REVITALIZING MATH LEARNING IN AMERICA

Character Education + Common Core State Standards-Mathematics

By the Center for Character and Citizenship
University of Missouri—St. Louis

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Center for Character and Citizenship (CCC)

The CCC engages in research, education and advocacy to foster the development of character, democratic citizenship and civil society. Funded by grants, individual donations, and through corporate and foundation support, the CCC focuses on generating and disseminating both knowledge and research pertaining to how individuals develop moral and civic character. By providing scholars, educators and social organizations with the tools they need to contribute to this development, the CCC plays the role of a think tank, offering workshops, consulting, and professional development. The CCC also provides resources and tool kits to assist educators, parents and scholars in character and citizenship education.

The CCC’s core programs include: the Leadership Academy in Character Education, the Character Education Research to Practice Clearinghouse, Missouri Youth Engaged in Local Government, Youth Empowerment in Action!, and the Journal of Research in Character Education. These, along with other programs, serve hundreds of schools, educators and students locally, nationally and internationally.
ACKNOWLEDGMENTS

This Brief and the in-depth Educator’s Guide that accompanies it grew out of a conversation I had with Marcia Argyris of the SD Bechtel Jr. Foundation. It was early 2013 and I had recently returned from delivering a keynote address and series of workshops at the 2012 INTASE Conference on Character Education and 21st Century Skills in Singapore. I was sharing how refreshing it was to experience such an overwhelming commitment to character education on the part of the Singapore Ministry of Education as well as by the K-12 educators filling every seat in the large lecture halls of the conference venue. The conversation moved naturally to Singapore’s phenomenal achievement on international tests of math and science and the similar performance of Taiwan and South Korea – all countries in which character education is a mandated component of the curriculum. Marcia was interested in knowing whether there was empirical evidence linking character education and higher math achievement and, if there was such evidence, what resources existed to help teachers, especially those in K-8, harness character education to better achieve the new CCSS-M. That was the first of several conversations that encouraged me and my colleagues to both review the research and identify the immediate needs of teachers and administrators as they struggle to meet the mandates of CCSS-M without losing the carefully cultivated character promoting cultures of their schools and classrooms.

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Math educators teach within a broader American cultural context in which math is considered the most valuable—yet most disliked—academic subject. Our Kindergarten through 12th grade (K-12) math students do not come out on top when compared to other nations’ students and could (and should) be doing much better. Since math skills are considered vital to college and career readiness in our globally competitive world, how can we cultivate “math positive” students? How can we create motivating math learning environments that engage students and connect their math learning with habits needed in their 21st century lives?

We took an in-depth look at research—economics, psychology, philosophy, neuroscience, and education—that strongly suggests that it is not how much knowledge a person gains that predicts success. Instead, strengths or virtues such as diligence, persistence, confidence and future-mindedness—those qualities that most of us call character, strengths—are better predictors. Sufficient evidence exists to demonstrate the value of character strength development in the achievement of mathematically proficient students.

Unsurprisingly perhaps, character education is an explicit and well-funded component of those education systems producing superior math achievement across the globe. A “character education versus improved academics” argument in the United States (U.S.) would be misplaced. While not a call for comprehensive character education, the Common Core State Standards—Mathematics (CCSS-M) readily acknowledge that math students need to acquire more than knowledge; they need to develop the “habits and skills,” or the character strengths necessary, for higher-order math learning.

With CCSS-M implementation, we have the opportunity to maximize the standards’ natural, powerful alignment to character education. However, few examples of specifically aligned CCSS-M and character-development curriculum materials or professional development resources currently exist. Our exploration did, however, reveal the existence of many excellent resources that could be collected, adapted, aligned, and made easily accessible to the math community.

This paper is a first step. Building upon David Shields’ (2011) multi-dimensional model of character we provide a framework for teaching math that promotes character development, along with illustrative sample projects. We also offer research-driven examples of how math teachers can help students develop greater math positivity, growth mindsets, and a relationship with math learning that feels “real-world” valuable.

It is our hope that by integrating the new CCSS-M with character education, we will revitalize math learning in America. Most importantly, we hope to empower our children to not only like and learn real-world math, but also to envision and create their very best selves.
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MATH & AMERICANS: THE CONTEXT

Looking at the global data, math students in the United States are below average performers. As beneficiaries of the world’s largest economy, thus having the resources to support a strong educational system, we could be doing much better. When the latest Program for International Student Assessment (PISA) results were reported in December 2013, 29 nations and other jurisdictions were found to have outperformed U.S. 15 year-olds in mathematics by a statistically significant margin, up from 23 nations/jurisdictions three years ago (U.S. Department of Education, 2013).

Consistently ranked below average for developed countries, research strongly suggests a significant portion of the global achievement gap in mathematical expertise has more to do with the development of character strengths than intellectual ability. In countries where students score particularly high on international math tests and in many of the countries that are on an upward trajectory (Woesssmann & Hanushek, in press), character education is an explicit component of the curriculum. Singapore, Taiwan, South Korea, Australia, and the United Kingdom all have nationally-established, well-funded character-education mandates. The inclusion, even emphasis, on comprehensive character education is believed to contribute to their students’ academic achievement.

The New Common Core State Standards-Mathematics (CCSS-M)

Currently, the U.S. mathematics education community is embarking on its third reinvention in just over two decades, the CCSS-M. Not without controversy, the Standards are intended to provide clear learning goals for all K-12 students, with each step designed to assist students in the college and career readiness process (National Governors Association Center for Best Practices, & Council of Chief State School Officers (NGACPB/CCSSO), 2010). When developing the CCSS-M, designers conducted an extensive review of the international education systems producing superior achievement in mathematics. They concluded that, in comparison to other nations’ successful systems, American math education was “a mile wide and only an inch deep.” (Phillips, 2007).

Woven throughout all eight of the CCSS-M is the need for students to learn and exhibit what are variously referred to as noncognitive factors, personal dispositions, social and
emotional competencies, and character strengths. The CCSS-M approach certainly is not a call for the kind of comprehensive character education that other nations’ employ, but it does acknowledge how crucial character strengths are to math learning.

Why Are U.S. Students Not Performing as Well in Math?

There are likely a number of reasons that U.S. students’ math performance comparatively falls short. As CCSS-M designers found, the American “mile wide and inch deep” approach in some ways reflects the ambiguous role that math plays in U.S. culture. On the one hand, strong individual math capacity is seen as essential preparation for higher education and a range of 21st century careers. American men rank math highest when asked what school subject has been most valuable to them in their lives, and, although U.S. women mentioned English as the most valuable subject, math was a close second. Collectively, our national mathematics proficiency is viewed as a tool for ensuring global economic competitiveness (Jones, 2013).

The flip side of the “college and career readiness” pro-math value, as mathematician John Allen Paulos (1988) noted, in the U.S. it is OK to say that you not a math person. Our indifference about math learning is culturally acceptable, and our negativity somewhat expected. One in five American adults lack the math skills expected of an eighth grader (U.S. Department of Education, National Center for Education Statistics, 2002), and more Americans say they hate math more than any other subject (Associated Press & AOL, 2005).

Math Negativity

Given what we know about typical U.S. adult feelings regarding math, we should not be surprised to learn that many children and adolescents also have negative feelings about math. In Learning to Love Math: Teaching Strategies That Change Student Attitudes and Get Results (2010), Judy Willis, a neuroscientist-turned-elementary-math-teacher, articulates a host of reasons for students’ negative attitudes. These include their parents and significant others’ negative attitudes toward math, low expectations of success as a result of previous negative experiences, inadequate skills and preparation for doing math successfully, failure to be engaged in math through their individual learning strengths, and fear of “looking dumb” if they make mistakes (Good, Aronson, & Inzlicht, 2003; Stephanou, 2012; Willis, 2010).

In short, we Americans profess to value math, but many of us do not really like it or “get” it.

Just How Bad Are We At Math?

In 2003, the National Assessment of Adult Literacy (NAAL) revealed that only 13% of American adults were at the level of math proficiency that would enable them to “compute and compare the cost per ounce of a food item” (Kutner et al, 2007). In a random sample of adult Americans, 78% could not explain how to compute the interest paid on a loan, 71% could not calculate miles per gallon on a trip, and 58% were unable to calculate a 10% tip for the waiter that served them lunch in a favorite restaurant.
A growing body of research into the psychological and behavioral consequences of math negativity supports Willis’ classroom experience of students that lack self-confidence in math (2010). These negative consequences include high stress, low motivation, feelings of helplessness and hopelessness, decreased class participation, boredom, diminished tolerance for challenge, failure to keep pace with the class, behavior problems, and avoidance of the advanced math classes necessary for subsequent professional success (Diener & Dweck, 1980; Hanson, 1994; Stephanou 2004, 2012; Willis, 2010).

Fixed (Math) Mindset
Born without a mind for math?

Many U.S. students find math to be mysterious or worse. As one study illustrated, fifth graders felt that they needed a teacher to guide them through the mysteries of mathematics, whereas they felt that social studies could be learned independently (Stodolsky, Salk, & Glaessner, 1991). Schoenfeld’s Research (1989) raises a further concern, showing that many students see math ability as innate, i.e., that some are “born” with math ability, and others are not. This line of research overlaps greatly with extensive research by Dweck (2000) on fixed vs. changeable mindsets, finding in general that a fixed mindset can limit students’ learning horizons.

Within a fixed mindset, there is often a perception along the lines of “If I’m just not good at it and can’t do anything about it, why bother trying?” Neither apathy nor feeling incompetent is helpful in building a positive regard for math as an interesting or useful endeavor. The combination of mystery, fixed math mindsets or even the sense that math ability is innate is a recipe for low math performance.

In a series of experimental studies, Mueller and Dweck (1998) gave fifth-grade students a moderately difficult set of logic problems. After completing the problems, one group of students received praise for their ability (“That’s a really high score. You must be very smart at these problems.”), one group of students received praise for their effort (“That’s a really high score. You must have worked hard at these problems.”), and one group received praise that was neutral (“That’s a really high score.”). All students were then given a very difficult set of problems on which they all performed poorly. Finally, students were given another set of moderately difficult problems.

Making Math Positive and Personal
A beginning-of-the-year activity is to have students create a math journal, their personal math experience autobiography (Willis, 2010). Use positive prompts such as:

- Describe your best math study habits. What do you do when you get stuck?
- What did you do differently when you were most successful compared to when you were less successful?
- What did past math teachers do that helped you learn best?
- In what ways have you used math outside of school?
- Do your parents, close relatives or friends have jobs or hobbies where they use math? Interview five adults you know to find out!
On this final set of problems, the “neutral praise” students performed at the same level as they had on the first set. The “effort praise” group of students did better than they did originally and asked for more challenging problems in the future. Most notably, the “intelligence praise” students solved 30% fewer problems and asked for easier problems in the future. Just one sentence of praise that reflected the theory that intelligence is fixed undermined students’ performance after an experience of failure, while just one sentence of praise that acknowledged the positive effect of effort promoted improved performance after an experience of failure.

Math Distance

T-Shirt Slogan: “Well, another day passed, and I didn’t use algebra once!”

Students feel greatly distanced from math as they encounter it in school. They do not “get” how it applies in their real lives. Whether it is because math curriculum embodies theoretical rather than “real-world” math, one thing is certain: It is hard to sustain interest, focus, and investment in an endeavor if it leaves you indifferent at best. An “indifferent at best” approach toward math will confound any efforts at improvement because students will remain passive participants. In the language of self-determination theory (Deci & Ryan, 2002), instead of providing engagement, theoretical math curriculum is experienced as “introjection,” i.e., externally imposed and dealt with until it goes away. Once this dynamic is in play, from policymakers to state and district administrators, down to the individual classroom teachers and parents, a carrot and stick game to encourage mathematical performance begins. For students, math is all too often just something to get through to achieve a greater goal, such as passing a class, avoiding disciplinary consequences, or graduating from high school.

Making Math Real

Close the math distance by making math “real-world” interesting with the concepts of area, density, and ratio:

- Ask students to find the concentration of fast food restaurants in their neighborhood and compare the concentration in a different community.
- Try a global project, like comparing the industrial waste or the emissions produced by various countries, and use Google Earth to produce visuals for public display.
- In Rethinking Mathematics: Teaching Social Justice by the Numbers, Gutstein and Peterson (2005) provide many examples of social justice projects, including several that have produced change. For instance, in “Tracking Public Address (PA) Announcements,” students collected and analyzed data to convince their school administration to reduce the number of obtrusive PA announcements (p. 208).
CHARACTER DEVELOPMENT AND MATH LEARNERS

“If U.S. schools are not currently preparing students well for the math skills needed in the 21st century economy, what would it look like to be fully prepared? What does “college and career ready” mean?

College and career readiness” refers to the content knowledge and skills high school graduates must possess in English and mathematics— including, but not limited to, reading, writing communications, teamwork, critical thinking and problem solving— to be successful in any and all future endeavors. Of course, readiness for college and careers depends on more than English and mathematics knowledge; to be successful after high school, all graduates must possess the knowledge, habits and skills that can only come from a rigorous, rich, and well-rounded high school curriculum. (Achieve, 2011)

Implicit in this definition and explicit in the new CCSS-M is the fact that a K-12 education must promote the development of specific, student- character strengths, as well as academic excellence to ensure college and career readiness and to close the global achievement gap (Wagner, 2012). Recent research has found strong evidence that character strengths, such as persistence, conscientiousness, and optimism, rather than cognitive ability, predict labor market success (Heckman, Stixrud, & Urzua, 2006; Lindqvist & Vestman, 2011). It is also generally agreed that success in higher education, employment, and/or entrepreneurship in the 21st century will be achieved by students who have higher-order mathematical understanding and superior communication skills; can work well in teams; take personal responsibility; are self-motivated; learn quickly; and have the ability to plan, prioritize, and creatively problem solve (National Education Association, n.d.; Wagner, 2012).

Researchers are not the only ones making the case for character development. Amanda Ridley, an investigative journalist and author of The Smartest Kids in the World and How They Got That Way, conducted an extensive inquiry into the world’s highest achieving school systems for math and science (Finland, South Korea, and Poland). Ridley writes:

“It’s not the I.Q., it’s the I WILL.”

“Character isn’t just about doing the right thing in an ethical sense; it is about doing our best work. If that is true, then character education isn’t about helping kids get along; it is also about teaching them to work hard, develop their talents, and aspire to excellence in every area of endeavor” – Lickona & Davidson 2005, p. 373
Over the next three decades, more and more studies showed that when it came to predicting which kids grew up to be thriving adults—who succeeded in life and in their jobs—cognitive abilities only went so far. Something else mattered just as much, and sometimes more, to kids’ life chances. This other dark matter had more to do with attitude than the ability to solve a calculus problem. In one study of U.S. eighth graders, for example, the best predictor of academic performance was not the children’s IQ scores—but their self-discipline. Successful skill sets had more to do with motivation, empathy, self-control, and persistence. These were core habits, workhorse traits sometimes summed up by the old-fashioned word character (Ridley, 2013, p.120).”

Paul Tough (2013) came to the same conclusion in his best-selling book, How Children Succeed: Grit, Curiosity, and the Hidden Power of Character. Tough had extensive discussions with U.S. administrators, teachers, scientists, students, and educational innovators, in both good schools and bad, and with academic researchers across the country. He found that what matters most to the future success of American children is not how much knowledge they acquire but is, instead, the quality that most of us call “character.”

While a precise and widely agreed-upon definition of character does not exist, lay people and educators tend to agree that a person’s character is multifaceted and develops over time through an integrated system that includes cognition (symbolized by the Head), affect or emotional (the Heart), and behavior (the Hand). Character is multidimensional and “good” character is made up of positive qualities called “virtues,” strengths, or traits.

K–12 teachers intuitively understand their grave responsibility to develop not simply good students, but whole people. In a recent national teachers’ survey, educators expressed their strong desire for the time and resources to focus on children’s social and emotional development. (Bridgeland & Bruce, 2013). However, because no national, comprehensive character development approach is employed in the U.S., it may be useful to explore the individual character traits or “virtues” needed for math learning and what an overarching character framework for the math education classrooms might look like.

Character “Virtues” and the CCSS-M

One of America’s founders, Benjamin Franklin, developed a classification of strengths of character that is still in use today. Franklin praised the merit of leading ordered, humble, industrious, sincere, clean, and just lives (Wright & Lauer, 2013) and actively worked to strengthen these qualities in his own character. More recently, Peterson and Seligman compiled a classification of Character Strengths and Virtues (2004). Based on an extensive review of historical and cross-cultural literature, these scholars and their colleagues describe 24 individual character strengths, which they group under six broad categories of virtue: Wisdom, Courage, Humanity, Justice, Temperance, and Transcendence.

Below, we highlight a few virtues necessary for higher-order math learning: Self-Confidence and Self-Efficacy, Courage, Diligence and Perseverance, and Carefulness and Precision.

To educate a man in mind and not in morals is to educate a menace to society.
−Theodore Roosevelt
**Self-Confidence and Self-Efficacy:**

A critical step in learning any subject matter is having a positive attitude and confidence in one’s ability to learn new things. Renowned psychologist Albert Bandura (1993, 1997) demonstrated that confidence in one’s ability to be successful at a given task—what he termed “self-efficacy”—influences how a person thinks and behaves. Regardless of what may be objectively true about their capabilities, students’ subjective beliefs about their abilities guide the choices they make, the effort they invest, and the persistence they display when they encounter obstacles (Walton & Spencer, 2009). Recent research has substantiated that students’ perceptions of their abilities are often better predictors of academic performance than their actual abilities (Pajares & Schunk, 2002) and that even talented students regularly fail to achieve their academic potential.

**Courage:**

This “virtue” has been defined as the ability to do what needs to be done despite fear. The preamble to the CCSS-M practice states, “Proficient students are experimenters and inventors” they are active problem-solvers that possess the “courage to plunge in and try something,” (NGACPB/CCSSO, 2010). “Courage in today’s classrooms involves making a commitment to excellence in the face of uncertainty, adversity, or the absence of support.” (Taulbert, 2006, p. 95).

Many students are fearful of speaking out in class, especially if they are unsure of a solution strategy, or if their ideas are contrary to those of their peers. If we aim to promote intellectual courage in all our students, then teachers must become adept at establishing and maintaining safe and supportive classroom environments, i.e., environments in which students have many opportunities to actively grapple with difficult or new problems and feel free to make mistakes. Class norms and routines can be designed to promote a sense of trust, confidence, and psychological safety that allows students to take risks, admit errors, ask for help, and struggle along the way to higher levels of learning (Delpit, 2012; Vincent & Groves, 2013).

**Diligence and Perseverance:**

Building a student’s tendency to persevere in the accomplishment of goals has historically been a targeted outcome of most character education programs and is explicitly included in the first CCSS-M practice standard, “Making sense of problems and fostering perseverance in the problem-solving process.”

Farrington et al (2012) defined perseverance in academic tasks as a “student’s tendency to complete school assignments in a timely and thorough manner, to the best of one’s ability, despite distractions, obstacles, or level of challenge” (p.9), thus encompassing the character strengths of diligence, self-discipline, ability to delay gratification, grit, and tenacity (Duckworth & Quinn, 2009). In fact, after an extensive review of the literature, Farrington et al (2012) posit a logic model of how what they call noncognitive factors influence academic performance that resonates with the logic behind most character education programming – past and present. In their model, academic mindsets lead to academic perseverance, which increases academic behaviors that ultimately result in improved academic performance.

**Carefulness and Precision:**

The development of intellectual carefulness is targeted throughout CCSS-M, both implicitly and explicitly. For instance, intellectual carefulness involves paying close attention to details, accuracy, and associations in both the acquisition and presentation of information. It promotes the deep foundational knowledge needed to persevere successfully in solving increasingly difficult and abstract problems.

Mathematically proficient students continually ask themselves, “Does this make sense?” Exhibiting carefulness in K–12 mathematics can include showing the details of the procedural steps one takes to solve a problem or checking one’s work using alternative methods. When a student has thoroughly and carefully engaged in intellectual inquiry, they gain the confidence to thoughtfully consider and meaningfully respond to challenges and critiques (Dow, 2013).
As discussed, character strengths or “virtues” impact math learning and are reflected in the CCSS-M without any explicit call for comprehensive character education. Part of the reason could be that, in the U.S., there is no agreement on terminology, with disparate terms such as moral education, positive youth development, values education, social and emotional learning, positive psychology, youth empowerment, and psycho-social or noncognitive development.

However, many scientists and practitioners now agree that when it comes to K-12 programming, once distinct approaches have converged (Battistich, 2007a; Berkowitz & Bier 2004). This convergence is accurately represented by what we think of as the field of Character Education, the investigation and intentional effort of schools to promote students’ positive development as people intellectually, socially, emotionally, and ethically (Battistich, 2007b).

Lickona and Davidson (2005) proposed this character equation: Character equals performance and moral character. Underlying the equation are these elegant definitions: “Performance character consists of qualities such as effort, diligence, perseverance, a strong work ethic, a positive attitude, ingenuity, and the self-discipline needed to realize one’s potential for excellence in academics, co-curricular activities, the workplace, or any other area of endeavor.” Moral character “consists of the qualities—such as integrity, justice, caring, and respect—needed for successful interpersonal relationships and ethical behavior” (p.18).

Particularly relevant to K-12 programming, David Shields (2011) identifies five dimensions of character education that offer a valuable framework: four dimensions at the individual level (Performance Character, Intellectual Character, Civic Character, and...
Moral Character) and one dimension at the group level (Collective Character). These dimensions are not distinct from one another, but are highly integrated as seen in the classroom activities provided below.

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?

With Performance Character, dominant issues relate to how students persist in working through difficult math problems, how willing they are to re-think and re-work problems, and whether they strive for higher-level mathematics or simply “work to script” to pass a test or meet minimum graduation requirements.

Given how poorly many students in the U.S. perceive math, it is a subject area ripe for the intentional integration of activities that employ and build Performance Character. Without finding anything inherently interesting in math and without a vision for how math (as it is learned in school) has any practical value, it is a subject that many students pursue passively and flee as soon as they are able.

Math + Character Development Activity “Four Fours” for Grade 3

Student goal: To work individually and/or in small teams to generate an equation for each number 1-100 using four instances of the number four and any math operations. For example, $4 \times 4 \times 4 + 4 = 68$.

Implementation overview: This project lends itself to being introduced either as a whole-class focus for a math activity, or as a challenge that could be the focus for a couple of minutes of time in a class meeting. However it is introduced, the key to it becoming part of a mathematical culture within the classroom is to make it a visible and sustained effort, not a one-time activity. One way to do this is to set up a large display with each of the numbers 1-100 and sufficient space to write a few equations for each. (Space for multiple equations lets students see that there is more than one viable solution for each of the goal numbers.) As students generate equations, they can ask peers to verify that the equation leads to the intended goal. This student checking is critical as it fosters mathematical dialogue and peer teaching when the solver uses a technique that is new to the checker, or when mathematical concepts, such as order of operations, need clarification. A common teaching technique, such as “Ask Three Before Me,” can help to keep the discussion focused on peer interaction rather than asking the teacher to check for correctness.

This activity works well for a couple of focused whole-class math periods, after which it can provide a focus for independent work as students seek to complete the table from 1-100. New solutions can be shared in class meetings offering a chance for recognition of those who persist in finding the more challenging solutions and opportunities for legitimate peripheral participation among other class members (Lave & Wenger, 1991).

Character dimensions: Performance Character is enhanced through an invitation to persistence in working on the harder equations. Intellectual Character is developed as students learn new mathematical concepts such as square roots, factorials, and order of operations. Civic Character is developed as students work to establish and maintain norms of common inquiry and constructive response when they seek clarification or do not agree and in their service to others as equation checkers. Moral Character is developed as students build their own mathematical identity and by maintaining positive interpersonal relations with their peers and by recognizing the talents and achievements of others.
Intellectual attributes, such as how we engage in argumentation, handle evidence, and deal with contrasting points of view are all part of Intellectual Character. Key issues here might be captured under the mantra “resolve within reason,” with an emphasis on holding to and defending positions using the intellectual tools at our disposal as warranted, but not in such a way that we become deaf to reason. If there is an alternative or complementary argument put forth, we have an intellectual obligation to consider it and debate it on its merits, not simply dismiss it because it came from another source. The inverse of this position, of course, is that Intellectual Character also requires that we not simply accede to another argument put forth; if we are truly truth seeking, we will weigh each position fairly on its merits. Doing this well requires a level of mathematical understanding and engagement well past formulaic memorization.

**Math + Character Development Activity**

**“Geoboard Detectives” for Grade 9**

**Student goal:** To investigate geometric construction challenges with geoboards, with a goal of identifying which challenges are mathematically not possible.

**Implementation overview:** This project assumes a basic understanding of geometric terminology (e.g., parallel, perpendicular, etc.), but it can serve as a good refresher to tighten up core understanding in these areas. Once students have been introduced to using a geoboard, they can be challenged to make the items listed below. For those they believe not to be possible, students should work with peers to discuss possible solutions, or to develop a mathematical justification for why such a construction is not possible.

- Two parallel lines
- Two perpendicular lines
- One line that does not have a parallel
- One line that does not have a perpendicular
- Two intersecting lines that do not have a perpendicular
- Two lines that will intersect only if they are extended off the geoboard
- Two lines that intersect at more than one point

**Character dimensions:** Intellectual Character is developed as students test their understanding of core geometric concepts. Some of these original constructions they will know to be impossible, thus requiring application of a sophisticated understanding of the underlying principles. Performance Character is developed as they are challenged to work at constructions that may appear to be impossible at first, testing multiple options before deciding if it is impossible. Civic Character is developed as students maintain classroom norms of common inquiry and constructive response when they seek clarification or do not agree. Moral Character is developed as students build their own mathematical identity and by maintaining positive interpersonal relations with their peers and by recognizing the talents and achievements of others.
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?*

Shields (2011) calls this dimension of character the “passion for the public good,” which equips us with the disposition to be actively engaged in the communities of which we find ourselves a part. This might be on a small scale such as a family or a working team, or in progressively larger groups, such as the classroom, school, community, and beyond. In each, there is an impetus to be a contributing member of that society, both in terms of what we bring to the table and in the ways in which our actions and attitudes serve to build up the vitality and functional ability of that community. This effort at improving the educational civitas may look out of place in an effort to improve students’ academic achievement (which, in the U.S., tends to be very individually focused), but project examples offer ways for the pursuit of individual excellence and to be a contributing member of a learning community.

**Math + Character Development Activity**

“Running with the Dogs” for Grade 6

**Student goal:** To work with a finite amount of fencing to optimize a dog run for the city park.

**Implementation overview:** Students can be presented with a challenge of helping to design a dog run at a local park. Given 100 feet of fence, how would they recommend setting up the dog run? ‘1’ x 49’ would be one option, giving 49 square feet of space. 2’ x 48’ would almost double this to 96 square feet. Is there a solution that maximizes the area? Is this maximum area the best solution in terms of the dogs’ use of the run? What are the trade-offs that have to be made?

Students can make individual or small group recommendations. As part of their presentation, they can be challenged to decide on the best way to present their data using tools such as graphs and tables. They can provide peer review of the different solution options, offering suggestions on key parameters, such as clarity of how the information is displayed and the recommendation are made, as well as aesthetic considerations. Students may also offer solutions that are based on optimized use, rather than simply maximizing the total area. For example, would a longer, narrow space allow dogs to run better than a more squared-up shape? This can lead to discussions where optimal use may not be the mathematically optimal solution.

**Character dimensions:** Civic Character is developed as students apply their mathematics skills to address a community issue, as well as when they work to establish and maintain classroom norms of common inquiry and constructive response when they seek clarification or do not agree. Intellectual Character is developed as students apply and extend mathematical concepts in search of the best answer and as they balance competing goals (optimal use vs. maximum area). Performance Character is enhanced through an invitation to persistence in considering the full range of possible solutions and as they are challenged to defend theirs as the best solution. Moral Character is developed as students build their own mathematical identity and by maintaining positive interpersonal relations with their peers and by recognizing the talents and achievements of others.
Moral Character
generally refers to how people interact with each other. Issues of kindness, consideration, and empathy are critical: What does it mean to be a good person and to see the value in others?

Considering moral dimensions might just hold the key to bringing new vitality to the K-12 mathematics field. Shields (2011) calls Moral Character “a disposition to seek goodness.” It involves knowing, caring about, and doing the right thing in an ethical sense, including “virtues” such as justice and honesty. It incorporates a disposition to act in ways that are kind, helpful, and respectful of other people’s needs and interests.

John Dewey (as cited in Fesmire, 2003), on the other hand, offers a more general framing of moral values as part of a pragmatic social intelligence. With Dewey’s approach, rather than running each situation through a fixed moral decision tree, a person faced with moral choices has the situational awareness to understand the relevant issues and is able to make a choice that is appropriate for the time and place. A different set of circumstances may call for a different response.

Math + Character Development Activity “Who Wins” for Grade 12

Student goal: To evaluate the fairness of a game in which two players move forward using different rules. If student find that the game is not fair, they are challenged to re-design it to enable an equal chance of winning.

Implementation overview: Students can work in pairs to play the following game: The first player moves forward three spaces each turn. The second player moves by rolling a standard die and moving that many spaces. The first one to move 100 spaces wins. After playing the game a few times, students should have a handle on who will win most often. From here they can address two challenges: Would a shorter or longer game change the outcomes? How could the game be altered to ensure an equal chance of each player winning?

For both of these challenges, students should use their growing understanding of probability and statistics to justify their conclusions, not simply make assertions that are based only on the results of the games they played. Conclusions and recommendations can be made with appropriate support, in the form of graphs and tables, as students deem them to be useful.

Character dimensions: Moral Character is developed as students build their own mathematical identity and by maintaining positive interpersonal relations with their peers and recognizing the talents and achievements of others. This project also challenges students to consider issues of fairness in competition and how rules can intentionally or otherwise bias a game in one direction. Intellectual Character is developed as students apply and test their understanding of basic probability concepts. Also, in making representations to justify their assertions about the fairness of the game (or the lack thereof), other basic math skills are employed intentionally, chosen for their applicability in this context. Performance Character is developed as students are challenged to work “off script” in a problem that is not amenable to a simple worksheet exercise. Instead, they need to develop and apply an investigative scheme to assess the fairness of the game. Civic Character is developed as students maintain classroom norms of common inquiry and constructive response when they seek clarification or do not agree.
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: Do students and teachers feel safe and happy at school? Does our school inspire adults and children to excel?

Working in tandem with the dimensions of individual-level character, Shields (2011) describes an overarching consideration for building a culture of character. Here, he is concerned with the school community, in which the students’ work serves to promote these dimensions of character. In the highly individualistic, test score-based culture of most current mathematics education in this country, considerations of character are secondary to the driving concern for “improvement” as measured through increased test scores. Thus, character education is all too often shut out or given short shrift in the limited time available in the class day.

Illustrative Activity Family Engagement Activities

Family Goal: To help families experience school as a welcoming, supportive place and to strengthen families’ support for students’ social, ethical, and intellectual development. Intentionally including activities that introduce CCSS-M learning activities will help parents experience math as fun and potentially reduce their own math negativity. Homeside Activities (Developmental Studies Center, 1995) are short activities that the teacher periodically assigns for students to do at home with the family to connect school learning with family experiences and viewpoints. These activities involve students in discussions with family members about diverse topics such as family history, values, and school experiences, including non-threatening math activities. (Battistich, 2007a). The goal is.

In Math Literacy and the Common Core (2012), author Steven James describes a third-grade activity that engages students in an interactive process of creating and acting out skits or plays that help students become fluent and precise in their use of math vocabulary. With this type of creative math activity, teachers can engage students in fun, relatively errorless math and in discussions related to conflict management and anti-bullying strategies. The play can be performed for parents and peers allowing the whole school community to experience the fun of math.
CONCLUSION

Throughout history, and in cultures all over the world, education rightly conceived has had two great goals: to help students become smart and to help them become good. —Thomas Lickona and Matthew Davidson, Smart & Good High Schools (2005)

How will the U.S. better prepare students for 21st century success? Research tells us that our students’ character—traits like persistence, optimism, carefulness and courage—matters more to their higher education and labor market success than their knowledge acquisition or cognitive ability. We found sufficient evidence to suggest that math achievement also depends on the development of character traits or virtues. However, unlike the nations producing superior math achievement, the U.S. does not have a nationally-established, well-funded character education curriculum.

We suggest that wide adoption of the new CCSS-M presents an opportunity because the standards emphasize the character traits necessary for math learning. Explicitly aligning the CCSS-M with character education could produce a fresh approach to K-12 math instruction that importantly will also help our students develop the traits needed to excel not only at math, but in life.

This paper is intended as a first step. We introduce a character development framework that involves five integrated dimensions of character: performance, intellectual, moral, civic and collective. Sample projects illustrate how math educators can use this character education framework in K-12 classrooms. Next steps, such as collecting and making easily accessible other excellence resources to support aligning character education and the Common Core would further support math educators. It is our hope that aligning the CCSS-M and character education will result in our students not only becoming more superior math learners, but also the best version of themselves.
REFERENCES


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