Introduction

> *My enthusiasm for mathematics was based principally perhaps on my horror of hypocrisy. . . . In my opinion hypocrisy wasn't possible in mathematics and, in my youthful simplicity, I thought the same went for all the sciences in which I had heard it said they were applied. What then when I realized that no one could explain to me how it is that a minus times a minus equals a plus* $(- \times - = +)$?
>
> *The Life of Henry Brulard* (Stendhal 1890)

> *An interest in history marks us for life. How we see ourselves and others is shaped by the history we absorb.*
>
> *The Crest of the Peacock: Non-European Roots of Mathematics* (Joseph 2011, p. 1)

An unspoken assumption exists that elementary math concepts are not that complex and that they are fully understood by the qualifying teachers who graduated from high school. Many of the professional development opportunities available for teachers are aimed at answering *how* to teach mathematics—few of them focus on *what* you teach when you teach mathematics. But elementary mathematics "is an intellectually demanding, challenging, and exciting field—a foundation on which much can be built. Elementary mathematics is fundamental mathematics" (Ma 2010, p. 116).

Middle school teachers are not immune to math anxiety. I know this only too well from my own teaching experience, which started in the intermediate grades with a solid mathematical background from my undergraduate degree. My Bachelor of Education diploma stated that I was qualified to teach in a junior/intermediate division as a mathematics specialist, though I must admit, the program was focused more on the pedagogy and context of delivering curriculum rather than on the mathematical content of it. It is undisputable that "high-quality teaching begins with the teacher's deep subject matter knowledge" (Randall 2005, p. 9), but there is a distinction between *knowledge* and *understanding*. So, when I was teaching intermediate math, I knew the rules and procedures and how to juggle mathematical formulas, but baffling questions kept piling up. Why does a minus times a minus equal a plus? Why is pi an irrational number? Why must you "multiply by reciprocal" to divide fractions? Why is BEDMAS the order of operations? Why can't you divide by zero? There were so many *whys*. I knew how to do the mathematics I taught. I knew the rules, procedures, formulas, and definitions, but I couldnot see the big picture of the mathematical ideas that I was teaching. The words of one of my favorite math bloggers, Kalid Azad, resonated perfectly with me: "Missing the big picture drives me crazy: math is about *ideas*—formulas are just a way to express them. Once the central concept is clear, the equations snap into place" (http://betterexplained.com).

I found the big picture of mathematics in its history. The Scottish mathematician Philip Jourdain once wrote, "But it is as true as it is natural that we should find that the best way to become acquainted with new ideas is to study the way in which knowledge about them grew up" (Jourdain 2000, p. 3). It took me years of studying the history of mathematics and applying its lessons to the concepts of the intermediate math curriculum before the pieces and parts of the big picture of middle school mathematics finally fell into place. The somehow amorphous body of intermediate mathematics transformed into a meaningful, logical, and historically determined structure. Concepts, rules, and formulas became branches of the beautiful tree of mathematics. I started teaching with renewed fun and enthusiasm, and my students, in school and in a teacher-training program, benefited from my enhanced understanding of mathematics.

Pedagogical content knowledge (Shulman 1986) is a blend of knowledge of content, knowledge of pedagogy, and knowledge of context. Knowledge of content cannot be underestimated. Without a deep, meaningful, and connected understanding of the central mathematical concepts, a middle school mathematics teacher cannot claim to possess adequate pedagogical content knowledge. Teaching the concepts without having a deep understanding is a gateway to math anxiety—for yourself and for your students. Knowing the history of mathematics that you teach gives your teaching an additional depth and breadth. Mathematics is a global affair. "Eurocentric" mathematics, as many of us know it, is a myth. Bringing the contributions of mathematicians of the Egyptian and Mesopotamian, Chinese and Indian, Islamic and other civilizations to the classroom is an essential part of culturally responsive mathematics teaching. Giving voice to non-Western cultures that have greatly contributed to mathematics fosters an inclusive and equitable environment in our diverse classrooms. The National Council of Teachers of Mathematics (NCTM 2016, p. 2) issued a call for equity-based mathematics teaching, suggesting some basic questions that teachers can and should ask themselves:

- How open am I to the different ways various cultures think about and do mathematics differently and how culture affects mathematics teaching and learning?
- How do I find ways to incorporate my students' cultures into my teaching and to engage them in rigorous mathematics?

These are big questions. For me, getting acquainted with the global history of mathematics has been an important part in tackling these questions. This book describes the key concepts of middle school mathematics from the perspectives of their historical development. The material presented in this book helped me to build a knowledge base needed to incorporate my students' cultures into my teaching and, at the same time, to engage them in rigorous mathematics. Sustaining culturally responsive pedagogy in math classrooms is a multifaceted endeavor. Using the world's mathematics history in understanding and teaching middle school mathematics proved to be an important piece of bringing culturally responsive pedagogy into my classrooms.

I was inspired to write this book by my friend, a middle school teacher, who once said after one of our math tutoring sessions, "Why don't you write a book? I think teachers would appreciate it."

I sincerely hope they do.

References

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