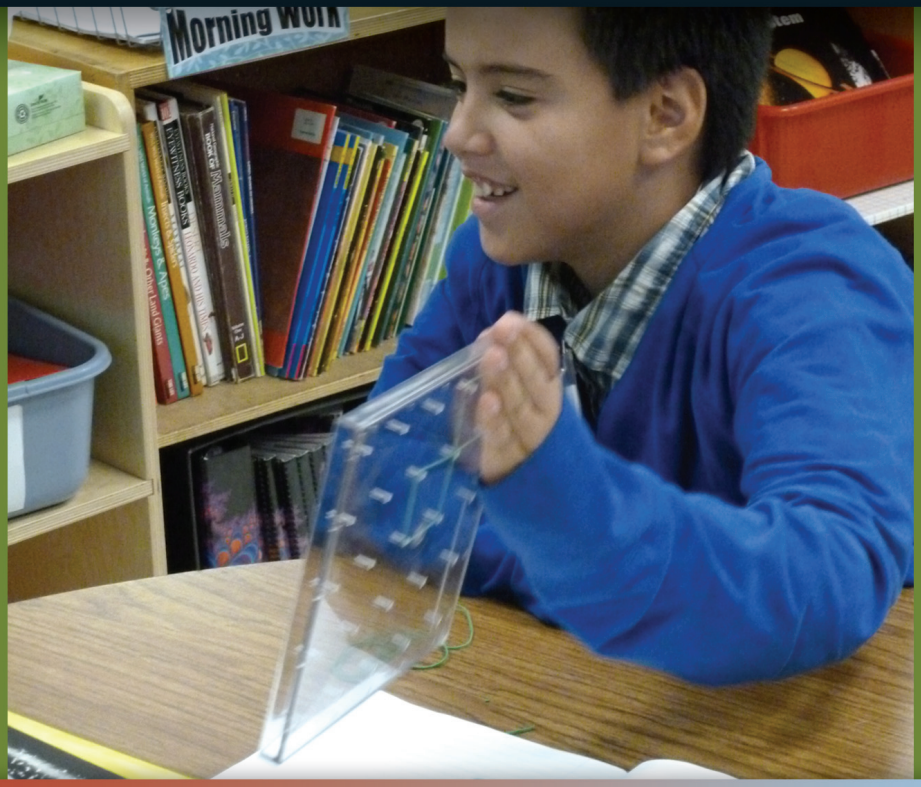
MATH TOOLS *in Action*

Manipulatives



Chris Confer & Marco Ramirez

Viewing Guide

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Introduction

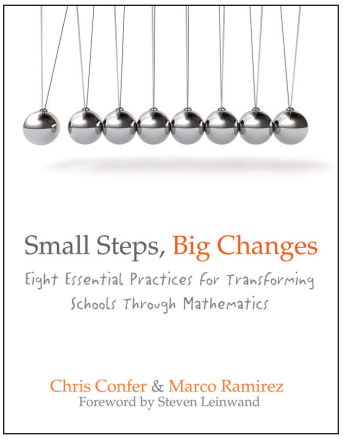
Math Tools in Action: Manipulatives was taped in Tucson, Arizona, at Pueblo Gardens Elementary School, which has a diverse population. Many of the students in the video are English language learners and speak Spanish or Vietnamese at home. About 90 percent of the students participate in the free lunch program, and the school receives Title I funds as a result.

In this DVD, Chris Confer and Marco Ramirez—both of whom are consultants and authors of books and videos on mathematics instruction—show how manipulatives are an invaluable part of daily math instruction. You will also hear Chris and Marco converse about how they use different types of manipulatives in classrooms, and why manipulatives and visual models are important for all learners to reach their potential.

This guide is designed to help you consider how manipulatives, a simple tool, can help create active classrooms where students think, reason, solve problems, and communicate. The Common Core State Standards for Mathematics require instruction that many teachers did not experience when they were students. Chris Confer and Marco Ramirez hope that these glimpses of real math lessons will provide interesting and useful images of students using manipulatives to engage in Mathematical Practices—the processes and proficiencies that are an important part of the Common Core State Standards.

The key questions and activity suggestions in this study guide also offer workshop facilitators and viewers the opportunity to engage with the ideas at a deeper level. By making connections to a teacher's own classroom and aiming to move "good ideas" to "consistent practice," the suggestions in the guide will help create professional learning communities with significant outcomes.

It is interesting to note that this DVD was taped during the second week of the school year. Although this schedule could make any teacher nervous, it was not a problem at Pueblo Gardens Elementary School. The teachers and students of Pueblo Gardens have been working hard on mathematics for more than a decade, and the school's culture of mathematical problem solving carried the students through the lessons.



To learn more about Pueblo Gardens Elementary School and the essential practices that helped this high-poverty school, and other schools, move from "underperforming" to "highly performing," you may wish to read *Small Steps, Big Changes: Eight Essential Practices for Transforming Schools Through Mathematics* by Chris Confer and Marco Ramirez (Stenhouse 2012). This short, readable book is filled with stories from teachers, coaches, and principals—engaging stories that breathe life into the doable, simple practices that can fundamentally change a school. The Math Tools in Action: Manipulatives DVD provides examples of these practices as well.

Why Manipulatives?

In the DVD's brief introduction, Chris and Marco provide an overview of the benefits of manipulatives and suggestions for including them in the classroom on a regular basis. Use this sequence to give participants a chance to hear Chris and Marco's perspectives and to connect to participants' own ideas and experiences with manipulatives. What is the value of using manipulatives and visual models? How have participants incorporated manipulatives into their own math instruction?

Discussion questions and activity suggestions:

1. What manipulatives and models do participants currently use? How do participants use them? Invite participants to do an Imaginary Scavenger Hunt. Have them work in groups to list, on separate sticky notes, each kind of manipulative and visual model that they have on their classroom shelves, in their closets, and on the walls. Ask participants to group the manipulatives according to the math topic they could support. For example, students could use color tiles to build arrays for multiplication, and they could also represent multiplication on number lines or the hundred chart. Note that a single manipulative can be used for a variety of topics, and have participants share their ideas for this.
2. How do you introduce students to manipulatives at the beginning of the year? How do you organize manipulatives and make sure that students have easy access to them? What routines and procedures do you use for students to get manipulatives out, use them, and put them away? Ask small groups to share their ideas, using Figure 1 ("Organizing and Using Manipulatives") as a graphic organizer to guide this discussion.
3. What challenges do you anticipate when incorporating manipulatives into your instruction? What solutions to these challenges can you come up with? Use Figure 2, "Manipulatives: Challenges and Solutions," as a graphic organizer for this small-group discussion.
4. How are manipulatives used in real-world careers? This discussion helps older students understand that manipulatives are not "toys" but are instead useful models for solving real-world problems and for communicating ideas. Use Figure 3, "Manipulatives and Models in the Real World," to help participants brainstorm ways that manipulatives and models are used in the workplace.
5. In the introduction, Marco says that manipulatives are models that help students think, remember, and communicate their ideas. How can a manipulative or visual model help students think and reason? How can it help students solve problems? How can a manipulative help all learners, but especially English language learners, communicate their ideas?
6. How might some models promote counting by ones? Which models promote counting by groups or chunking numbers?
7. Chris says that the most concrete model can be the children themselves. What does she mean by this? How can the children themselves be models for some of the key topics that you teach?
8. In what ways can you use a specific manipulative or model to represent a math concept concretely, pictorially, and abstractly? (Remember that digital or virtual manipulatives are important and engaging pictorial representations.)

9. Numbers, expressions, and equations are the most abstract models for students, yet abstraction is an important goal for learning. When might a teacher ask students to use manipulatives along with equations? When might a teacher ask students to use only numbers and equations?
10. Would you ever ask students who easily solve abstract problems to use manipulatives? When might you do so, and why?
11. Marco notes that manipulatives do not have meaning in and of themselves. He says that students must construct their own understanding of the manipulative or model. What suggestions does Marco offer for helping students bring meaning to the number line?

Getting Started with Manipulatives

When beginning to use manipulatives, first decide which manipulatives will be most helpful for specific mathematics content. Review the standards for your grade level, paying close attention to the models that are explicitly required. For example, the Common Core State Standards ask that first-grade students "develop strategies for adding and subtracting whole numbers . . . us[ing] a variety of models, including discrete objects and length-based models (e.g., cubes connected to form lengths)."

Manipulatives and models used for whole number computation often include objects such as counters, tiles, and cubes, as well as hundred charts, number lines, base ten blocks, part-part-whole mats, grids for arrays, and bead boards (for information about bead boards, see Confer, *Teaching Number Sense, Grade 1*). Be sure to provide models that chunk manipulatives into fives, tens, and twenties, such as five frames, ten frames, double ten frames, and bead boards.

Fractions are frequently modeled with pattern blocks, paper fraction strips, equally partitioned rectangles or other geometric shapes, number line diagrams, and sets of objects. Some useful models for decimals are 10 x 10 grids, base ten blocks, hundredths disks (see Van de Walle and Lovin, *Teaching Student-Centered Mathematics, Grades 3–5*), dimes and pennies, place-value disks, and place-value charts.

Manipulatives in Classrooms

Determine where in the classroom you will store your manipulatives. Will they be on a shelf devoted to mathematics tools that is accessible to students? Are some models so important that students should have them on hand at all times? For example, a hundred chart might always be in their desks or affixed to their math journals. Your decision will depend on how often students will need to use that tool, and you may make different decisions for different students.

Determine ahead of time—or with your students—the procedures you will follow for using manipulatives. Help your students understand that concrete manipulatives help them think, and that math tools can be as useful as a computer or a calculator. Consider creating group sets of manipulatives by filling ziplock bags with color tiles or pattern blocks. If your students will be working with place value on a regular basis, consider keeping connecting cubes in towers of ten, and ask that students put them away in that same arrangement.

When you introduce a new manipulative, model your expectations for taking it out, using it, and returning it. Provide students with time to freely explore the manipulative to allow them an opportunity to use this new tool however they choose, and to help you see which of its attributes the students notice.

As students learn to use more abstract models, help them understand how these models relate to each other. Differentiate instruction by allowing students to use concrete models when necessary.

Grade Three Lesson

1. When does Chris encourage students to use gestures or movements to model a math concept? Why is this important for students to do?
2. Why does Chris have students record the focus in their math journal? Why does she have students refer to the anchor chart?
3. Why does Chris encourage students to answer questions using complete sentences? Why does she have students repeat math vocabulary? When is it helpful to ask students if they would be willing to share an idea with the whole group, as Chris does with David?
4. With what different models do the children see the concept "difference" during this lesson?
5. Chris has the students use their fingers to represent the approximate length of an inch. Why is it important for students to develop referents for measurement units?
6. When does Chris observe the students to see how they use manipulatives and models to represent a specific concept? What kind of feedback does she provide to them?
7. How does Chris make sure that students bring meaning to specific manipulatives and models?
8. Why is it useful to include the 0 when introducing number lines to students? When might you not include the 0?
9. When Arlette shared her number line for Adult Popper and Baby Popper, she showed some confusion. What was the source of her confusion? What about number lines does Arlette find difficult? How can teachers support students who have fragile understandings about what number lines represent?
10. How do the students respond to the idea of comparing real-life champion animals? Why?
11. When does Chris model how to use an open number line to model a problem? When does she "gradually release" the responsibility to the students?
12. When working independently, how do student partners support each other?
13. During the discussion, how did Christian use what he knew about the difference between 24 and 100 to solve 23 and 100?
14. How did Chris bring closure to the lesson?
15. How can manipulatives support students in developing the following Mathematical Practices from the Common Core State Standards? Which practices could manipulatives promote especially well?
    a. Make sense of problems and persevere in solving them
    b. Reason abstractly and quantitatively

c. Construct viable arguments and critique the reasoning of others
d. Model with mathematics
e. Use appropriate tools strategically
f. Attend to precision
g. Look for and make use of structure
h. Look for and express regularity in repeated reasoning

16. Engagement strategies and strategies for supporting English language learners are important for all math instruction. What strategies did Chris incorporate? What other strategies might she have included? Provide participants with Figure 4, "Engagement and ELL Strategies," to note their observations.

Your Turn: Next Steps

1. What key insights did you gain from viewing this video and participating in these discussions?
2. If you already use manipulatives, what validated your decision to use them? If you don't yet use manipulatives, why might you give them a try?
3. Many students learn new concepts more easily when using manipulatives, so it is especially important to incorporate them in lessons when topics are introduced. What topics do your students find challenging? How might manipulatives support your students?
4. What new way will you incorporate manipulatives into your instruction? What benefits do you anticipate? What challenges might you encounter? How might you deal with these challenges? Figure 2 provides a graphic organizer for this discussion.

References

Confer, Chris. 2005. *Teaching Number Sense, Grade 1*. Sausalito, CA: Math Solutions.

Van de Walle, John A., and LouAnn H. Lovin. 2006. *Teaching Student-Centered Mathematics, Grades 3–5*. New York: Pearson.

Figure 1: Organizing and Using Manipulatives

1.	**1.**	**1.**
2.	**2.**	**2.**
3.	**3.**	**3.**
4.	**4.**	**4.**

Figure 2: Manipulatives: Challenges and Solutions

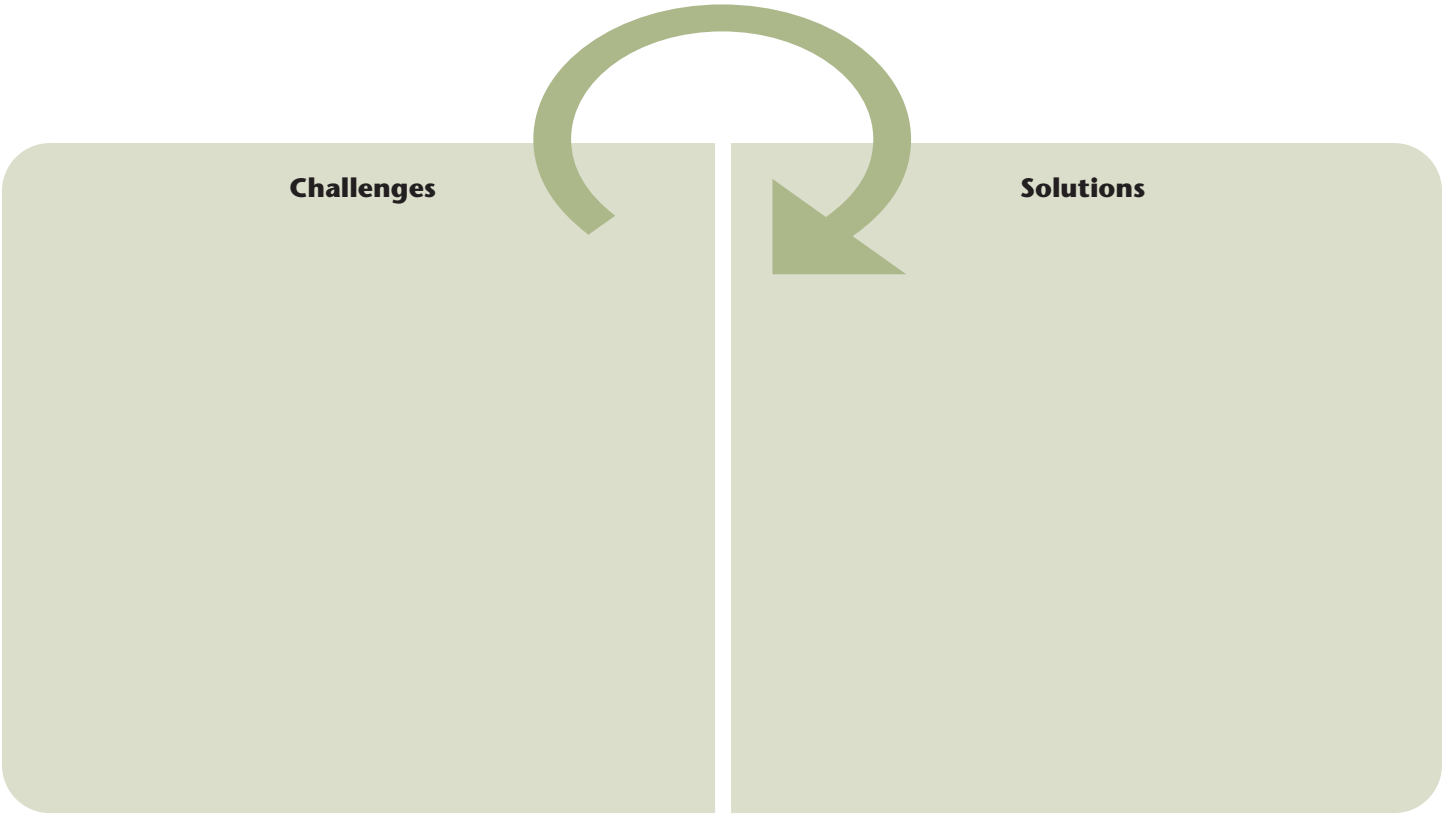
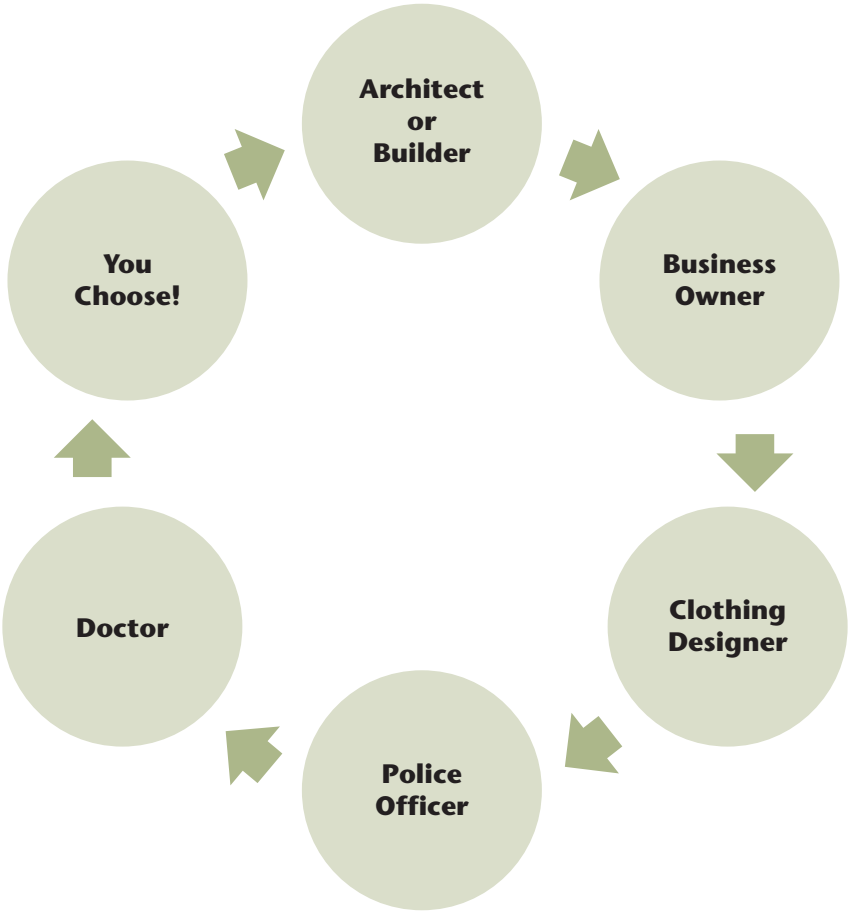


Figure 3: Manipulatives and Models in the Real World



Adults often use models when solving problems in the workplace. Models may be three-dimensional or they may be pictorial, such as drawings, diagrams, or maps. Flowcharts and T-charts help businesspeople plan and keep track of projects. Computer-generated software supports the design process, permits views from different perspectives, and allows for the evaluation of alternative designs, procedures, and processes. Students who use manipulatives and models prepare for the adult world by developing a firm foundation of conceptual ideas and by learning different ways to represent them.

Figure 4: Engagement and ELL Strategies

Student Engagement Strategies

Strategies for Supporting English Language Learners

Time Codes

Welcome	00:00–03:28
Introducing the Mathematics Lesson, Third Grade	03:29–10:32
Moving Further into the Math Task	10:33–19:43
Comparison Investigation	19:44–29:50
Modeling Another Strategy	29:51–32:59
Individual and Partner Comparison Investigation	33:00–35:18
Reflecting on Solutions	35:19–38:28