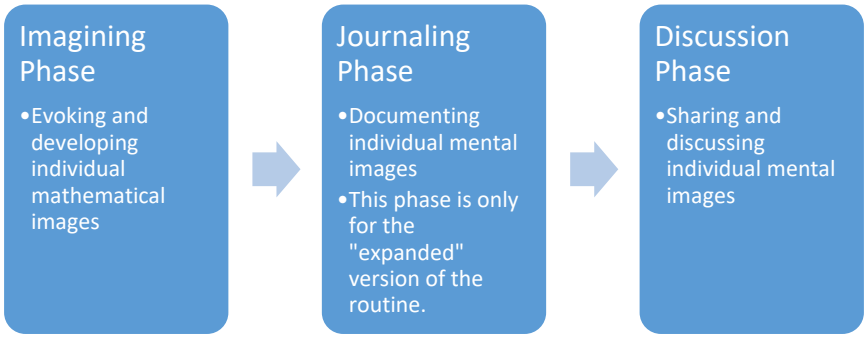

Figure 1. The three phases of the expanded mathematical imagining routine.

The middle, journaling phase may be used in the "expanded" version of the routine (as opposed to the "minimal" version), when images are particularly complex, or when it would be useful to discuss using drawn pictures or accompanying text.

Using multiple examples of "simple but rich tasks" (p. 3), Weber walks the reader through each phase. Weber also provides practical advice when beginning to undertake routines of mathematical imagining. He encourages teachers to allot time in class regularly so students become used to the routine; and to be comfortable with a little student giggling at the beginning. After a few rounds of mathematical imagining students can grow comfortable and be excited to participate.

Weber provides a rubric for mathematics content that may be well-suited for mathematical imagining:

- Content that is simple, yet rich,
- Content that can be visualized, and
- Content that can be embedded in everyday contexts of objects and actions.

In the second half of the book, Weber provides the reader with over 30 examples of mathematical imagining routines, with facilitation notes, a potential script, and possible avenues of discussion. He partitions the examples into four types of mathematical activities:

- Construction tasks
- Problem-solving tasks
- Reasoning tasks
- Paradox tasks

In Table 1, I have summarized each of these task types, with select examples of associated mathematical imagining tasks.

Table 1: Four Types of Imagining Tasks, Descriptions, and Select Examples provided by Weber (2020)

Task type	Description	Examples
Construction	Construct mathematical objects and explore its features.	Use imagined checkers to create understanding of "triangular numbers" (numbers that are the sum of consecutive natural numbers, starting with 1). Cut off the corners of a triangle to form a hexagon.
Problem-Solving	Make conjectures and test hypotheses.	Visualize patterns of matchsticks to create algebraic expressions.
Reasoning	Construct arguments or informal proofs.	Visualize building blocks to prove that for positive numbers a and b $a^2 + b^2 < (a + b)^2$.
Paradox	Construct contradictory images or scenarios.	Imagine what to do when new guests show up at a hotel with an infinite number of rooms and no vacancy.

While many of the routines draw heavily on spatial geometry, the example activities Weber provides also address concepts of algebra, number sense, and arithmetic.

MATHEMATICAL IMAGINING AND PROVIDING AN AVENUE FOR AGENCY

Mathematical Imagining provides a pathway for student agency. While many pedagogies implore teachers to let students be agents of their own learning, Weber provides a routine that fundamentally centers the student as the central doer and knower of math. By its very nature, students are in control of the mathematical scenario.

Each routine concludes with the question "what did you imagine?" In the discussion phase of the routine, students share what they saw with their peers. They may be encouraged to draw or journal what they imagined. Weber encourages teachers to reframe questions: from "how many sides does a triangle have" to "how does a triangle look in your mind's eye?" (p. 33). These simple prompts can flatten the hierarchy of the classroom: the teacher is no longer the sole agent of mathematical ideas.

MATHEMATICAL IMAGINING AND MINDFULNESS

Mathematical Imagining is a complement to mindfulness. Recent research has illustrated that students' abilities to learn new information requires a relaxed state of mind (Hammond, 2014). Mindfulness exercises can help students achieve such a state which can help them learn new information. Consider the following instructions from the beginning of one of Weber's routines:

> *"Pay attention to your breathing for a moment. Don't change it -- just be conscious of how air is flowing in … and out of your lungs … And now, we can begin with our imagining task." (p. 18-19)*

Without naming it, Weber gives teachers a path to enact mindfulness in the mathematics classroom.

COMPLEXITY AND CLARITY

Some of the mathematical concepts Weber provides in the book are complex (for example visualizing $a^2 + b^2 < (a + b)^2$, see Table 1). Still, there is value in exploring the concept first, even if the concept mismatches from the teachers' intent. Such activities require the teacher to become a "curious researcher," (p. 33) exploring students' visualizations. Weber acknowledges that lessons may not always go as planned. For imagining tasks that may be more challenging, Weber recommends supplementing the visualization prompts with written instructions for students or even drawing the initial setup.

Weber's routine is, by nature, heavy on vocabulary, syntax, and sentence structure, which may represent a challenge for teachers in linguistically diverse classrooms. Emergent bilingual students and their teachers are familiar with pertinent dual language vocabulary and cognates. Additional pre-work to seek out such dual language vocabulary or

repeating the prompts in students' native languages may help with the complexity of mathematical imagining.

THE MENTAL MATH TALK ROUTINE SECONDARY TEACHERS HAVE BEEN WAITING FOR

When I facilitate professional development, I often incorporate number talks to showcase there are often multiple, equally brilliant ways of approaching a math task. Middle and high school teachers are left enjoying the activity but clamoring for routines that address their content standards. It appears, at last, that secondary teachers have their own version of number talks: a routine that celebrates individual brilliance and novelty while fostering conceptual understanding and discourse.

Christof Weber's *Mathematical Imagining* provides a fascinating a new way of exploring mathematical concepts to secondary students. It is a unique routine that is worth exploring for your classroom.

REFERENCES

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Author: Geoff Krall is a PhD student for Math Education at the University of Wyoming. He is also a part-time instructional coach, supporting math teachers to develop inquiry-based practices. He is the author of *Necessary Conditions: Teaching Secondary Math with Academic Safety, Quality Tasks, and Academic Safety* from Stenhouse Publishers and writes frequently about math instruction on his website, emergentmath.com. Geoff can be reached at gmkrall@gmail.com and is on Twitter at @geoffkrall.

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