

Foreword

Designing a Garden Where Seeds can Grow

When I initially read the title to this book, *Planting the Seeds of Algebra PreK–2: Explorations in the Early Grades*, I saw the word *algebra* and anticipated that the pages inside would provide types of algebraic experiences that are appropriate in the early grades (which it does). But, the more I read, the more the opening words *planting the seeds* took on meaning. I am a novice gardener, but my father is a farmer and my parents are both avid gardeners, so I draw from these experiences to illuminate the unique and powerful opportunities this book can provide for teachers and for students in cultivating young students to become good thinkers, strong in number sense and algebraic reasoning.

Landscaping. In landscaping, it is important to select the right plants for the setting and to be sure that the plants complement each other in ways that lead to a garden that effectively can grow and will provide overall beauty. In *Planting the Seeds*, four tasks are selected for in-depth development; they address addition, subtraction, patterns, and special numbers, respectively. These are foundational concepts in K–2. The Common Core State Standards (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010), in an effort to press for a focused curriculum, identify two to four critical areas at each grade level; these include the following:

- Representing and comparing whole numbers, initially with sets of objects (K)
- Developing understanding of addition, subtraction, and strategies for addition and subtraction within 20 (Grade 1)
- Building fluency with addition and subtraction (Grade 2)

These significant concepts in K–2 are then connected to foundational and central algebraic thinking concepts: properties of numbers and operations (looking for structure); meaning of symbols/notations, in particular variables (that may vary or may represent an unknown value) and the equals sign; and connecting patterns to functions to algebra. What these concepts mean and why they are important are explicitly discussed in the chapters following the classroom implementation of the selected tasks (Chapters 2, 5, 8), providing important insights to the broader landscape that is our K–12 mathematics curriculum.

Fertile Soil. In order for our classrooms to be fertile environments for our students to learn, we must have our eye on the mathematical horizon, seeing what concepts relate to or build on each other, and then focusing student thinking on those ideas. *Planting the Seeds* is designed to support teacher learning in a way parallel to student learning. When we teach children mathematics, we begin with concrete explorations that set up the

opportunity to follow up with discussions about the important mathematical concepts; we connect back to the concrete experience to develop an understanding for the more abstract mathematical ideas, and then provide opportunities for students to apply, connect, and extend their new knowledge. *Planting the Seeds* is organized in this way through the organization of its chapters.

The first chapter in each set (Chapters 1, 4, 7) provides the actual concrete experience—an exemplar task or set of tasks taught in a classroom, including visuals, student work, and vignettes. For example, in Chapter 1, we can “see” how finding “partners of 7” can enhance students’ understanding of number combinations, part-part-whole, missing addends, symbols, the commutative property, and making generalizations. In Chapter 4, we experience a lesson in which algebraic thinking is used to expand students’ understanding of what subtraction *means* in order to help them be better at subtracting (what turns out to be a very effective intervention). Finally, Chapter 7 illustrates how repeating patterns can be analyzed and developed to connect to functions, while engaging students in important number relationships. The teacher moves in these chapters illustrate the critical importance of knowing the mathematics in our own garden and in the broader landscape.

As mentioned above, the chapters following each of these chapters (2, 5, 8) discuss the key mathematical ideas, with a particular focus on the connections between number and algebra. Because these discussions relate back to the lesson itself, it is comprehensible, regardless of the reader’s previous understanding of algebra. With a deeper understanding of mathematics (related to the focus task), we are ready to extend our mathematical thinking (or our students’ thinking), which is the focus of the third chapters in each set (Chapters 3, 6, 9). Chapter 10 models this same approach of using concrete experiences to illuminate mathematical concepts and extend understanding in a shortened version intended for parents.

This book structure—from concrete to abstract to application—is excellent for individual teacher learning, collaborative book study (e.g., through a professional learning community), or modified lesson study.

Growing the Seeds. I have learned one thing about gardening. If a plant is dying, it is probably for one of two reasons: too much water or too little water. So it is with student learning of mathematics. If we tell the students too much, we lower the level of cognitive demand in the lesson, and they are not able to see the connections that we are telling them to see. If we give a rich task, but do not provide enough scaffolding or the right tools, then the students will not be able to engage in the task and learn the intended mathematics. The transcripts of the lessons in Chapters 1, 4, 7, and 10 provide valuable insights into striking a balance that maximizes student opportunities to learn. For example, the first lesson is a differentiated lesson where one group uses dice to explore sums that equal 7, while a second group explores how seven birds can land on a tree and bush. The “set up” part of each lesson illustrates how to ensure students are ready to engage in the problem without taking away their thinking. In Chapter 4, we see how students (who understand subtraction only as “take-away”) can benefit from dropping back to simpler problems to expand their understanding. (In this case, that subtraction is also the distance or difference between two numbers). This additional “watering” allows the students to return to the initial problem they were trying to solve with an enhanced understanding that allows them to successfully solve the problem.

In addition to differentiation, scaffolding, questioning, and use of tools, there are many other teacher moves in these chapters that can provide for rich discussion in a professional development setting—considering how the task selection (design) and teacher moves (implementation) of the tasks support or inhibit student understanding of number and of the related algebraic concepts (and mathematical practices).

In her introduction, Monica Neagoy tells us that one of her purposes for writing the book is so that teachers may be able to, “*Experience* algebraic acculturation: that is, *cultivate* new thought and behavior patterns that naturally weave into algebra’s cognitive fabric” (p. 2). Through the use of classroom vignettes, explicit connections to content, and opportunities to extend our knowledge, *Planting the Seeds* provides an opportunity for us as teachers, elementary mathematics specialists, coaches, and teacher educators to cultivate our own understanding of the mathematics we teach and how to teach it in ways that maximize students’ opportunity to learn and connect foundational concepts in number and algebra. If PreK–2 children are nurtured and challenged in these ways, they will blossom into children who have sound mathematical foundations and the capacity (and disposition) to reason and think algebraically.

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