



Rigor: Defined and Embedded in  
**Number Worlds**

By Robyn Silbey

Why is rigor a sought-after element in mathematics classrooms around the country? To find the answer, consider what it means to be “career-ready” in the 21st Century. Cutting-edge companies have determined that their goals for the workplace include identifying and completing tasks that require invention, creativity, and teamwork. Colleagues apply pertinent skills based on their deep understanding of a concept to identify and solve problems. Daniel Pink observes in his landmark book, *DRiVE!*, that 70 percent of all job growth is heuristic, or focused on innovative problem solving. This shift in job growth requires a shift in learning, which can be accomplished only if we make a corresponding shift in instruction.

Enter the Common Core State Standards (CCSS)<sup>2</sup>, which addresses the content, processes, and proficiencies needed to prepare students for a successful future. Within the CCSS, rigor is defined as “deep, authentic command of mathematical concepts.”<sup>3</sup> Adding rigor to program design provides students with the conceptual understanding, procedural skill and fluency, and application of learning in context<sup>4</sup>. **Number Worlds** is proven to develop conceptual understanding and procedural knowledge. Weekly project-based learning modules tie the application of knowledge to conceptual development to ensure that all three facets of a rigorous math curriculum are part of the learning process.

To help students meet this goal, the CCSS cite three aspects of rigor on which to focus: conceptual understanding, procedural skills and fluency, and application.

- 1. Conceptual understanding:** Concepts must be accessible from a number of perspectives in order to see mathematics as more than a set of mnemonics or discrete procedures. Researchers have investigated the manner in which children construct number knowledge and conceptual understanding of content and have proven that these precursor understandings are required to allow students to build the conceptual understanding they need to handle increasingly complex information and topics<sup>5</sup>.
  - Hands-on activities with manipulatives are embedded in every **Number Worlds** lesson, allowing students to explore and demonstrate abstract concepts in a concrete way.
  - Building Blocks, the result of NSF-funded research, develops students’ mathematical thinking through interactive, web-based practice activities. Students progress through research-proven learning trajectories, making connections and building mathematical conceptual understanding.

**2. Procedural skills and fluency:** Core procedural skills must be mastered in order to access more complex concepts and procedures. Fluency is addressed in the classroom and through supporting materials to be used over an extended period of time.

- Number Worlds embeds fluency practice opportunities throughout each lesson, utilizing a variety of formats— games, manipulative work, traditional practice, and many others— for optimal engagement by all students.
  1. The Skills Focus gives teachers a quick overview of how the week progresses across learning objectives to effectively meet weekly key standards.
  2. Every lesson includes features designed to easily build connections between key standards for the week and daily instruction.
  3. Game boards are provided in both the teacher material kits and online to support student engagement in a variety of settings.
  4. Tools to help students build fluency and precision in their math vocabulary skills are embedded in each lesson.

**3. Application:** Application is the outcome—and the goal—of the conceptual understanding and procedural skills or fluency. Students must continuously use their knowledge in situations that require applying mathematical concepts to relevant, every day activities.

- Number Worlds weekly lessons launch with a relevant, *Find the Math* application that takes students out of the classroom and into daily life.
  1. Real-World applications allow students to think critically about how the concepts presented in each lesson relate to everyday scenarios and demonstrate higher levels of mastery.
  2. Weekly projects entice students to enrich their learning with additional engaging, real-world, multi-layered experiences.
  3. The Digital Dashboard consolidates online resources for each lesson in one place to support conceptual development and at-home connections. Device-friendly resources maximize accessibility. A To-Do list provides quick access to assignments and activities. Online student assessments reflect CCSS objectives and goals.

In order to embed rigor into daily practice, teachers must create a learner-centered, discourse-rich, risk-free learning environment in which students are intrinsically motivated to succeed. The Common Core Standards for Mathematical Practice<sup>6</sup> provide a clear description of this type of classroom—one in which students productively persist through difficult and challenging problems to find a justifiable and reasonable solution. Three research-driven strategies put teachers and students on the path to creating this dynamic, learning atmosphere.

**1. Teachers engage students in thought-provoking student discussions that are prompted by open-ended, stimulating questioning.** Classroom conversations involve all students. A teacher poses questions to the class for students to discuss in small groups or with a partner. Every student is held accountable to think about and articulate a response. Teachers facilitate the collection of students' ideas and encourage a clarifying discussion regarding them. In one scenario, a teacher embracing Cognitively Guided Instruction<sup>7,8</sup> listens to children's mathematical thinking and uses their responses to drive instruction.

- Number Worlds is designed to support discourse by building academic language and creating context before lessons begin. Math activities are an excellent way to give English Learners and struggling students practice listening to each other. Lessons conclude with Reflect, which connects the day's learning to the broader, Common Core Standards-based goal and the weekly Key Standards. Students see how each piece fits in the overall body of mathematical knowledge, and teachers can listen to students' responses to inform future instruction.

**2. Teachers nurture a risk-free atmosphere in which students believe that mistakes are markers on the road to success.** In Mindset<sup>9</sup>, Carol Dweck suggests nurturing a growth mindset, where students are encouraged to work through productive persistence. Praise is given to students who demonstrate perseverance. Dweck says, "When children are taught the value of concentrating, strategizing, and working hard when dealing with academic challenges, this encourages them to sustain their motivation, performance, and self-esteem."<sup>10</sup>

- Number Worlds lessons feature interactive differentiation supported practice, targeted strategic intervention, ELL support, digital tools, and adaptive instruction to ensure that every student's needs are met and challenges are presented to advance each learner's highest potential.

**3.** Teachers encourage students to become intrinsically motivated to learn mathematics. In DRiVE<sup>1</sup>, Pink describes three elements of intrinsic motivation: autonomy, mastery, and purpose. Using the lens of rigorous math instruction, teachers nurture intrinsic motivation using these elements:

- A) **Autonomy:** Students independently think through problems, choose their best solution strategies, and develop their own individual style of problem solving.
- Number Worlds lessons expose students to a variety of workable approaches and strategies. Students are invited and encouraged to select or invent their own solution pathway and are then held responsible to discuss and justify their thinking.
- B) **Mastery:** Students believe in their own capability, knowing that with effort and persistence, they are cognitively able to deeply understand everything they learn.
- Number Worlds lessons create a growth-mindset environment in which errors are an expected part of learning. This motivates students to strive for mastery.
    1. Alternative grouping suggestions help teachers adapt instruction to fit various learning environments such as one-on-one tutoring, summer school, and after school settings.
    2. Daily progress monitoring allows teachers to swiftly adapt instruction for immediate feedback and deliver targeted remediation for struggling students to get them on track and keep them on track.
    3. Other assessment tools allow teachers and administrators to correctly place and monitor at-risk students. A variety of assessment options evaluate student proficiency, inform instruction, and visually track progress.
- C) **Purpose:** Students place a high value on their own learning, recognizing that the knowledge they accrue is necessary for success in the world.
- Number Worlds lessons expose students to relatable, relevant, real-world problems that support students' aspirations for learning the mathematical concepts presented in the classroom.
    1. Real-world applications are a critical part of every lesson, during which time students solve a problem using one of many approaches that appeals to them, reinforcing their ability to utilize their personal knowledge base.
    2. Weekly, standards-driven, project-based learning increases long-term retention of concepts. Real-world scenarios are used to help build college and career readiness for all students. Each project wraps up with a discussion, presentation, or reflection of the project.

To teach the skills our students need, instruction must be redefined. It is not a checklist of procedures for teachers to present and students to memorize. Great teaching involves ensuring that all students deeply understand and make sense of the concepts they need to succeed as lifelong learners, workers, and citizens. More importantly, students must be able to identify patterns, make connections, draw conclusions, and apply what they have learned to new situations and unique settings. Further, to be career-ready in today's marketplace, our students must excel at critical thinking, communication skills, and collaboration. **Number Worlds** provides the innovation, tools, strategies, and support to achieve a new and higher standard of rigor, defined by 21st-century criteria.

## REFERENCES

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