BUILDING A SCHOOL CLIMATE THAT FOSTERS MATHEMATICAL BRILLIANCE: Bringing Character to the Common Core State Standards

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Workshop Leaders

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Session Overview

- Three brief activities
  - Four Fours
  - Equations
  - Cosmic Wimpout
- Character linkages
- What does the research say?

Our Hope for You

We hope that this session contributes toward what Davis and Renert describe as “a way of being with mathematics knowledge that enables a teacher to structure learning situations, interpret student actions mindfully, and respond flexibly, in ways that enable learners to extend understandings and expand the range of their interpretive possibilities through access to powerful connections and appropriate practice.”

Brent Davis and Moshe Renert, *The Math Teachers Know*. Routledge, 2014 pp. 11-12
Activity Overviews

Four Fours —
Take four fours and any math operations you want, and try to construct an equation for each number 1-100. For example:

\[16 = 4 + 4 + 4 + 4\]
\[12 = 4 + 4 + \sqrt{4} + \sqrt{4}\]
\[27 = 4! + \frac{4}{4} + \sqrt{4}\]

Related Projects:
Consecutive Sums: Can you write an equation for each number 1-100 using consecutive sums? In fact, you can’t, but the numbers that can’t be created this way have an interesting pattern.

Dollar Words: Assume “a” is worth one cent, “b” is worth 2 cents, and so on. So, bob would be worth 19 cents (.02 + .15 + .02) Can you write a word that is worth exactly a dollar? What is the least valuable word in this system? The most valuable you can find?

Equations —
Groups of 4-5 players gather around a game board. One player rolls 20 cubes with different numbers and operations on each face. This player sets a goal (e.g. 25). From there, players take turns placing a cube in one of three places on the game board:

- **Required:** All players must use the number or operation on the cube face in their solution.
- **Permitted:** Each player can choose to use the number or operation, or not
- **Forbidden:** No player can use that cube. If the same number or operation is on another cube, it may still be available.

Play continues until a player “flubs” by making it impossible for anyone to construct a solution, or by making it possible to construct a solution using at most one more cube. Scoring rewards the one who first notices a flub. The net result is a dynamic, ever-changing game which requires sustained attention and diligence.

The game played in the workshop is a variation of a long-standing mathematics game developed by Layman Allen in 1963. The rules shared here have been used in greater St. Louis for approximately 20 years in enrichment programs sponsored by the Gifted Resource Council, a local non-profit, and by many schools.

- Rules used in this workshop can be downloaded from giftedresourcecouncil.org. (Search under Academic Challenge Cup if needed.)
- Games can be purchased from the Accelerated Learning Foundation (gamesforthinkers.org).
- Alternative rules are also available through the Academic Games League of America (agloa.org/equations).
Cosmic Wimpout —
Cosmic Wimpout is a long-standing cube-based math game with applications from middle-elementary school arithmetic practice through high school probability exercises. Each player takes turns rolling five cubes. Scoring numbers (5’s, 10’s, and sets representing three or five of a kind) are retained, and players have the option of re-rolling the non-scoring cubes to increase their score. At times it’s a forced choice, and the player must re-roll the non-scoring cubes.

Mathematically, a nine-year old can work out multi-digit addition and simple multiplication, while a 16 year-old can work out the formal probability in making strategic decisions.

Games and rules can be obtained at cosmicwimpout.com.

Dimensions of Character
Drawing from David Shields’ typology, we invite you to consider four dimensions of character as we explore mathematics teaching and learning:

- **Performance character** describes how people approach tasks: Do they work hard and persevere in their efforts? Are they focused on doing their best or just getting by?

- **Intellectual character** describes ways in which people approach information and ideas: Do they keep an open mind and weigh evidence? Are they willing to reconsider previously held beliefs in light of new information?

- **Civic character** moves past the individual to describe ways in which people show their commitment to their community: Are they committed to improving the quality of life for themselves and others? Are they seeking to improve the local environment?

- **Moral character** generally refers to how people interact with each other. Issues of kindness, consideration, and empathy are key here. What does it mean to be a good person, and to see the value in others?

- **Collective character** refers to the patterns of school life, the procedures and routines that reflect the norms, goals, values, expectations and teaching, learning and leadership style. Key issues here include maintaining an atmosphere of excellence, respect, and trust. Do students and teachers feel safe and happy at school? Does our school inspire adults and children to excel?

Executive Summary

Introduction/context: We establish the general need for a fresh look at mathematics, identify key issues, and frame character education as an essential tool for addressing these issues. Specifically, we show that while the United States has had more than 60 years of concern about academic standards, math still has an ambiguous role in our culture and a real but perhaps unnecessary anxiety-producing effect in schools. On the one hand, strong capacity in math is seen at the individual level as essential preparation for a range of careers. Also, our national mathematics capacity is seen as a tool for ensuring our global economic competitiveness. Balancing these strongly pro-math values is the negativity produced at the individual level by the “gate-keeper” status of various math courses as well as general malaise about math in the broader society. As mathematician John Allen Paulos famously noted, it’s OK at a cocktail party to say that you’re not a math person, whereas you would never say that you just “don’t get” language. In short, we value math in the abstract, but we don’t really like it.

Against this background, the United States is embarking on our third effort to create meaningful change through national standards. Despite ostensibly good intentions, it is a fair question to ask whether this effort will succeed where previous ventures have not. In this paper, we take the position that without due attention to factors beyond curriculum change, the mathematical expertise targeted in the Common Core will be thinly realized at best. More specifically, we argue that various aspects of character are explicitly identified (courage, diligence, persistence, cooperation, precision, creativity, and future-mindedness), while other aspects are implicitly assumed (empathy, confidence, fairness), within the Common Core vision, and use this paper to articulate their role (and advocate for their inclusion) in math reform discussions.

Position taken: For teachers, students, and community members to embrace and realize the vision of the Common Core State Standards, a fundamental shift will be required in how we envision teaching and learning mathematics. Merely adjusting the curriculum sequence and holding workshops to orient teachers to the new standards will amount to what Tyack and Cuban have called “tinkering toward Utopia.” Efforts to double down on business-as-usual – even with increased rewards and consequences – will not lead to significant change. Instead, we need to build confidence, intrinsic interest, growth focused orientations toward mathematics, and toward learning in general. In this paper we identify specific research-supported interventions for building these character strengths and increasing academic performance in math. We articulate ways in which constructs developed within the character education field hold the key to a more vibrant mathematical learning environment.
**Specific actions recommended:** We advocate the creation of a Dewey-inspired character-building model of “communities of inquiry” toward mathematical tasks that moves beyond training students to replicate procedural knowledge. Done well, this establishes a culture of engagement and intrigue with diverse strands of mathematics. Countering the standard objection that group work limits individual achievement, we show how participation in a community of inquiry leads to higher real achievement, both for individuals and groups. Within a community of inquiry, the scope of work is defined by the practice and content standards, while norms of group membership are defined by concerns for personal, civic, performance, and intellectual character.

To make this vision tangible, we present four extended vignettes (primary, intermediate, middle, and high school) exemplifying how a richer learning space emerges through the intersection of character education, strong pedagogy, and the Common Core State Standards. Complementing improvements in the classroom environment, we look at ways in which the community beyond the classroom can be a resource for students needing additional support or enrichment, and how parents can be engaged in these changes. We include 8 detailed lesson plans aligned to the CCSS-M practice standards and the encompassed virtue that also include opportunities for reflection by students, teachers, and families. We also articulate the relevant administrative, assessment, and pedagogic issues raised by our character-infused model, and offer a research and development agenda to guide a path forward.

*Revitalizing Math Learning in America — An Educator’s Guide to the Ways Character Strength Supports K-8 Mathematics and the Common Core State Standards* was developed under funding from the S.D. Bechtel, Jr. Foundation. The full report can be downloaded at the Center for Character and Citizenship website (www.characterandcitizenship.org).