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A Review of Ben Orlin's *Math with Bad Drawings*

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From cover to cover, Ben Orlin's *Math with Bad Drawings* is modest. By this we do not mean to suggest that the book underwhelms in its contributions to the popularization of mathematics. In fact, we take the exact opposite as true, and the commendations from prominent popularizers of mathematics such as Steven Strogatz, Hannah Fry, and John Urschel that are printed on the book jacket provide us ample evidence. By modest we mean the book cloaks its potent insights on mathematics and mathematics education in self-effacement. Of course, this modesty is entirely intentional, and employed by Orlin with pinpoint precision. As a result of his winsome trope, which developed from its early days on his blog, he manages to take a subject ignored by a large subsection of the population and unfurl it through his unique mixture of self-proclaimed "bad" drawings, quippy narrative, and acute insight into the intersections of mathematics, mathematics teaching, and society.

The book addresses, but is not limited to, topics that appear in typical school mathematics standards (including geometry, probability, and statistics). Each of these three categories is the subject of a section of the book, with each section composing several deep dives into scenarios inspired by the mathematical discipline. For example, in the geometry section, Orlin explores the geometry of paper sizes, and the probability section looks at wacky variations on insurance. Throughout each section, his drawings serve as clever invitations to readers to engage with the mathematics. After all, if an author who claims to be bad at

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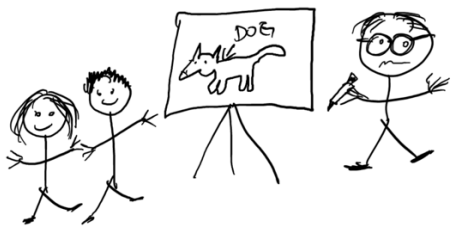
drawing can be so audacious as to publish a book filled with drawings, can't we be so bold as to read a book about mathematics?! While we contest his claim that his drawings are, in fact, "bad" (Figure 1), it is this unassuming tone that truly creates a book written for the general public, one that can be enjoyed by those, like ourselves, with a background in mathematics, but also by someone with a passing interest in mathematics, someone with an axe to grind with their mathematical past, or someone with a morbid curiosity in mediocre artwork. We hold little doubt that this broad appeal emerged from Orlin's history as a classroom mathematics teacher, a setting in which he repeatedly grounds his anecdotes. In fact, a good portion of the introduction to the book is seemingly written directly to his students—past, present, and future—with a mixed tone of admiration and apology.

Figure 1. A legitimately bad drawing inspired by Orlin's "bad" drawing on page 3.



In this review, we, as mathematics educators, wish to interpret Orlin's past as a mathematics teacher as more than a simple contribution to the book's undeniable charm. Rather, we propose that Orlin's time in mathematics classrooms, and involvement with the field of mathematics education in general, influenced the work beyond the inclusion of some topics from the school mathematics standards. From the very opening line of the book, which claims that "this is a book about math" (p. 1), Orlin's contribution to the popularization of mathematics might also be considered a text in the popularization of mathematics education. This is where we present two themes that suggest that it is not a bridge too far to consider *Math with Bad Drawings* as a book about mathematics education.

First, *Math with Bad Drawings* is composed in much the same manner as many popular textbooks we have chosen for our courses in methods in mathematics education at the primary, middle years, and secondary levels (e.g., Brahier, 2013; Small, 2017; Van de Walle et al., 2018). It should be noted, however, that no methods textbook that we are aware of manages to present curricular topics with such flamboyant imagery (which Orlin accomplishes by anthropomorphizing the measures of central tendency and illustrating the mathematics of scaling with references to Dwayne "The Rock" Johnson and pans of brownies, among other examples). A text in undergraduate mathematics education typically begins with a discussion of wide-lens questions pertinent to the mathematics classroom. These introductory sections attempt to address questions like, "What is mathematics?", "How do we learn mathematics?", and "What is the role of the teacher in fostering this learning?" This is typically done with a theoretical grounding in constructivism, and mathematics is presented as an active pursuit of making sense, where learning becomes the process of constructing that sense in mathematical contexts, and the teacher takes on the role of facilitator of those contexts. Coupled with these themes, introductory sections usually contain chapters on preparing lessons, addressing a wide range of abilities in the classroom, and assessing students' mathematics.

Orlin begins with these same themes in his effort to popularize mathematics (and mathematics education). In fact, many of his introductory themes are supported with direct references to grade school classrooms. His view of mathematics is juxtaposed to the world he participated in as a schoolteacher, one that "took a beautiful, imaginative, logical art, shredded it into a bowl of confetti, and assigned students the impossible, mind-numbing task of piecing the original back together" (p. 1). Scathing, yet effective, commentary to say the least. Orlin's introductory chapters, flowing from his experience in the school mathematics classroom, effectively addresses the question, "What is mathematics?" by comparing the view of a mathematician with the image of mathematics presented *en masse* in math class. He even goes as far to pen a short apology to his students, complete, of course, with a collection of self-depreciative jabs and "bad" drawings. However, if one wades through the harsh and upfront rhetoric, it is possible to decipher the exact same message that exists in the introductory chapters of methods textbooks: We are doing it wrong.

After establishing the principles of teaching and learning mathematics, it is typical for a textbook in mathematics methods to then narrow its focus to specific strands of mathematics that exist in the standards. Chapters organized around the topics of number, fractions, proportional reasoning, algebra, geometry, and statistics (among others), each presenting problems, discussing pertinent research, and discussing the development of student thought in the area. Orlin takes a similar approach, with sections two, three, and four focusing on the topics of geometry, probability, and statistics, respectively. Sure, these content-focused chapters don't include lists of problems in tandem with student responses that you might expect from a standard textbook in mathematics methods. Instead, he illustrates the power of the mathematical content through collections of anecdotes that oscillate on the cusp between reality and imagination (e.g., using coin tosses to model the human genetic code). Nevertheless, Orlin, like the authors of many textbooks, moves the book from the general to the particular.

Near the end of the book, Orlin moves into discussions of mathematical content not necessarily present in the mainstream school content standards. In this fifth and final section, he discusses topics like economics, the electoral college, and chaos theory. This parallels the structure of some textbooks in mathematics methods (e.g., Posamentier & Smith, 2015) that include a series of enrichment units designed to be used as differentiation tools in the classroom. In both cases, the authors of the books end with intriguing possibilities to extend the possibilities. Orlin, presumably, aims to extend what people consider as "mathematics" with this last section, while math education authors aim to extend mathematical possibility outside of the classroom walls and school standards. We see these two goals as having much more in common than in difference.

Second, Orlin situates the book, through the introductory section discussed above, as a sort of response to the issues that he sees, and has experienced firsthand, with the public's impression of mathematics. While doing so, he points the finger directly at the way mathematics is encountered in schools and writes about many themes that parallel important lines of inquiry in the research of mathematics education to this moment. This, we feel, is further evidence that *Math with Bad Drawings*, although filled with whimsical

explorations into mathematics, is actually motivated by many prevalent themes in mathematics education.

For example, one of the most dominant themes Orlin addresses is the lack of conceptual understanding in school mathematics, and, by extension, in the public's impression of mathematics. This same theme has sat at the very core of research in mathematics education reform for decades (e.g., Skemp, 1976), and has served as a driving mandate for large organizations such as the National Council of Teachers of Mathematics (NCTM), which forefront conceptual understanding as a core principle of school mathematics (NCTM, 1989, 2000, 2014). Orlin pushes against a hyper-instrumental (again, see Skemp, 1976) version of mathematics where "mathematical symbols don't symbolize; they just dance across the page in baffling choreography" (p. 20). He does so by connecting the mathematical content (e.g., expected value) to a meaningful—yet obscure—context (e.g., shipwreck insurance). When we look at Orlin's stories through a lens of math education, the driving, punchy narratives are aimed at accomplishing more than just spicing up the same, disconnected cannon of mathematics. Throughout the book, the importance of conceptual understanding sits at the very core of his message, and, as it so happens, this same message sits as the driving force of mathematics education reform.

Subsumed in his message on conceptual understanding, Orlin touches on other important topics in mathematics education research. He illustrates how mathematical thought advances on the back of posing new parameters in old contexts, of searching out differences that make a difference (Bateson, 1972; Brown & Davis, 2004). He tries his hand at defining what makes a task a rich one (see Griffin, 2009), and speaks about mathematical creativity (see Leikin & Pitta-Pantazi, 2013), ultimately settling on the definition that "creativity is what happens when a mind encounters an obstacle" (p. 13). Many of his inventive contexts then go about doing just that: constructing obstacles—facilitating difference—for us, as readers. We see these as acts of pedagogy.

Orlin also engages with important social themes in mathematics education that are getting increased attention. Early on, he addresses his distaste for the gatekeeping role of school mathematics, where achievement in mathematics becomes a torturous rite of

passage—a "weightlifting stunt, a pointless show of intellectual strength, a protracted exercise in résumé building" (p. 2). In other words, just jump through a hoop or two and more colleges will welcome you with open arms. Orlin's opinion of the gatekeeping role of school mathematics is reiterated in the research in mathematics education (e.g., Stinson, 2004), and these accounts have been expanded on in other popularization attempts (e.g., Hacker, 2010).

Complicit in the gatekeeping efforts, and arguably at the very core of the exploit, is the culture of testing that permeates every corner of school mathematics, sending very clear and definitive messages to students (see Lockhart, 2009). Orlin once again aligns himself with the research in mathematics education when he claims that school mathematics, through its obsession with regular, timed, individualized testing, "sends a loud, clear message: *Speed is everything*" (p. 39), and advocates for a mathematics that is replete with good questions, opportunities to work alongside one another, and, of course, bad drawings. In light of the above evidence, we feel it fair to argue that *Math with Bad Drawings* goes beyond engagement with central issues in mathematics education. We claim that the book is born from, and aligned to, the central issues in the history of mathematics education research. This situates the book to be interpreted as a text in the field.

In summary, Orlin presents a playful and delightful image of mathematics, and we consider the book not only mathematically enjoyable, but educationally profound. However, the real success of the book, for us as mathematics educators, is that he manages to draw the reader into it. That is to say, that even though Orlin is writing about mathematics, we, as mathematics educators find it impossible to avoid reading into how Orlin expertly establishes the conditions for this exploration. That irresistibility, we contend, is not only a characteristic of a book intended to popularize mathematics; it is the mark of a successful piece geared at the popularization of mathematics education.

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