Ten Myths About Math Education And Why You Shouldn't Believe Them

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For almost two decades, mathematics education in K-12 classrooms has been driven by unsupported pedagogical theories constructed in our schools of education and propagated by the National Council of Teachers of Mathematics (NCTM). Their curricular and pedagogical "vision" for mathematics education reform, articulated in the two NCTM standards documents (1989 and 2000), has dominated local, state and federal education decision-making and policies, as well as public discussions, and press coverage. But many parents, mathematics experts, and K-12 teachers of mathematics do not share this vision.

A well-informed group of education stakeholders rejects the NCTM doctrine and model for mathematics reform. The expertise and viewpoints of this diverse group, comprised of mathematicians and scientists, K-12 teachers of mathematics, educational researchers, and concerned parents across our nation has been regularly eclipsed and marginalized by the dominant voice of mathematics educators in our schools of education and of NCTM officials. This constituency's expertise is often entirely absent from the decision-making process. We are members of that constituency, and are part of an informal bipartisan grassroots coalition of advocates for authentic reforms in mathematics education.

The chart below offers our point by point refutation of a set of common myths propagated by mathematics educators in our schools of education and NCTM officials that are often presented as fact to policy makers and the general public.

"NCTM" (Fuzzy) Myth	Reality	References
Myth #1 *Only what students discover for themselves is truly learned.*	Students learn in a variety of ways. Basing most learning on student discovery is time-consuming, does not insure that students end up learning the right concepts, and can delay or prevent progression to the next level. Successful programs use discovery for only a few very	Dixon, R., Carnine, D., Lee, D. Wallin, J., & Chard, D. (1998). Review of High Quality Experimental Mathematical Research: Executive Summary. Eugene, OR: National Center to Improve the Tools of Educators, University of Oregon. Klahr, D. & Nigam, M. (2004). The

	carefully selected topics, never all topics.	Equivalence of Learning Paths in Early Science Instruction: Effects of Direct Instruction and Discovery Learning. Psychological Science, 15, 10, 661-667. Becker, W. C. and Engelmann, S.; Sponsor Findings From Project Follow Through. University of Oregon. John R. Anderson, Lynne M. Reder, Herbert A. Simon. Applications and Misapplications of Cognitive Psychology to Mathematics Education. R. James Milgram, "What is Mathematical Proficiency?," March, 2004. Invited address, First Workshop on Mathematics Education. Mathematics and Science Research Institute, Berkeley, CA.
Myth #2 *Children develop a deeper understanding of mathematics and a greater sense of ownership when they are expected to invent and use their own methods for performing the basic arithmetical operations, rather than study, understand and practice the standard algorithms.*	Children who do not master the standard algorithms begin to have problems as early as algebra I. The snubbing or outright omission of the long division algorithm by NCTM- based curricula can be singularly responsible for the mathematical demise of its students. Long division is a pre-skill that all students must master to automaticity for algebra (polynomial long division), pre-calculus (finding roots and asymptotes), and calculus (e.g., integration of rational functions and Laplace transforms.) Its demand for estimation and computation skills during the procedure develops number sense and facility with the decimal system of notation as no other single arithmetic operation affords.	General reference: The algebra, pre-calculus and calculus teachers and professors who must remediate or flunk these children. From 1998 issue of the Notices of the American Mathematical Society: *"We would like to emphasize that the standard algorithms of arithmetic are more than just 'ways to get the answer' -- that is, they have theoretical as well as practical significance. For one thing, all the algorithms of arithmetic are preparatory for algebra, since there are (again, not by accident, but by virtue of the construction of the decimal system) strong analogies between arithmetic of ordinary numbers and arithmetic of polynomials."* (The above was quoted in an open letter to Secretary of Education Richard Riley in 1999, which was signed by 200 prominent U.S. mathematicians.) The Role of Long Division in the K-12 Curriculum; David Klein (California State University, Northridge), R. James

		Milgram (Stanford University)
Myth #3 *There are two separate and distinct ways to teach mathematics. The NCTM backed approach deepens conceptual understanding through a problem solving approach. The other teaches only arithmetic skills through drill and kill. Children don't need to spend long hours practicing and reviewing basic arithmetical operations. It's the concept that's important.*	"The starting point for the development of children's creativity and skills should be established concepts and algorithms... Success in mathematics needs to be grounded in well-learned algorithms as well as understanding of the concepts." What is taught in math is the most critical component of teaching math. How math is taught is important as well, but is dictated by the "what". Much of understanding comes from mastery of basic skills - an approach backed by most professors of mathematics. It succeeds through systematically empowering children with the pre-skills they need to succeed in all areas of mathematics. The myth of conceptual understanding versus skills is essentially a false choice - a bogus dichotomy. The NCTM standards suggested "less emphasis" on topics needed for higher math, such as many basic skills of arithmetic and algebra. "That students will only remember what they have extensively practiced - and that they will only remember for the long term that which they have practiced in a sustained way over many years - are realities that can't be bypassed."	Kenneth Ross, Chair, Mathematical Association of America President's Task Force on the NCTM Standards. (June 1997). Response to NCTM's Commission on the Future of the Standards. Basic Skills vs Conceptual Understanding; a Bogus Dichotomy; Hung-Hsi Wu, Department of Mathematics, University of California, Berkeley (American Educator, Fall, 1999). Willingham, D. (Spring 2004). Practice Makes Perfect-But Only If You Practice Beyond the Point of Perfection. American Educator. Algorithms, Algebra, and Access, by Stanley Ocken (Sep 2001). In Defense of "Mindless Rote", by Ethan Akin (Mar 30, 2001). On the Algorithms of Arithmetic, by Ralph Raimi (2002).
Myth #4 *The math programs based on NCTM standards are better for children with learning disabilities*	"Educators must resist the temptation to adopt the latest math movement, reform, or fad when data-based support is lacking..." Large-scale data from California and foreign countries show that	Miller, S.P. and Mercer, C.D., "Educational Aspects of Mathematics Disabilities." January/February 1997, Journal of Learning Disabilities, Vol. 30, No. 1, pp. 47-56. Darch, C., Carnine, D., & Gersten, R.

learning disabilities than other approaches.	children with learning disabilities do much better in more structured learning environments.	(1984). "Explicit Instruction in Mathematics Problem Solving." The Journal of Educational Research, 77, 6, 351-359.
Myth #5 *Urban teachers like using math programs based on NCTM standards.*	"Mere mention of [TERC] was enough to bring a collective groan from more than 100 Boston Teacher Union representatives..."	Editorial, "Mathematical Unknowns," The Boston Globe, November 8, 2004, A10.
Myth #6 *"Calculator use has been shown to enhance cognitive gains in areas that include number sense, conceptual development, and visualization. Such gains can empower and motivate all teachers and students to engage in richer problem-solving activities." (NCTM Position Statement)*	Children in almost all of the highest scoring countries in the Third International Mathematics and Science Survey (TIMMS) do not use calculators as part of mathematics instruction before grade 6. A study of calculator usage among calculus students at Johns Hopkins University found a strong correlation between calculator usage in earlier grades and poorer performance in calculus.	Calculating the cost of calculators, Lance Izumi, Capitol Ideas, Pacific Research Institute, Vol. 5, No. 51, December 21, 2000. W. Stephen Wilson, K-12 Calculator Usage and College Grades Educational Studies in Mathematics.
Myth #7 *The reason other countries do better on international math tests like TIMSS and PISA is that those countries select test takers only from a group of the top performers.*	On NPR's "Talk of the Nation" program on education in the U.S. (Feb. 15, 2005), Grover Whitehurst, Director of the Institute of Education Sciences at the Department of Education, stated that test takers are selected randomly in all countries and not selected from the top performers.	Grover Whitehurst, Director, Institute of Education Sciences; on NPR Talk of the Nation, February 15, 2005;
Myth #8 *Math concepts are best understood and mastered when presented "in context";*	Applications are important and story problems make good motivators, but understanding should come from building the math for universal application. When story problems take center	The Mathematician and Mathematics Education Reform; Hung-Hsi Wu, University of California, Berkeley; in Notices of the American Mathematical Society, 43(1996), 1531-1537).

in that way, the underlying math concept will follow automatically.	stage, the math it leads to is often not practiced or applied widely enough for students to learn how to apply the concept to other problems. "[S]olutions of problems ... need to be rounded off with a mathematical discus-sion of the underlying mathematics. If new tools are fashioned to solve a problem, then these tools have to be put in the proper mathematical perspec-tive. ... Otherwise the curriculum lacks mathematical cohesion."	
Myth #9 *NCTM math reform reflects the programs and practices in higher performing nations.*	A recent study commissioned by the U.S.Department of Education, comparing Singapore's math program and texts with U.S. math texts, found that Singapore's approach is distinctly different from NCTM math "reforms." Also, a paper that reviews videotaped math classes in Japan shows that there is teacher-guided instruction (including a wide variety of hints and helps from teachers while students are working on or presenting solutions).	What the United States Can Learn From Singapore's World-Class Mathematics System (and what Singapore can learn from the United States); American Institutes for Research; for U.S. Department of Education; January 28, 2005; Washington, D.C. Siegel, Alan R. Telling Lessons from the TIMSS Videotape: remarkable teaching practices as recorded from eighth-grade mathematics classes in Japan, Germany and the US. Chapter 5 in ``Testing Student Learning, Evaluating Teaching Effectiveness," Williamson M. Evers and Herbert J. Walberg, Eds., Hoover Institution Press, May, 2004, pp. 161-194.
Myth #10 *Research shows NCTM programs are effective.*	There is no conclusive evidence of the efficacy of any math instructional program. Increases in test scores may reflect increased tutoring, enrollment in learning centers, or teachers who supplement with texts and other materials of their own choosing. Also, much of the "research" touted by some of the NSF programs has been	On Evaluating Curricular Effectiveness: Judging the Quality of K-12 Mathematics Evaluations; National Research Council, the National Academies Press; September, 2004. The state tests in Maryland have a number of 3 point problems in which students are awarded 1 point for performing the math correctly and 2 points for explaining it. It is thus possible to do the math right but get half

	conducted by the same companies selling the programs. State exams are increasingly being revised to address state math standards that reflect NCTM guidelines rather than the content recommended by mathematicians.	the credit that another student gets with the wrong answer.

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Additional web resources for mathematics education advocacy

National Organizations

New York City HOLD # Mathematically Correct

News

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Local Activism

Illinois Loop # Parents for Evidence Based Education (IA) # Teach Us Math, Parents Concerned With Penfield (NY)'s Math Programs # Plano (TX) Parental Rights Council # PBSfx: Parents for Better Schools (Fairfax, VA) # Save Our Children from Mediocre Math (Conejo Valley, CA) # Simsbury (CT) Math Wars # Teach Utah Kids # Kids Do Count (UT)

Curriculum Reviews

Mathematically Correct Program Reviews # NYC HOLD Curriculum Reviews # Illinois Loop Mathematics Reviews and More # Earlier MC Program Reviews for Grades 2, 5, and 7

Reviews of Mathematics Standards

The State of State Math Standards 2005 #

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* Affiliations or positions are provided for identification purposes only and do not imply institutional or organizational support.

State Mathematics Standards 1998 # NCTM Principles and Standards for School Mathematics # NYC HOLD on Standards and Assessments

Personal Pages and Weblogs

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