NCSM Journal

of Mathematics Education Leadership

Spring 2008
Vol. 10, No. 1

Start at Square One

Which Way Will You Effect Change in Our Profession?

NATIONAL COUNCIL OF SUPERVISORS OF MATHEMATICS

The NCSM Journal of Mathematics Education Leadership is published at least twice yearly, in the spring and fall.

The editors of the NCSM Journal of Mathematics Education Leadership are interested in manuscripts that address concerns of leadership in mathematics rather than those of content or delivery. Editors are interested in publishing articles from a broad spectrum of formal and informal leaders who practice at local, regional, national, and international levels. Categories for submittal include:

- Key Topics in Leadership
- Case Studies
- Research Report and Interpretation
- Commentary on Critical Issues in Mathematics Education
- Professional Development Strategies

Note: The last two categories are intended for short pieces of 2 to 3 pages in length.

Submission/Review Procedures

Submittal of items for this publication must include three hard copies and a disk copy in text format. Do not put any author identification in the body of the item being submitted, but do include author information as you would like to see it in the Journal. Items submitted for publication will be reviewed by two members of the NCSM Review Panel and one editor with comments and suggested revisions sent back to the author at least six weeks before publication. Final copy must be agreed to at least three weeks before publication.

Cover photo from istockphoto.com

Inquiries about and materials for the NCSM Journal of Mathematics Education Leadership may be sent to:

Gwen Zimmermann
Adlai E. Stevenson High School
One Stevenson Drive
Lincolnshire, IL 60069
Email: gzimmermann@district125.k12.il.us

Other NCSM inquiries may be addressed to:

National Council of Supervisors of Mathematics
9373 S. Prairie View Drive
Highlands Ranch, CO 80126
Email: ncsm@forum.swarthmore.edu
ncsm@mathforum.org

Table of Contents

Purpose Statement

The purpose of the National Journal of Mathematics Education Leadership is to advance the mission and vision of the National Council of Supervisors of Mathematics by:

- Strengthening mathematics education leadership through the dissemination of knowledge related to research, issues, trends, programs, policy, and practice in mathematics education

- Fostering inquiry into key challenges of mathematics education leadership

- Raising awareness about key challenges of mathematics education leadership, in order to influence research, programs, policy, and practice

- Engaging the attention and support of other education stakeholders, and business and government, in order to broaden as well as strengthen mathematics education leadership

Comments From the Editor

The Starfish Story

Gwendolyn Zimmermann
Adlai E. Stevenson High School
Lincolnshire, Illinois

"One day a man was walking along the beach when he noticed a boy picking something up and gently throwing it into the ocean. Approaching the boy, he asked, "What are you doing?" The youth replied, "Throwing starfish back into the ocean. The surf is up and the tide is going out. If I don't throw them back, they'll die." "Son," the man said, "don't you realize there are miles and miles of beach and hundreds of starfish? You can't make a difference!"

After listening politely, the boy bent down, picked up another starfish, and threw it back into the surf. Then, smiling at the man, he said . . . "I made a difference for that one." (Original story by Loren Eisley)

The story of the starfish reminds us that making a difference can begin with helping just one. For a teacher, this can mean making a difference with one student or with one colleague. For leaders, we can begin to make a difference by working with one administrator, one parent, one teacher, or one student. No matter how one might feel about NCLB, as educators we embrace the vision of each and every student learning meaningful mathematics from high quality teachers. The task of realizing this vision for every student is daunting. Yet we can begin by making a difference for just one.

Each of the four articles in this issue gives us food for thought on how we might lead for effective change in the teaching and learning of mathematics. With so many stakeholders in mathematics education, opportunities for change are plentiful.

The first article addresses the topic of effective use of manipulatives in the mathematics classroom. Kathryn Chval and Robert Reys invite the reader to take a brief quiz to determine his or her knowledge of research about the use of manipulatives in elementary school classrooms. The authors then offer practical advice on how leaders can support teacher use of manipulatives in meaningful ways to enhance student learning.

The second article examines secondary mathematics initiatives and programs being implemented in urban schools that show promise in improving student achievement. After collecting data from 30 schools and districts, analysis revealed 22 "practices worthy of attention." These practices are organized into five categories ranging from programs focused algebra concepts and skills to the use of assessments. As high school districts and buildings explore options to positively impact student achievement in mathematics, the initiatives and programs Pamela Paek identifies might be considered.

The third article describes an NSF-funded project focused on improving student achievement in low-performing districts in Maine, through the implementation of new curriculum materials combined with professional development for teachers and administrators. The BEAMM project implemented a framework of differentiated professional development. To sustain the work of teachers, a leadership component was also identified. Upon analysis of their data, Cheryl Rose and Francis Eberle found students' performance in mathematics had increased.

The fourth article outlines the journey that one state took to revise its state standards to align with NCTM's *Curriculum Focal Points*. The intent was that the new standards would be more rigorous and coherent than the previous standards. As you might imagine, being the first state to attempt to align to the *Curriculum Focal Points* presented many challenges. Juli Dixon and Gladis Kersaint share how the group addressed different issues that arose through the process of rewriting Florida state standards in mathematics.

As a mathematics education leader, which starfish will you choose to begin with in your journey to effect change in the teaching and learning of mathematics? Perhaps you will work with a teacher to support use of manipulatives in her classroom. Maybe you will work with a school or district to identify promising initiatives that target student achievement. Opportunities to facilitate the implementation and professional development of newly adopted curriculum could be a possibility. Or maybe you can get involved at the state level influencing policy and educational decisions about mathematics. Whatever your sphere of influence may be, remember that to make a difference only needs to begin with one starfish.

To make a difference,
you only need to begin
with one starfish.
Which starfish will you choose?

Effective Use of Manipulatives Across the Elementary Grade Levels:

Moving Beyond Isolated Pockets of Excellence to School-Wide Implementation

Kathryn B. Chval and Robert Reys
University of Missouri

Imagine a school where first grade students solve problems and discuss their mathematical thinking with the support of manipulatives, but when students enter the second and third grades, they are no longer able to use manipulatives. When these same children enter fourth grade, the manipulatives become available again. What are the implications for the children in this scenario? Now imagine you are the fourth grade teacher. The children have not used manipulatives in the mathematics classroom for two years. What are the implications for your instruction in this scenario? Obviously, this situation suggests that uneven use of manipulatives is not in the best interest of children or teachers. Therefore, it is important to not only consider the effective use of manipulatives within individual classrooms, but also their appropriate use across elementary grade levels. This article discusses the research base on the use of manipulatives and strategies for leaders to help colleagues begin to use or strengthen their use of manipulatives so that effective school-wide implementation becomes a reality in more elementary schools.

What Are Manipulatives?

Manipulative materials are objects that appeal to several senses — sight and tactile, so they can be touched and moved about. Ideally these manipulative materials serve as physical models allowing mathematical ideas to be abstracted from use with them. Manipulatives have become prevalent in curriculum materials and in elementary classrooms. Commercial manipulatives abound, including, copyrighted Cuisenaire Rods® to generic base ten blocks, pattern blocks, and interlocking cubes. In addition to commercial manipulatives, the use of teacher made/gathered manipulatives, such as buttons, ten-frame tiles, mirrors, and straws add to a variety of materials that can be used to model mathematical concepts and facilitate active engagement in learning mathematics. Advances in technology have also resulted in many applets that have expanded the notion of "hands-on" manipulatives (Clements and McMillin 1996) to include "virtual manipulatives" (Hodge 2003). For example, see the Math Forum (http://mathforum.org/mathtools); National Library of Virtual Manipulatives (http://www.matti.usu.edu); and NCTM Illumination Activities (http://illuminations.nctm.org/ActivitySearch.aspx). Overall, elementary teachers have an overwhelming number of choices and decisions to make when it comes to not only selecting but also using manipulatives to improve the teaching and learning of mathematics. For example, teachers may decide to model or demonstrate a mathematical idea using a specific manipulative. Teachers may also provide manipulatives to students to use as tools to investigate mathematical problems they do not know how to solve.

What Does the Research Say About Using Manipulatives?

A steady line of research on manipulatives and their impact on mathematics teaching and learning has been reported for decades (Beougher 1967; Suydam and Higgins 1977; Sowell 1989; Uttal, Scudder, and DeLoache 1997). While research related to manipulatives in school environments is complex,

This article resulted from classroom teachers supported by the Center for the Study of Mathematics Curriculum funded by the National Science Foundation under Grant No. ESI-0333879. The opinions in this article, however, are solely those of the authors and do not necessarily reflect the policy or position of the National Science Foundation.

the research findings are overwhelmingly positive in their support of teachers using manipulative materials in mathematics classes. Despite strong support from research and the existence of more manipulatives, many elementary teachers are reluctant if not resistant to using manipulatives as a regular part of their mathematics teaching. Unfortunately, this reality can lead to situations that are similar to the one described in the opening paragraph.

While research supports the use of manipulatives in helping children learn mathematics, research on the value and impact of manipulatives is complicated by many factors, such as which manipulatives were used, the length of time they were used, how they were used, and who used them (children/teacher). Nevertheless, a number of reasonable conclusions can be drawn from the existing research base that may help dispel some myths about manipulatives. Take the true/false quiz in Figure 1 to assess your own knowledge regarding the research/policy base on the use of manipulatives in elementary school classrooms.

Figure 1

Write "True" or "False" for each statement.

_____ 1. Teachers' use of manipulatives decreases as the grade levels increase.

_____ 2. Good mathematics teaching always includes the use of manipulatives.

_____ 3. Manipulatives are more useful with less-experienced students than more-experienced students.

_____ 4. Students need not necessarily manipulate the materials to gain mathematical understanding.

_____ 5. Teachers sometimes overestimate the value of manipulatives because they know and understand the mathematical concept being represented.

_____ 6. Manipulatives may be used before or after a procedure is learned with generally equal success.

_____ 7. Teachers need to help students connect the mathematical concept(s) being explored with the manipulatives.

_____ 8. Students need to reflect on their actions with concrete materials to maximize their learning.

_____ 9. Almost any manipulative can be used to teach any mathematical concept.

_____ 10. Manipulatives are more useful in the elementary grades than in the upper grades.

See Figure 2 for answers.

Why Are Some Teachers Reluctant to Use Manipulatives?

For a number of reasons, teachers' use of manipulatives in elementary classrooms has grown significantly in the past twenty years. Yet, in some schools effective use of manipulatives has been in isolated pockets. Even when manipulatives are available and included in mathematics textbooks, some teachers make decisions to limit their use. This reluctance to use manipulatives may be a consequence of teachers' lack of familiarity with the available manipulatives. It may be influenced by the fact that their own experience as learners in K-12 mathematics classes did not include manipulatives. It may be based on their experiences with using manipulatives during instruction that led to challenging classroom management situations or frustrated students. Regardless of the influencing factors, many teachers show reluctance to using manipulatives to help children learn mathematics. This leads to uneven or ineffective use of manipulatives across the grade levels and it raises the question:

How Can Leaders Support Teachers?

How can you support teachers to effectively use manipulatives in every elementary grade level in your school or district? We asked experienced classroom teachers this question, and received many excellent suggestions.[1] As we examined their suggestions, we recognized that their ideas would be useful to other leaders. Multiple stages of action were suggested, with the first step to understand why teachers are resistant to use manipulatives and then to identify some specific actions that might help promote change. Throughout this process, it is essential to proceed with caution, being careful not to overwhelm or push too hard in bringing about change. The following suggestions may be useful for your school or district.

Determine what is available. A teacher survey may be used to determine what manipulatives are available (Hatfield 1994; Scott 1983). It may lead to an inventory of manipulatives that are available by room, grade or building. Such information is helpful in determining the range of manipulatives that exist, and may reveal shortages or areas of need for additional materials. This information may also lead to a discussion about characteristics of manipulatives to be used in mathematics teaching. Discussions of physical as well as pedagogical criteria for manipulatives can be informative and generate healthy discussions about home made and commercially available manipulatives (Hynes 1986; Reys 1971). It may result in teachers reflecting on and discussing their current mathematics curriculum, mathematical concepts, and more specifically student mathematical thinking.

Understand why teachers are resistant to using manipulatives. The challenge here is to learn why teachers are resistant to using manipulatives in a non-threatening and non-critical way. Allow teachers to present their thoughts, concerns, fears, and experiences. For example, teachers may describe objections related to prior unsuccessful classroom use of manipulatives, lack of access to manipulatives, lack of understanding the connections between the manipulatives and the mathematical concepts, or difficulty managing children and manipulatives. Identifying specific objections is the first step in finding solutions.

Address concerns. After assessing the concerns of teachers throughout the school, you may realize that several teachers have similar concerns while other individuals have unique concerns. In either case, teachers will need to work together to address concerns that have been raised.

Determine who has expertise about and experience with manipulatives. Teachers who have used specific manipulatives effectively to address mathematical goals can share how they use them. This sharing will allow other teachers to contribute additional ideas and suggestions, as well as provide a climate where teachers may ask questions about using the manipulatives. This setting may also lead to discussions about how these manipulatives actually facilitate mathematics learning, and the important role that teachers play in helping children make connections between manipulatives and mathematical concepts.

Start with a few lessons. Focus on a few teachers or a specific grade level. As a group, collaborate and plan a few lessons together. Identify the teachers' mathematical goals for each lesson and then help them select and use appropriate manipulatives to accomplish their goals. After each teacher in the group has taught the lessons, meet to discuss how to improve the lessons. Focusing on a few lessons each semester that target the use of manipulatives will create a collection that can be slowly expanded without overwhelming teachers. More importantly, the establishment of this regular process of teachers working together to develop, teach, and reflect on their mathematics lessons will improve mathematics teaching and learning.

Watch others. Providing structured opportunities for teachers to observe one another teach can facilitate more effective teaching. Observations and related discussions regarding manipulatives may help teachers with issues related to classroom management and student learning. Observations focused on one small group of students using manipulatives or focused on how a teacher helps students make connections between the manipulatives and the mathematics may increase the effectiveness of the observations by providing structure. If teachers are uncomfortable observing colleagues, observing and discussing videotapes (e.g., Cognitively Guided Instruction or Project Construct videos) in a group provides an alternative approach. This approach allows larger groups of teachers to observe classrooms and allows video segments to be replayed and analyzed more carefully.

Provide a rationale for using manipulatives. Much has been written about the value of manipulatives and their potential role in elementary classrooms. Discussing a few of the true/false questions in Figure 1 or professional articles (Kennedy 1986; Moyer, Bolyard, and Spikell 2002) can both inform and stimulate discussion. Such readings help establish an important intellectual foundation for using manipulatives as well as provide guidance on how to use manipulatives to facilitate mathematical learning. An examination of some research, either first hand reports (Uttal, Scudder, and DeLoache 1997) or research summaries (Driscoll 1981; Suydam 1996, Thompson and Lambdin 1994) can be very helpful. However, the most persuasive evidence will be gathered from actual student performance in your building. Therefore, showing examples of student work that documents improved understanding and performance in mathematics as a result of using manipulatives will be very powerful.

Tread carefully. While manipulatives can be powerful instructional tools for helping children learn mathematics, their use alone does not guarantee success. The challenges of using manipulatives effectively and related issues that teachers need to keep in mind have been voiced (Ball 1992; Baroody 1989) and need to be considered. Keep lines of communication open with teachers to provide support and discuss questions/challenges that are bound to arise. As you interact with and listen to teachers, ask how you can support them and encourage their efforts. Involve teachers and administrators in planning a course of action. In general, tread lightly and respect the bee hive!

[1] *Thanks to the following teachers and curriculum coordinators for sharing their ideas: Rob Allen, Aina Appova, Marlene Anderson, Sandra Baker, Bob Borst, Marilee Cameron, Linda Coutts, Lottie Creasy, Sarah Croom, Shannon Dingman, Nancy Fagan, Stephanie Grimes, Sharon Jacoby, Kim Jett, Elle Liu, Jenine Losing, Jennifer Mast, Ryan Nivens, Teresa Norton, Chris O'Gorman, Travis Olson, Troy Regis, Vickie Rorvig, Chip Sharp, Dawn Teuscher, and Junko Togashi.*

Conclusion

Developing teachers' knowledge and comfort in using manipulatives is an on-going challenge. The challenge exists for teachers who are resistant or hesitant to use manipulatives, as well as for lead teachers who have acquired expertise with manipulatives. As new models/manipulatives continue to become available, it takes time and energy to learn when and how to use them well to facilitate mathematical learning. These stages—from initial awareness to hesitation to instructional attempts to continuing refinement—are learning cycles that every teacher experiences. Even though this discussion has focused on supporting teachers who have shown reluctance to using manipulatives, we believe the identified strategies will support the professional growth of all teachers and thus improve mathematics teaching and learning at the school-wide level. Uneven or ineffective use of manipulatives at the school-wide level is not in the best interest of children or teachers. Ensuring that isolated pockets of success are expanded across the grade levels to achieve effective school-wide implementation requires a conscious, sustained effort facilitated by effective leaders.

Figure 2

True-False Answers

__True__ 1. Teachers' use of manipulatives decreases as the grade levels increase.
Use of manipulatives is greatest among primary grade teachers, and manipulative use decreases as the grade levels increase (Hatfield 1994; Grouws and Smith 2000).

__False__ 2. Good mathematics teaching always includes the use of manipulatives.
Teaching is a complex practice and good teaching of mathematics is "not reducible to recipes or prescriptions." (NCTM 1991, p. 22).

__False__ 3. Manipulatives are more useful with less-experienced students than more-experienced students.
Manipulatives have been recommended as a means of improving performance for all levels of students, including gifted students (Peterson, Mercer, and O'Shea 1988).

__True__ 4. Students need not necessarily manipulate the materials to gain mathematical understanding.
Teacher demonstration of manipulatives can be effective in facilitating mathematical learning (Suydam 1996).

__True__ 5. Teachers sometimes overestimate the value of manipulatives because they know and understand the mathematical concept being represented.
Children do not have the same understanding as their teachers so it becomes very important that teachers help children make connections between the manipulative and the mathematical concept being developed (Suydam and Higgins 1977; Fuson, et. al. 1997).

__False__ 6. Manipulatives may be used before or after a procedure is learned with generally equal success.
Models and manipulatives seem to be most effective in the developmental stages and prior to procedures or algorithms being learned (National Research Council 2001).

__True__ 7. Teachers need to help students connect the mathematical concept(s) being explored with the manipulatives.
Manipulatives have many components and children may not always focus on the key variables. Teachers need to help children make connections between relevant variables and the mathematics (Beishuizen, Gravemeijer, and van Lieshout 1997; National Research Council 2001).

__True__ 8. Students need to reflect on their actions with concrete materials to maximize their learning.
Children may use the manipulatives without making any connections to relevant mathematical concepts. Teachers need to ask questions and encourage students to reflect on their actions with the materials (Uttal, Scudder, and DeLoache 1997).

__False__ 9. Almost any manipulative can be used to teach any mathematical concept.
One size does not fit all. Manipulatives need to be carefully selected to embody the mathematical concepts being developed (Dienes 1969).

__False__ 10. Manipulatives are more useful in the elementary grades than in the upper grades.
Manipulatives have been shown effective in supporting mathematics learning and achievement with elementary, middle and high school students (Driscoll 1981; Sutton and Krueger 2002).

References

Ball, Deborah Lowenberg. "Magical Hopes: Manipulatives and the Reform of Math Education." *American Educator* 16 (1992): 14-18.

Baroody, Arthur J. "Manipulatives Don't Come with Guarantees." *Arithmetic Teacher* 37 (2) (October 1989): 4-5.

Beishuizen, Marco, Koeno Gravemeijer, and Ernest van Lieshout, eds. *The Role of Contexts and Models in the Development of Mathematical Strategies and Procedures*. Utrecht: CD-B Press/Freudenthal Institute, 1997.

Beougher, Elton. *The Review of the Literature and Research Related to the Use of Manipulative Aids in the Teaching of Mathematics*. Pontiac, MI: Division of Instruction Oakland Schools, 1967.

Carpenter, Thomas, Elizabeth Fennema, Megan Franke, Linda Levi, and Susan Empson. *Children's Mathematics: Cognitively Guided Instruction*. Portsmouth, NJ: Heinemann, 1999.

Clements, Douglas H. and Sue McMillen. "Rethinking 'Concrete' Manipulatives." *Teaching Children Mathematics* 3 (6) (January 1996): 270-278.

Dienes, Zoltan. *Building Up Mathematics*. London: Hutchinson Educational, 1969.

Driscoll, Mark. *Research Within Reach: Elementary School Mathematics*. Reston, VA: National Council of Teachers of Mathematics, 1981.

Fuson, Karen, Diane Wearne, James Hiebert, Hanlie Murray, Pieter Human, Alwyn Olivier, Thomas Carpenter, and Elizabeth Fennema. "Children's Conceptual Structures for Multidigit Numbers and Methods of Multidigit Addition and Subtraction." *Journal for Research in Mathematics Education* 28 (2) (March 1997): 130-162.

Grouws, Douglas and Margaret Smith. "NAEP Findings on the Preparation and Practices of Mathematics Techers." In *Results from the Seventh Mathematics Assessment of the National Assessment of Educational Progress*, edited by Edward Silver and Patricia Kenney, pp. 107-140. Reston, VA: National Council of Teachers of Mathematics, 2000.

Hatfield, Mary. "Use of Manipulative Devices: Elementary School Cooperating Teachers Self-report." *School Science and Mathematics* 94 (6) (October 1994): 303-308.

Hodge, Tim. "Web-based Manipulatives." *Teaching Children Mathematics* 9 (8) (April 2003): 461.

Hynes, Michael C. "Selection Criteria." *Arithmetic Teacher* 33 (6) (February 1986): 11-13.

Illuminations Activities. National Council of Teachers of Mathematics. Accessed November 21, 2006. http://illuminations.nctm.org/ActivitySearch.aspx.

Kennedy, Leonard M. "A Rationale." *Arithmetic Teacher* 33 (6) (February 1986): 6-7.

Math Tools. The Math Forum @ Drexel. Accessed November 21, 2006.
http://mathforum.org/mathtools.

Moyer, Patricia S., Johnna J. Bolyard, and Mark A. Spikell. "What are Virtual Manipulatives?" *Teaching Children Mathematics* 8 (6) (February 2002): 372-377.

National Council of Teachers of Mathematics (NCTM). *Professional Standards for Teaching Mathematics*. Reston, VA: NCTM, 1991.

National Library of Virtual Manipulatives. Utah State University. Accessed November 21, 2006. http://www.matti.usu.edu.

National Research Council. "Adding it up: Helping Children Learn Mathematics." In *Mathematics Learning Study Committee, Center for Education, Division of Behavioral and Social Sciences and Education,* edited by Jeremy Kilpatrick, Jane Swafford, and Bradford Findell. Washington, DC: National Academy Press, 2001.

Peterson, Susan K., Cecil D. Mercer, and Lawrence O'Shea. "Teaching Learning Disabled Students Place Value Using the Concrete to Abstract Sequence." *Learning Disabilities Research* 4 (1988): 42-56.

Project Construct. Project Construct National Center. Accessed November 21, 2006. http://www.projectconstruct.org/.

Reys, Robert. "Considerations for Teachers Using Manipulatives Materials." *Arithmetic Teacher* 18 (8) (December 1971): 551-558.

Scott, Patrick. "A Survey of Perceived Use of Mathematics Materials by Elementary Teachers in a Large Urban School District." *School Science and Mathematics* 83 (1) (January 1983): 61-68.

Sowell, Evelyn. "Effects of Manipulative Materials in Mathematics Instruction." *Journal for Research in Mathematics Education* 20 (5) (November 1989): 498-505.

Sutton, John and Alice Krueger, eds. *EDThoughts: What We Know About Mathematics Teaching and Learning*. Aurora, CO: MCREL, 2002.

Suydam, Marilyn. "Mathematics Materials and Achievement." *Arithmetic Teacher* 33 (6) (February 1996): 10+.

Suydam, Marilyn and Jon Higgins. *Activity-based Learning in Elementary School Mathematics: Recommendations from Research*. Columbus, OH: ERIC/SMEAC, 1977.

Thompson, Patrick, and Diana Lambdin. "Research into Practice: Concrete Materials and Teaching for Mathematical Understanding." *Arithmetic Teacher* 41 (9) (May 1994): 556-558.

Uttal, David, Kathryn Scudder, and Judy DeLoache. "Manipulatives as Symbols: A New Perspective on the Use of Concrete Objects to Teach Mathematics." *Journal of Applied Developmental Psychology* 18 (1997): 37-54.

Practices Worthy of Attention: Improving Secondary Mathematics Teaching and Learning

Pamela L. Paek
Charles A. Dana Center
University of Texas at Austin

Recent changes in federal and state education policy call for a substantial increase in the breadth and depth of mathematical knowledge that students must master to graduate from high school. A growing number of states, for example, that once required only knowledge of middle school mathematics for high school graduation have begun over the past five to seven years to require all students to master an exit examination on the content of Algebra I and Geometry. Moreover, several states now require three years of high school mathematics for graduation.

Unfortunately, few school districts in the nation have the capacity to help their students meet these more demanding mathematics requirements. National and state-level reports document critical shortages and high attrition in the overall supply of appropriately trained and certified mathematics teachers. The majority of secondary mathematics teachers lack deep knowledge of the mathematics content they are expected to teach (Barth & Haycock, 2004; Massell, 1998).

In fact, Ingersoll (1999) found that one-third of all secondary school teachers of mathematics nationwide have neither a major nor a minor in mathematics. Moreover, research shows inconsistencies in instruction across classrooms within the same district and even within the same school. Though teachers in a given school may be using the same textbook, they still make independent decisions about what to teach and how to use available resources (Marzano, 2003). Stigler and Hiebert (1998, 1999) found that schools within a given district often do not even share common learning goals. These differences in teaching methods and learning goals result in widely varying content and depth of instruction classroom-by-classroom.

Given the multitude of additional challenges in urban districts, the variability of teaching methods and learning goals is likely more extreme in such locations, which only exacerbates the difficulties that urban districts must overcome to close the achievement gap in mathematics. All too often, students in urban school districts are not given adequate opportunity to experience challenging mathematics in their secondary education (National Science Board, 2006). Reasons for this lack of opportunity include a dearth of high-quality, effective teachers able or willing to teach advanced or challenging mathematics in problem-plagued urban districts; administrators who do not understand what is needed to support a high level of mathematics learning; and low expectations from both teachers and administrators for the performance of their students (Bamburg 1994; Beck-Winchatz & Barge, 2003; Tauber 1997). In addition, most urban systems are struggling with overcrowding, high teacher and administrator turnover, and high student attrition (Hanushek, Kain, & Rivkin, 2004; Lewis, et al., 2000; Loeb & Darling-Hammond, 2005).

To address these problems, school districts are pouring enormous quantities of resources into their secondary mathematics programs to improve these programs' capacity to deliver a rigorous and aligned high school curriculum that prepares students for success in college and entry into high-quality workplaces. A recent study shows that some districts spend nearly $200 per year per student on

The Dana Center's PWOA work is part of a two-year initiative of the Dana Center and Achieve Inc., funded by the Bill and Melinda Gates Foundation.

teacher professional development alone (Killeen, Monk, & Plecki, 2002). Yet despite these substantial investments, district and school reform efforts vary greatly in quality and usefulness. A fact that is increasingly clear as researchers study those efforts in districts across the country.

The Charles A. Dana Center at the University of Texas at Austin conducted a national search in urban districts, led by the author, for school and district practices that based on early evidence and observation of increasing student learning in secondary mathematics show promise, especially for students traditionally challenged in this area. We call such practices "Practices Worthy of Attention" (PWOA).

When identifying practices worthy of attention, the focus was on practices in urban schools and districts that show early or anecdotal evidence of success but that have yet to be formally analyzed or evaluated. Our PWOA work has three components.

1. Better understand existing initiatives, innovations, and programs that are being used to improve secondary mathematics learning around the country, and mark these for further scientific inquiry.

2. Identify common themes in these practices that can be used to strengthen student achievement in urban systems across the country.

3. Provide research support to all PWOA practitioners by becoming a partner and critical friend who can help them strengthen their methods of operation by helping them more rigorously evaluate how well their practices are working.

This article describes our work to date on identifying promising initiatives, innovations, and programs in urban districts and analyzing our research findings to highlight the common themes that can be used to strengthen student achievement in other districts. A separate report discusses the analysis of common themes and laying the groundwork for partnering with the PWOA districts to more formally evaluate their practices.

Understanding Existing Initiatives and Programs

The PWOA work focuses on secondary mathematics because research suggests that specific courses, such as Algebra I, serve as gatekeepers to higher-level mathematics courses and learning which can affect mathematics achievement in high school and beyond (Adelman, 2006; Ma, 2001). In addition, the National Educational Longitudinal Study (NELS) indicates that students who take rigorous high school mathematics courses are much more likely to go to college than those who do not (U.S. Department of Education, 1997). Specifically, the NELS data show that 83 percent of students taking Algebra and Geometry went to college within two years of graduating from high school. This percentage enrolling in college drops to 36 percent for those who did not take Algebra I and Geometry. Data from the National Assessment of Educational Progress (NAEP) shows that only 27 percent of eighth-graders nationwide took Algebra I in 2000, increasing to 42% in 2005 (Mathews, 2007). Understanding the factors that affect and thereby improve student learning in Algebra I is a critical first step toward increasing the number of postsecondary science, technology, engineering, and mathematics (STEM) related opportunities available to students.

In examining information about practices that show promise for improving secondary math learning, the focus was on practices that specifically addressed the concerns of urban districts and their mathematics needs, including developing upper-level high school courses that provide adequate preparation for a smooth transition to higher education and the work force; finding ways to help all students succeed in Algebra; addressing the mathematics needs of special populations; and strengthening teacher capacity and quantity available for teaching such courses.

Each school and district studied had a different perspective and a unique set of practices in place to improve secondary mathematics achievement and close the achievement gap. District and school staff in over 30 schools and districts was interviewed. Based on our findings, our focus was narrowed to 22 practices, which I call the nominated PWOA. For each of the 22 nominated PWOA a case study was written that included a description of the practice, its goals, the need it serves, the research behind it, the theory of action, and any evidence the school or district is using for measuring gains in student learning.

In the PWOA districts, the nominated practices tended to fall into one of five categories.

Secondary Mathematics/Algebra I Focus: The focus on secondary mathematics differs across sites. Some practices focus on struggling students by providing an opportunity for students to learn academic and self-efficacy skills in addition to algebraic foundations in the summer prior to their freshman year in high school. Others use a double period and specialized courses with catch-up opportunities for those students behind schedule, thus allowing them to complete the mathematics courses required for high school graduation and/or college admission. Still other practices require all eighth grade students to pass Algebra I prior to entering the ninth grade. Some schools and districts in this category have realigned the K-7 math curricula to prepare students for mastery of Algebra I in eighth grade.

Special Population Cross-Training and Collaboration: These practices focus on groups of students with special needs, such as students in special education or English language learners. The focus is on providing high-quality mathematics rather than dramatically slowing down the instruction or providing watered-down mathematics content. These practices encourage 'good teaching' by focusing on the types of instructional tasks that teachers can use for differentiating instruction, encouraging use of academic vocabulary, and providing various entry points for students to learn the mathematical concepts, while also providing teachers feedback on the ways some students may struggle, based on issues of language acquisition or cognitive impairment.

District Leadership with Mathematics Focus: These practices focus first on district reform efforts by working to change the perceptions of administrators and teachers about students' learning abilities. They then provide professional development specific to mathematics to reinforce the idea that all students have the capacity to learn, meanwhile engaging teachers in professional learning communities or as teacher leaders. Administrators can support and assist teachers further by finding convenient times (e.g. common planning periods) for teachers to meet and work specifically on substantive teaching and learning issues in mathematics, and by offering release time for teachers to visit each other's classrooms.

Assessment: This category looks at different aspects of assessment such as formative assessments, benchmark assessments, large-scale assessments, item analysis comparing results of different assessments, and the development and implementation of local assessment systems. These practices view assessment as a vehicle for driving, revising, and supporting instruction. As such, professional development is built around how teachers can assess student knowledge based on the data from these different levels of assessments while also helping teachers improve their instruction of different mathematics concepts.

Charter/Small Schools: Charter/small schools are usually formed as a result of dissatisfaction with how larger public schools are functioning. The schools in this category are being investigated to learn more about the structure in which they are yielding high success for first-generation college-bound students (typically economically disadvantaged and ethnic minorities). The purpose of studying these schools is to learn how large public schools can implement similar aspects of school reform to replicate the success of these schools.

PWOA work differs from other work describing "best practices" or "promising practices" in that PWOA takes struggling schools and districts from where they presently are, focusing on the practitioners' work and ideas currently in progress. It is worth noting that many practices touted as "best practices" have not necessarily been proven to be so through rigorous external criteria and evaluation. By starting with current school and district practices that have not yet been identified as "best" or "promising" through a specific national criteria, such as What Works Clearinghouse or the National Center for Educational Accountability, there is often little to no documentation discussing the implementation of the practice and scarce evidence of impact or effectiveness of these practices. In fact, if there is any documentation, it may simply be a PowerPoint presentation providing general information about the practice, but not enough prescriptive information for other districts to know what to avoid or specifically do. As such, the first step in nominating and documenting a PWOA is spending time with each school or district to find the theory of action behind the practice and documenting the evidence used thus far. This step not only provides a historical record of activities, it also honors the work such that practitioners can see their ideas and efforts written in ways that show a full picture of the work to date. This step also provides a starting point for further work of researchers with practitioners on better measuring the impact and effects of the practices on secondary mathematics teaching and learning.

Identifying Common Themes

In step two of this work, identifying common themes that can be used to strengthen student achievement in urban systems across the country, we convened a national advisory committee consisting of district mathematics staff, current former and secondary mathematics teachers, education policymakers, college professors in mathematics, state-level mathematics representatives, and district mathematics specialists. The advisory committee met to discuss the nominated PWOA and to think about how they could be rated in terms of the rigor of curricular and academic goals, the depth and breadth of professional development, and early evidence of the practices' effects on meeting academic goals.

Findings from the examination of the collective body of practices from the 22 different sites comprising the PWOA study can be discussed in two main themes: (1) raising student achievement and improving student learning in mathematics, and (2) increasing teacher capacity.

Raising Student Achievement

All of the schools and districts profiled in this study have increased their expectations for student achievement, but some of them focused particularly on academic intensification strategies to help students meet the higher expectations. These strategies include raising standards and expecting higher levels of achievement for all students and providing targeted and intense support to help students achieve at a higher level. The types of practices that emerged in support of academic intensification include: building summer bridge programs, requiring and supporting more rigorous mathematics courses, and providing intense and ongoing support throughout the school day.

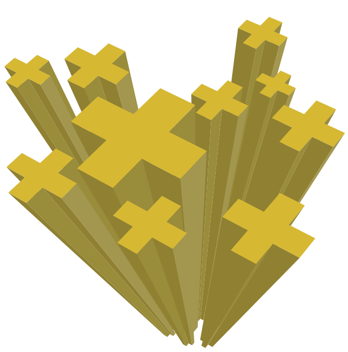
Raising student achievement through academic intensification requires changes in the attitudes and practices of administrators, teachers, and students. In summer bridge programs, students learn about the value of academic effort and build peer and teacher relationships that will support them throughout high school. Success in these programs necessitates firm belief on the part of teachers that their students really can succeed in high school mathematics and that collegial student peer groups can be a strong support for that success; when the teachers in these programs believe and demonstrate these ideas, they have a greater chance of convincing students to engage wholeheartedly in their own education.

Similarly, requiring rigorous courses of all students demands a change in how districts and schools think about student ability. In the practices focused on raising student achievement, districts and schools are getting students into rigorous mathematics courses earlier and providing much more support for both students and teachers. Intense, embedded daily supports, for example, constantly reiterate the idea that mathematics is important and that, with hard work and a strong network of teacher and peer support, all students can take and pass rigorous mathematics courses.

Building Teacher Capacity

All of the schools and districts programs profiled in this study have increased their expectations for what teachers should do, but some of them have focused intense attention on improving teacher practices. The practices designed to build teacher capacity provide opportunities for teachers to expand their current practices through focused interaction with other teachers and through accessing resources with individual support. The practices require support from administrators if the traditional ways teachers have interacted are to be overcome. As teachers are asked to support students with various experiences and backgrounds, districts and schools are asked to support teachers the same way instead of providing all teachers the same training and expecting all of them to perform the same way. Three main approaches emerged from our observations: redefining mathematics teacher roles and responsibilities, making instruction public, and having new, customizable tools for teaching.

With broadened roles and responsibilities, teachers redefine how they think of teaching and what they can contribute. They learn that they can gain expertise for successfully working with subpopulations of students in need of their help, be part of a development team for building common assessments at the district level, or participate as leaders in the district for promoting change in mathematics. When instruction is public, teachers learn about the power of collaboration for improving their practice and lose the fear of observers in the classroom. With structured observation protocols and regular opportunities for feedback, teachers forget about working in isolation and focus more on the ways they can work together on student achievement.



Raising student achievement through academic intensification requires changes in the attitudes and practices of administrators, teachers, and students.

Finally, with new tools and customized support, teachers can access the individual training and feedback they need to make good practices part of their daily instruction.

The advisory committee members were also asked to think about the innovative or animating ideas behind the nominated practices, to see which ones had fresh ideas and approaches for improving learning and closing the achievement gap in secondary mathematics. They were also asked to think about which practices had components that could be scalable and usable across various sites, meaning ideas that can be used across a variety of districts, not just sites with specific frameworks or types of students. The advisory committee further provided specific feedback about the types of data they thought should be collected and analyzed to evaluate the practice, as well as preliminary recommendations, based on their own research and practice experience, about how the school or district can improve its practice. It is this data that is being analyzed to inform step three of this work.

Conclusions

Schools and districts and teachers as well as administrators often adopt or continue practices without a true understanding of the meaning behind these practices or without a complete understanding in how the practices are helping improve their students' achievement or close the achievement gap. Our PWOA work is beginning to shed light on what needs to be done by researchers and practitioners together to uncover meaningful information about whether certain practices are successful and how those practices can be adapted and incorporated in other classrooms to improve students' academic success.

Many of the articles and discussions about closing or eliminating the mathematics achievement gap have been focused on broad approaches and ideas. Although these approaches and ideas capture the essence of strategies and next steps, the vocabulary being used can be interpreted in different ways. More time needs to be spent in schools and districts to see how broad ideas are codified within and across districts in order to tackle the challenges faced by all educators and leaders in improving mathematics teaching and learning. The PWOA work is a first step toward having a larger audience of practitioners share and learn specific strategies from one another, opening the doors across districts much as classrooms have been opened within schools. By investing time to look at the actual practices, we can find out directly how research is interpreted and implemented, and also advise mathematics leaders and teachers in ways that directly impact their work.

The next phase of this work is to partner Dana Center researchers with schools and districts to raise the standards of evidence by which we measure the effectiveness of these practices. This will allow for the fulfillment of a key purpose of this work: not only to identify common themes in these practices that can be used to strengthen teachers' practices and student achievement in urban systems across the country, but also to determine the effects of districts' initiatives for improving teacher practices and, in turn, the effects of those practices on students' secondary mathematics progress and achievement.

References

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college*. Washington, DC: U.S. Department of Education.

Bamburg, J. (1994). *Raising expectations to improve student learning*. Oak Brook, IL: North Central Regional Educational Laboratory.

Barth, P., & Haycock, K. (2004). A core curriculum for all students. In R. Kazis, J. Vargas, & N. Hoffman (Eds.), *Double the numbers: Increasing postsecondary credentials for underrepresented youth* (pp. 35-45). Cambridge, MA: Harvard Education Press.

Beck-Winchatz, B., & Barge, J. (2003). A new graduate space science course for urban elementary and middle school teachers at DePaul University in Chicago. *The Astronomy Education Review*, 1(2),120-128.

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2004). Why public schools lose teachers. *Journal of Human Resources*, 39(2), 326-354.

Ingersoll, R. M. (1999). The problem of underqualified teachers in American secondary schools. *Educational Researcher*, 28(2), 26-37.

Killeen, K. M., Monk, D. H., & Plecki, M. (2002). School district spending on professional development: Insights available from national data (1992-1998). *Journal of Education Finance*, 28(1), 25-49.

Lewis, S., Baker, N. D., Jepson, J., Casserly, M., Powell, L. C., Barrengos, J. R., Johnson, J., & Eisner, C. (2000, October). *Great expectations: Reforming urban high schools*. Washington, DC: U.S. Department of Education Office of Elementary and Secondary Education and the Council of the Great City Schools.

Loeb, S., & Darling- Hammond, L. (2005). How teaching conditions predict teacher turnover in California schools. *Peabody Journal of Education*, 80(3), 44-70.

Ma, X. (2001). A longitudinal assessment of antecedent course work in mathematics and subsequent mathematical attainment. *Journal of Educational Research*, 94, 16-28.

Marzano, R. J. (2003). *What works in schools: Translating research into action*. Alexandria, VA: Association for Supervision and Curriculum Development.

Massell, D. (1998). *State strategies for building local capacity: Addressing the needs of standards-based reforms*. Philadelphia, PA: Center for Policy Research in Education, University of Pennsylvania.

Mathews, J. (2007, March 12). Adding eighth-graders to the equation: Portion of students taking algebra before high school increases. *Washington Post*. Retrieved March 14, 2007 from http://www.washingtonpost.com.

Stigler, J. W., & Hiebert, J. (1998, Winter). Teaching is a cultural activity. *American Educator*. Retrieved March 14, 2007, from http://www.aft.org/pubs-reports/american_educator/winter98/index.html.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York: Free Press.

Tauber, R. (1997). *Self-fulfilling prophecy: A practical guide to its use in education*. Westport, CT: Praeger.

Tripod Project. (n.d.). *Conceptual model: A theory of change for raising achievement and narrowing gaps*. Boston, MA: Author.

U.S. Department of Education. (1997). *Mathematics equals opportunity*. Washington, DC: Author. Retrieved March 24, 2007, from http://www.ed.gov/pubs/math.

A Local Systemic Change Project in Mathematics Professional Development for Improving Student Achievement in Low-Performing Districts in Maine

Cheryl Rose, Senior Program Director
Francis Eberle, Ph. D., Executive Director
Maine Mathematics and Science Alliance

Broadening Educational Access to Mathematics in Maine (BEAMM) was a K-8 mathematics curriculum implementation project funded by the National Science Foundation (NSF) as a Local Systemic Change project. The BEAMM project involved seven low performing Maine districts with 500 teachers and 13,000 students, the Maine Mathematics and Science Alliance (MMSA)— a non profit organization, and two mathematics faculties from Colby College. The thrust of BEAMM was to have teachers and building administrators participate in various professional development experiences to improve student learning in mathematics.

The goal of BEAMM was to increase student performance in mathematics by providing professional development and support for the implementation of high quality curriculum materials for all K-8 teachers of mathematics in the seven school districts. These districts had not met the AYP targets in grades 4 and 8 for three years or more. They were asked to commit to participate in BEAMM.

Given the goal of BEAMM, the professional development needed to focus on improving student performance, the implementation of new curriculum materials, reaching all the teachers, and providing them with substantial learning experiences. The outcomes required teachers to:

- Utilize and build their mathematics knowledge and skills through professional development.
- Understand mathematical ideas and pedagogy for long-term student learning and achievement.
- Create student-centered classrooms by using exemplary instruction, curriculum materials, and assessment practices.
- Reflect on their practices and participate in collegial discussions about teaching and learning.
- Work and communicate with their K-8 colleagues in the partner districts and beyond.

As none of the districts had the same mathematics curriculum across all of their schools, the first task was for each of the districts to choose an elementary program and middle level program from a prescreened list of NSF funded standard-based programs. This selection process resulted in a choice of three elementary programs and two middle level programs across the seven BEAMM districts.

Professional Development Model

BEAMM's professional development model was originally comprised of three parts. These included 1) support for all teachers with activities such as 2 week summer institutes, one and two day events, and on site support by teacher leaders; 2) professional development for teacher leaders which included an additional one week summer institute and curriculum developer/publisher training in specific curriculum materials; 3) assistance for administrators in the partner districts including Advisory Board involvement, one day events at institutes, and training in supervision and observation techniques. This approach was based on the assumption that all of the teachers would participate in at least one of the three parts in the design.

After the initial curriculum program summer training, project staff and district leaders were faced with the reality of the teachers' background, district disposition for and support of teachers, and teachers' personal commitment or interest in learning mathematics. These factors combined made for demands that were more complex than the “neat” three part model could adequately address. The initial professional development approach was more of a traditional static, undifferentiated model with teachers attending structured sessions delivered by primarily mathematics leaders. Several additional factors also influenced how we thought about the delivery of the professional development. There was a significant level of mobility, about 30% of teachers and 82% of building principals over the period of the project. New teachers included those who were new to teaching, those who were experienced but new to the curriculum, and those who were experienced but had not taught math consistently were being added to the districts’ mathematics teaching staff. At the same time, the existing teachers were learning more about their new curriculum and were beginning to ask more targeted and relevant questions. The progression from a “beginner” to “user” to “expert” varied much more than had been expected. Consideration of this mixed audience was a strong influence in designing additional opportunities for district level professional development involving all teachers of mathematics.

The professional development model was adapted in an attempt to provide support in the context of these dynamic realities. The plan became more comprehensive, more responsive, and less centralized. A new framework, adapted from *Concerns-Based Adoption Model* (CBAM) (Hall and Hords, 2001), defined the type of professional development needed by various audiences. The framework included three stages: Level I, Beginning Stage of Implementation; Level II, Implementation with Reflection; and Level III, Implementation with Refinement.

A description of each of the professional development levels follows.

Level I: Beginning Stage of Implementation: Training/support at this level was for teachers new to the profession, content, the curriculum program, or to the grade level. A majority of BEAMM sites provided this level of support for new hires within the district through participation at regional sessions or mentoring by teacher leaders. These sessions were offered though the entire life of the project rather than just in the first year as previously planned.

Level II: Implementing with Reflection: Teachers at this level were typically in the first few years of using the district’s chosen curriculum program. Their professional development focused on issues of early implementation such as choosing a management system for grading/assessing, tracing a content strand through the grades, and becoming experienced with the instructional activities. Many topics discussed at initial trainings were revisited later in deeper conversations. Professional development at this level focused on how the curriculum materials are being implemented in each classroom. Important topics at this stage include pacing, content coherence, instructional techniques, use of technology, student grouping, changes in assessment strategies, and looking at student work. An Everyday Math Assessment Series, specific curriculum sessions, and district level activities such as bi-monthly grade level meetings facilitated by teacher leaders or BEAMM project staff are all examples of professional development activities for Level II educators. These types of sessions developed into regular ongoing activities within and outside of the districts.

Level III: Implementing with Refinement: Teachers at this level had been implementing a specific program for several years, had participated in a variety of professional development activities at the initial and reflection stages, and were very comfortable with the instructional philosophy, mathematical content, and assessment features of their program. The professional development focused on refinement of content knowledge and teaching processes. Activities included institutionalizing assessment, online book studies, researching and discussing best practice, conducting peer observations, examining student work to identify evidence of understanding, and planning instructional activities to extend and enhance content knowledge beyond the parameters of the program. Although many of the Level II sessions also focused on assessment, Level III reflected deeper levels of discussion, content, and connection to instructional practices. These types of professional development support were provided cross-district or on district request. Table 1 shows some examples of the activities within this plan for differentiated professional development.

Leadership Strategies

To sustain the efforts and to reach all teachers, even those who were the reluctant learners, BEAMM strove to build the content and curricular leadership of teachers. Strong embedded leadership was a critical factor for a variety of reasons including: sustaining the vision of mathematics learning and teaching, maintaining continuity despite teacher and administrator mobility, and developing ongoing support structures such as study groups. Continuous improvement required leadership at three levels: central administration, building administration and teacher leaders.

Teacher Leader strategy. On-site teacher leaders represented a key to sustaining the momentum of the reform efforts. These teachers were self-selected or were nominated by their districts and by the BEAMM Advisory Group. The teacher leaders committed

Table 1: Examples of Supported Professional Development by Implementation Level

Level I Beginning Implementation	Level II Implementation with Reflection	Level III Implementation with Refinement
Mathematics problem solving K-8 Curriculum Showcases Curriculum orientation and structures	User groups in a Math curriculum Assessment series specific to programs Content focused sessions	Mathematics sessions for specific grade spans Special populations focus for specific mathematics programs Users support and enhancement for implemented units Formative Assessment Strategies using cognitive research

to attending Advisory Board meetings and summer leadership institutes, hosting and organizing school or district professional development, and attending monthly BEAMM district meetings with the site-contact. The support for the teacher leaders enabled them to: recognize quality professional development, develop a repertoire of techniques for conducting professional development, connect the techniques to multiple and specific curriculum programs, and gain additional mathematics content and pedagogy. University faculty, national experts and project staff provided training and support to the teacher leaders. Some examples include: examining and assessing student ideas, classroom observation, algebra across the grades, mathematical learning paths, professional development strategies (Loucks-Horsley, Love, Stiles, Mundry & Hewson. 2003), facilitating adult learning and the change process with the CBAM.

The blend of mathematics content and adult learning strategies was very helpful to leaders as they became discouraged with the slow pace change by their colleagues. The content provided the basis for their confidence in mathematics, and the adult learning strategies provided a context for them to be patient and to stay focused on guiding the process and not get frustrated. It was enlightening for them to realize that there was a body of literature and set of strategies to help them work with their peers and that working with their peers was different than working with their students. At the end of BEAMM, thirty-two teacher leaders had exceeded 100 hours of PD. This represents about 6% of the total BEAMM teacher population of 500, or about 1 teacher leader for every 16 teachers.

Administrator strategy: The BEAMM project recognized the importance of administrator support for mathematics education. Hence each participating district was asked to build its own internal capacity to carry out professional development activities during and after the project ended by: providing cross grade face-to-face meetings for teachers; implementing exemplary mathematics curriculum materials; creating and maintaining K-12 mathematics committees; releasing teachers for 5 days during the year to work on BEAMM activities; fostering study groups during the year; and participating in electronic web-based professional development forums.

To accomplish these objectives each partner district convened a leadership team with at least one administrator to guide and assess progress, to represent their site on the BEAMM Project Advisory Board and to help the district team write and revise a yearly professional development plan with an evaluation component. At each Advisory Board session, team members gave updates, evaluated impact of professional development on classroom instruction, and planned or refined next steps. The project provided a variety of opportunities to keep administrators informed and connected. The Advisory Board also recommended specific supports for administrators such as curriculum trainings, one-day workshops with teacher leaders, and Lenses on Learning training (Miles-Grant, Scott Nelson, Davidson, Sassi, Shulman-Weinberg, & Bleiman, 2003). Administrators took an active role in the development and implementation of these plans.

Analysis

The question that needs to be answered for BEAMM is: *Did the BEAMM professional development and implementation of high quality curriculum materials help improve 4th and*

8th grade students' mathematics performance? Several analyses were conducted to attempt to determine the impact of the BEAMM project on student learning. The first was a comparison of the state Maine Educational Assessment (MEA) scores between the BEAMM districts and Comparison Districts, the second was an effect size score analysis, and the third was a student cohort comparison over the period of the project.

The MEA data was collected for the BEAMM sites and Comparison Districts as it was the only common large scale assessment used by all the districts. The BEAMM districts were located across the state, ranging in size from 3 schools to 9 schools serving about 13,000 students. Each BEAMM district was matched with a comparison district based on their socioeconomic status, similar geography and school size, grade spans (K-6, 6-8 and K-8), and similar student performance. Not much is known about the professional development or the mathematics curriculum used in the Comparisons Districts.

The MEA is administered every year to all grades 4, 8 and 11 students in the state. The MEA is a standardized criterion reference exam with 40% multiple choice and 60% constructed response items. It is aligned to the state's standards as each mathematics question is written based on a performance indicator in the state's Learning Results. The MEA produces two types of student performance data, both scaled scores for students and schools and performance level assignments for students that are aggregated to percentages for schools and districts. All the 4th and 8th grade students in each of the districts are included in the assessment data. Over 98% of Maine students in grades 4 and 8 take the MEA with a special waiver required for exceptions.

Students' scores in the BEAMM districts were compared to their own prior performance, to Comparison Districts, and to the state average scores. The categorical student performance data from the MEA's - *Does Not Meet Standards, Partially Meets Standards, Meets Standards,* and *Exceeds Standards* - was analyzed using a proportional statistics technique to quantitatively determine the amount of movement of students in the different performance levels reported by the MEA.

The analysis employed the standard error for proportion differences in the performance levels to the <.05 level. The formula for this analysis is: $\sqrt{((C/T) \times (1-C/T)/T)} = G$ where C represents the number of students in category, T is the total of students and G is the proportional difference between student performance levels categories. To a >.05 level $(G \times 1.96) \times 100 = se$ where se is the standard error. This analysis determines if the change in numbers of students scoring in a particular performance level was significant as compared to what might occur with normal variation due to population changes.

Results

For the BEAMM District and Comparison Districts MEA comparisons, two of the four student performance levels were used, *Meets Standards* and *Does Not Meets Standards*. The two other levels, *Exceeds Standards* and *Partially Meets Standards* do not reflect the areas of emphasis for the project. The percentage of BEAMM students performing at the Meets Standards level on Maine's 4th and 8th Grade MEA increased and the percent at Does Not Meet the Standard category decreased (Table 2).

At the 4th grade level, the percent of students in the BEAMM sites meeting the standards increased from 15% in 1999 to 24% in 2004, a 60% change. The percent of students not meeting the standards decreased from 35% in 1999 to 23% in 2004, a 34% change. At the 8th grade level, the percent of students in the BEAMM sites meeting the standards increased from 15% in 1999 to 20% in 2004, a 33% change. The percent of students not meeting the standards decreased from 42% in 1999 to 33% in 2004, a 20% change.

At the same time the Comparison Districts and the State average score also reported increases in the number of students in the *Meets Standards* category and decreases in the *Does Not Meet Standards* category. The BEAMM districts reported a higher percentage gain than both the State and the Comparison Districts (with the exception of grade 4 *Meet Standards* in the comparison schools).

A second set of results from an effect size analyses showed whether the changes were significant. Over the course of the five years, the districts' average 4th grade scaled scores on the MEA improved from 527 to 536 (9 points) while the state average improved from 531 to 536 (5 points). The Comparison Schools improved from 530 to 535 (5 points) similar to the statewide average. The mean score gain between 1998 -1999, the year before BEAMM began, and 2004 -2005, the year after it ended was 7.14 across the BEAMM sites with a standard deviation of 2.54. The average gain across the comparison schools was 5.43 with a standard deviation of 3.46. The BEAMM schools showed greater improvement and the variation among the sites was less than that among the Comparison Districts. The effect size of the BEAMM Initiative is .52 or a moderate or large difference for an effect size difference (Coe, 2000. Cohen,1998).

In addition an analysis was made to determine whether the same cohort of students' performance was static, sustained or grew over four years of the BEAMM project. Test results for two cohorts of students over a span of four years starting in grade 4 and then four years later in grade 8 were compared. For both cohorts of students there were increases in the percentage of students in the *Meets Standards* and decreases in the *Does Not Meet Standards* performance levels. At the same time, the state average scores reported decreases or no change for the same two cohorts of students in the *Meets Standards* performance level and increases in the *Does Not Meet Standards* performance levels. See Tables 3 and 4.

These results indicate that the students in the BEAMM Districts demonstrated increases in their performance over the course of the project. Their rate of change illustrates that BEAMM had greater increases in numbers of students moving into the Meets Standards performance level, and had larger decreases in numbers of students moving out of the Does Not Meet Standards performance level than the state average. Because there was some student movement in and out of the districts over the course of four years, this comparison is not a precise measurement. Nevertheless, the number of students in each cohort is approximately 1600 so the variation due to student mobility is minimized.

Conclusion

A number of features of BEAMM seem to have contributed to the better than expected improvements, but to the project staff the adjustments to the professional development model was key. BEAMM provided ongoing offerings that included levels of complexity and depth depending on the expertise and needs of the teachers and was able to reach teachers who initially would not attend events at their schools. There was professional development for administrators and teacher leaders creating a district level team to help sustain the ideas and momentum of the efforts at the local level with the teacher leaders helping to lead and focus the district/school based professional development. BEAMM's professional development maintained coherence by focusing on the targeted mathematics and on program implementation issues. Significantly, however, the activities offered a range of complexity for the content and skills to parallel teachers' developmental needs.

Differentiating professional development to support practicing teachers is a goal of most professional development. Although it is difficult to deliver tailored experiences with large numbers of teachers, doing so addresses the important connection between the dynamic wants and needs within a district. Everyone in the BEAMM

Table 2: Student Performance for 1999 and 2004 for BEAMM and Comparison Districts.

	1998-1999 Percent			2003-2004 Percent			DIFFERENCE in percent '98-'99 to '03-'04		
FOURTH GRADE	**BEAMM**	**Comparison Districts**	**State**	**BEAMM**	**Comparison Districts**	**State**	**BEAMM**	**Comparison Districts**	**State**
Meets Standards	15	22	22	24	32	30	+9	+10*	+8
Does Not Meet Standards	35	29	27	23	20	20	-12	-9	-3
EIGHTH GRADE	**BEAMM**	**Comparison Districts**	**State**	**BEAMM**	**Comparison Districts**	**State**	**BEAMM**	**Comparison Districts**	**State**
Meets Standards	15	14	21	20	15	21	+5**	+1	0
Does Not Meet Standards	42	44	37	33	39	32	-9***	-5	-5

* The Comparison Districts were statistically higher than the BEAMM districts for *Meets Standards* category; however the BEAMM Districts closed the size of the gap that originally existed.
** The BEAMM sites were statistically different from the Comparison Districts in increasing the number of students in *Meets Standards*.
*** The BEAMM sites were statistically different from the Comparison Districts in decreasing the number of students in the category of *Does not Meet Standards*.

Districts, from central office administrators to new classroom teachers contributed to and learned from the BEAMM project. In addition to the range of needs among educators across a district, the high mobility in and out of districts represented a challenge to improvement efforts. Situations in which few, if any, in leadership positions remained in a district over the course of the project - to carry the vision and maintain momentum - struck BEAMM project staff as a significant threat to reform. Addressing these dynamic aspects of the educational system, the continuum of teachers' professional needs and educator mobility, is critical for ensuring successful professional development and for sustaining reform efforts.

BEAMM is not the first project to identify the idea of differentiated professional development, but its importance needs to be reiterated because of the current context of educational reform with high expectations for rapid change. Gamoran (2005) among others proposes that schools can best support teaching for understanding by responding to teacher learning (Mundry, 2005; Gamoran, et al. 2003). The factors in BEAMM that contributed to the improvement for low performing districts seem to include consistent, coherent and differentiated professional development that meets the various needs of teachers, involvement and support for administrators at the building level, principals, and central office levels, knowledge and skill building of talented teacher leaders, and having high expectation for all teachers and students through a high quality curriculum. The authors believe that differentiation of professional development is critical to addressing the many aspects of the educational system to support the range of roles within districts.

Table 3: Cohort 1 BEAMM and State Percentages for Two Cohorts of Students for Four Years

	1998-1999		2002-2003		CHANGE	
Performance Level	**BEAMM 4th**	**State**	**BEAMM 8th**	**State**	**% Change in BEAMM**	**% Change in State**
Exceeds Standards	0.00%	1%	1.00%	1%	+ 100%	0
Meets Standards	14.42%	22%	20.00%	17%	+ 38.6%	- 22.7%
Partially Meets Standards	50.10%	50%	50.00%	50%	- .2 %	0
Does Not Meet Standards	35.27%	27%	30.00%	32%	- 14.9%	+ 18.5%

Table 4: Cohort 2 BEAMM and State Percentages for Two Cohorts of Students for Four Years

	1999-2000		2003-2004		CHANGE	
Performance Level	**BEAMM 4th**	**State**	**BEAMM 8th**	**State**	**% Change in BEAMM**	**% Change in State**
Exceeds Standards	1%	2%	1%	1%	0	- 50%
Meets Standards	16%	21%	20%	21%	+ 25%	0
Partially Meets Standards	46%	48%	46%	46%	0	- 4.1%
Does Not Meet Standards	37%	29%	33%	32%	- 10.8%	+ 34.4%

References

Coe, R. (2000). “What is an Effect Size” CEM Centre, Durham University.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New Jersey: Lawrence Erlbaum.

Hall, Gene E. & Hord, Shirley M. (2001). *Implementing change: patterns, principles, and potholes*. Boston: Allyn and Bacon.

Gamoran, A. (2005). Organizational capacity for change. (Romberg, Carpenter & Dremock. Editors) in *Understanding mathematics and science matters*. Matwah, NJ: Lawrence Erlbaum Associates, Publishers.

Gamoran, A., Anderson,C., Quiroz, P, Secada, W., Williams, T. & Ashman,W. (2003) *Transforming teaching in math and science: How schools and districts can support change*. New York: Teachers College Press.

Loucks-Horsley, S., Love, N., Stiles, K., Mundry, S., & Hewson, P. (2003). *Designing Professional Development for Teachers of Science and Mathematics*. Thousand Oaks, CA. Corwin Press.

Miles Grant, C., Scott Nelson, B., Davidson, E., Sassi, A., Shulman Weinberg, A., Bleiman, J. (2003) *Lenses on Learning: A New Focus on Mathematics and School Leadership.* Lebanon, IN: Pearson Learning Group.

Minium, Clarke, and Coladarci, (1999) *Elements of Statistical Reasoning*. New York, NY: John Wiley and Sons.

Mundry, S. (2005) Changing perspectives in professional development. *Science Educator*. National Association Science Education Leadership Association. 14(1), 9-15.

Unchartered Territory: Using the *Curriculum Focal Points* as a Basis for Designing State Standards

Juli K. Dixon
University of Central Florida
Gladis Kersaint
University of South Florida

According to Fennell (2007/2008), there is evidence to suggest that the *Curriculum Focal Points* (CFP) are receiving widespread attention "in boardrooms, schools, school districts, and state departments of education" (p. 315). Fennell reported that "over one-fourth of the states and many local school districts have decided to use NCTM's *Curriculum Focal Points* to drive discussion about what's important in pre-K-8 mathematics curricula" (p. 315). The purpose of this article is to share one state's experiences with this endeavor.

Florida decided to use a two-phase process to revise its mathematics standards. First, a committee was convened that included representatives from various stakeholders (e.g., K-12 teachers, K-12 mathematics supervisors, mathematicians, and mathematics educators) to hear presentations from experts in the field about the current standards, issues related to those standards, and to establish a framework for the design of the new standards. This committee recommended that the CFP be used as the foundation for the new K-8 mathematics standards. Following this meeting, another committee was convened to write the new standards. This committee represented the same set of stakeholders and was charged with the task of actualizing the intent of the CFP within a set of grade-level specific standards. This represented a significant shift from the current state standards written in 1996 that were organized by grade bands, following the organizational structure of the Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989). The goals of the new standards were to increase the rigor, coherence, and clarity of the K-8 standards while at the same time eliminating redundancy and reducing the number of standards that are addressed at each grade level.

As the writers engaged in the process of translating the intent of the CFP into a standards document, they discovered many issues that needed to be addressed in order to help teachers and the general public understand the nature and intent of the suggested changes. As members of the writing team, we felt that it might be important to share these issues as a means to guide others who may find themselves in a similar circumstance. The writing team was in uncharted territory because Florida was the first state to initiate this process. We could not rely on or consult others about the best approach for engaging in this work based on their experiences. Although teachers and administrators appeared to embrace the new directions for K-8 mathematics, including the need to reduce the breadth of the curriculum to focus on fewer topics, many issues related to the new standards were left unanswered and needed to be addressed by the writing team. In this article, we share the experience of the standards writing team with using the CFP as a foundation for revising state standards and discuss issues to be considered by those who might engage in a similar endeavor.

Organizing the Standards: What Should They Look Like?

The writers debated the appearance of the new standards. In particular, writers grappled with whether the new standards should be organized similarly to the CFP or use some other organizational structure. Initially, some of the writers argued that the new standards document would work in conjunction with the current 1996 Florida standards document, in the same way that the CFP builds on and enhances the Principles and Standards for School Mathematics (NCTM, 2000). That is, the new standards document would identify key mathematics ideas to be addressed at each grade level. In this way, it would be a supplement to the standards document currently in place. However, the state department of education indicated that a new standards document would be developed. The new document would replace the 1996 standards document and needed to stand alone on its own merits. Ultimately, the decision was made to organize the Florida standards for grades K-8 around three Big Ideas per grade level. These Big Ideas reflect the intent of the grade level curriculum focal points in the CFP with Supporting Ideas for each grade that include the content discussed in the connections to the focal points. The Supporting Ideas serve three purposes: 1) to establish connections to and between the strands of mathematics as defined by NCTM (2000), 2) to prepare students for future mathematics teaching and learning, and 3) to address gaps in instruction that are important to the understanding, fluency, and application of mathematics ideas to problem solving. In this way, the curriculum remained focused on important mathematical ideas while including connections to other important mathematics and prerequisites for future topics. (The new Florida standards are available at www.fldoestem.org).

Another area of debate was where Algebra 1 would be taught for the majority of Florida's students. As a means to increase the rigor of the mathematics curriculum, some wanted 8th grade Algebra 1 to be the norm for most students. Others, however, were concerned about the preparation for such a change. Many wondered whether it was appropriate to expect that all students would be prepared to take and succeed in Algebra 1 in the 8th grade when there were challenges associated with Algebra 1 currently offered to the majority in the 9th grade year. This discussion was important because the decision made would influence whether there was a need to move some of the topics identified in the Grade 8 Focal points into earlier grade levels. After much debate, it was determined that Florida was not yet ready to implement Algebra 1 at the 8th grade level for all students. Included among the discussions were issues related to the preparation of middle school teachers to teach Algebra 1. After much debate, the decision was made for the standards to address three general mathematics courses at the middle school level; however the 8th grade courses would emphasize algebraic thinking and reasoning.

The writers also had to address the issue of instructional goals versus learning objectives. As part of the CFP document, NCTM states,

> These curriculum focal points should be considered as major instructional goals and desirable learning expectations, not as a list of objectives for students to master. They should be implemented with the intention of building mathematical competency for all students, bolstered by the pedagogical understanding that not every student learns at the same rate or acquires concepts and skills at the same time (2006, p. 10)

However, how might these instructional goals be reframed so that they address learning objectives? How do the writers make sense of this information in ways that allow teachers to make sense of the standards in the spirit in which it was intended? Among all of the complexities associated with developing standards, this was one of the most challenging. The writers continually grappled with how the *Curriculum Focal Points* were being used. In particular, members of the writing team debated whether we were honoring and correctly interpreting the messages outlined in the document. In particular, we wondered whether we were debasing the intent of the CFP because we were attempting to identify particular learning objectives from statements of instructional goals. When there was a debate, decisions were more often than not guided by the information provided in the CFP.

A Line of Demarcation Between Standards Development and Implementation

Writers were often reminded that the development of the new state standards should be considered a separate process from the implementation phase. However throughout the writing process, questions were raised regarding the implementation of the new standards, including the placement of topics, which topics to include or exclude, and how the standards

Ultimately, the decision was made to organize the Florida standards for grades K-8 around three Big Ideas per grade level.

would be interpreted for use. Specifically, how do we communicate the intent of significantly changed standards to large numbers of teachers and insure that they are interpreted as intended? How do we address the transition period where there might be inconsistencies between learning expectations from the previous standards and the new standards as tested on high stakes assessment? Each writer came to the table having had discussions with other stakeholders who either lacked an understanding of the intent of the CFP or misinterpreted provided information. It was felt that the issues of implementation had to be considered at this stage. Thus, the writing team discussed implementation issues while deciding how to address topics where consensus had to be negotiated. Two important implementation issues were constantly revisited throughout the writing process and are discussed below.

Narrowing the Curriculum, Increasing Depth: How Do We Communicate the Intent?

In general, the education community supported the need to reduce the breadth of the curriculum to focus on fewer topics. However, some teachers do not have a clear understanding of what is meant by developing depth of students' knowledge. These teachers initially embrace specific standards; but they grapple with the particulars of implementation. By design, not all mathematics topics are addressed in the CFP so writers had to address how teachers would interpret particular topics not included as part of the standards. What do you do about topics, such as absolute value, that are not addressed within the CFP? Where are topics placed that need to be taught but might not fit clearly with a "big idea" or a "supporting idea" in any given grade, such as telling time? How do you maintain focus on "Big Ideas" while addressing topics that are deemed important to the curriculum but are not "focal points"? How do we communicate how mathematics knowledge is developed over time and across grade levels?

As part of the writing process, a draft of the new standards underwent public review. The comments provided during the review period shed light on issues that needed to be addressed through revisions of the standards as well as on issues that needed to be addressed through professional development on the new standards. Overall public comments shared during the public review indicated support for the new K-8 standards. However in some cases, comments revealed a lack of understanding regarding the intent of the standards and with regard to particular standards statements. To clarify the intent of particular standards, the writing team prepared a set of "remarks" that further elaborated the standards and benchmarks. The remarks were created as a separate document from adopted version of the standards. In this way they could be a fluid document that can be altered as more information is gained as the new standards are implemented. The remarks will be made available as the standards are implemented. The purpose of the remarks are to: 1) clarify what is described in the standards, 2) provide context to be addressed as part of the standards, 3) provide examples of the types of problems the standards address, and, 4) provide content limits when appropriate

When striving for depth versus breadth in curricular topics, it becomes necessary to make decisions about where to teach topics and where to reduce redundancy in order to allow for a focus on depth of understanding. The writing team often discussed the intent of particular standards and whether readers would understand that the intent was to develop students' understanding rather than focus on particular procedures. A member of the Florida Department of Education shared a reaction by a teacher during an open forum regarding the new Florida standards. The teacher looked at the short list of curricular topics in a grade and said, "I can teach this in 20 days; what do I do the rest of the year?" Although this comment may cause a jarring reaction, when we consider the list of topics from the perspective of a teacher who has taught a new topic every two days in the past, this teacher's misperception is not so far fetched. (Florida has had as many as 93 grade level expectations to be taught in a given year (Reys, 2006).) A concern was also expressed about how the new standards moved topics from year to year. Teachers are protective of the topics they teach. Consider a fourth grade teacher who has successfully taught a mathematical topic in the past examining the new standards and finding that this topic has been moved to grade 6 such as determining the mean, median, and mode(s) of a set of data. He wonders, "Why would they move it? Clearly the students could do this work." In contrast another teacher wonders why a topic has been moved to an earlier grade, "This is too difficult for my students." Indeed, these teachers cannot reconcile what they have done in the past with new goals and expectations. It was obvious that in conjunction with the introduction of the new standards professional development was needed to help teachers come to understand what is meant by facilitating "deep understanding, mathematical fluency, and an ability to generalize" (NCTM, 2006, p. 5).

Although the writing team recognized that the standards were statements about the nature of the mathematics to be taught, they found that readers interpreted these statements through the lens of classroom implementation. That is, readers had difficulty separating the description of the mathematics from how that mathematics might be taught. Because of this, writers continually grappled with methods for conveying the message in ways that would be clear. Florida is addressing this issue with widespread professional development throughout the state. The Florida Department of Education is providing workshops and meetings across the state to share the new standards and their intent. Large grants are being funded to broaden these efforts relative to preparing practicing and prospective teachers with the content and pedagogical content knowledge necessary to teach according to the intent of the new standards.

Unpacking Lingo: Do We Agree on the Meaning?

The language used in mathematics education evolves and develops meaning within the community. As a result, we make assumptions about what meanings might be taken as shared. As writers engaged in the collaborative work of developing state standards based on the CFP, they discovered that other educators did not share those same meanings. It was necessary to negotiate meanings and attempt to reach consensus among all stakeholders regarding the intent of the language in the CFP, even within the writing team. For example, many stakeholders and some writers did not understand the purpose of the vocabulary “compose” and “decompose.” Some had no idea what the terms meant while others felt that the terminology could be simplified into the more common lay terms, “put together” and “take apart.” In some cases, teachers wondered whether students were expected to learn this vocabulary. One teacher shared, for example, that administrators in her district require that teachers post on the board the standards being addressed in class each day. Therefore, for the standard to have meaning to her students the teacher would be required to define difficult, and sometimes unnecessary vocabulary. The writing team had to come to terms with their position on the need for students to learn all language embedded in the focal points. Overall, the writing team decided that the audience for the standards document is teachers and other adults. Students are responsible for learning the mathematics and that teachers and districts were responsible for communicating with students in ways that are grade level appropriate. In many instances, the language of the CFP was included in the standards document. Because some of this language is different from language used in the previous standards document, the Florida Department of Education is in the process of creating a glossary to help teachers, parents, and administrators make sense of this terminology.

Conclusion

According to NCTM, “Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics provides one possible response to the question of how to organize curriculum standards within a coherent, focused curriculum, by showing how to build on important mathematical content and connections identified for each grade level, pre-K-8” (2006, p. 3). However, using this document as the basis for developing state standards requires attention to issues that may arise as a result of such use. How you choose to answer the questions posed above should depend on the specific needs of the students and teachers in your state. In our journey, questions included those that focused on organization, intent, and language. At the time of this writing, Florida has now begun to address the implementation of the standards. Emphasis has been placed on providing professional development that is fluid enough to meet the changing needs of teachers and districts. Like issues identified during the standards writing phase, we anticipate that others will be identified that relate to implementation. We encourage others to share their stories along with insights gained from their experiences as other states initiate discussion related to the use of the CFP.

References

Fennell, F. (2007/2008). Focal points: What's your focus on why. *Teaching Children Mathematics*, 14, 315 – 316.

National Council of Teachers of Mathematics (1989). *Curriculum and Evaluation Standards for School Mathematics*. Reston, VA: NCTM.

National Council of Teachers of Mathematics (2006). *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics*. Reston, VA: NCTM.

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: NCTM.

Reys, B. J. (Ed.) (2006). *The Intended Mathematics Curriculum as Represented in State-Level Curriculum Standards: Consensus or Confusion?* Greenwich, CT: Information Age Publishing, Inc.

NCSM Membership / Order Form

Use this form to renew a membership, join NCSM, update member information, and/or order items. You must be a member of NCSM in order to purchase any materials. Complete this form and return with payment. The information you provide will be used by the NCSM office for member communication, mailing lists and the NCSM Membership Directory. Check here if you do not want your information to be shared in the NCSM Membership Directory. ☐

PLEASE PRINT LEGIBLY OR TYPE.

NCSM sometimes provides its mailing list to outside companies. These companies have been approved to send catalogs, publications, announcements, ads, gifts, etc. Please check the box below to be removed from ALL mailing lists. In addition, by checking this box, only your name without contact information will be included in the NCSM Membership Directory. ☐

Circle One: Mr. Mrs. Ms. Miss Dr. Fr. Sr.

First Name ______________ Middle Name or Initial ______________ Last Name ______________

Position ______________ Employer ______________

This is my complete ☐ Home ☐ Work mailing address: ☐ Update ☐ Renewal ☐ New Member

Address line 1 ______________ Home Phone ______________

Address line 2 ______________ Work Phone ______________

City ______________ State _____ Zip ______________ Fax ______________

Country ______________ (if NOT United States)

E-mail ______________ (membership confirmation will be sent via email)

To help us better serve you and foster networking, tell us more about yourself.

Please check all that apply. *I am a leader in mathematics education at the following levels:*

- ☐ National
- ☐ Regional (more than one state/province)
- ☐ State/Province
- ☐ District/County/City
- ☐ Building (teacher, principal, etc.)
- ☐ University/College
- ☐ Senior High School
- ☐ Junior High/ Middle School
- ☐ Elementary School
- ☐ Pre-school
- ☐ Publisher
- ☐ Author
- ☐ Consultant/Independent
- ☐ Student
- ☐ Retired
- ☐ Other: ____________

Do you make purchasing decisions?

☐ Yes ☐ No

Check ALL the areas you serve:

- ☐ Rural
- ☐ Suburban
- ☐ Urban
- ☐ Second Language
- ☐ Free/Reduced Lunch
- ☐ Special Needs
- ☐ Other: ____________

Work Experience:

- ☐ Pre-service teacher
- ☐ First year on the job
- ☐ 1–5 years on the job
- ☐ 6–10 years on the job
- ☐ 11–20 years on the job
- ☐ 21–30 years on the job
- ☐ over 30 years on the job
- ☐ Retired

Since designations vary over time, check the one you feel best describes you:

- ☐ African American/Black
- ☐ Asian American
- ☐ Bi-racial/multi-racial
- ☐ European American/White
- ☐ Hispanic/Latino
- ☐ Native American
- ☐ Pacific Islander
- ☐ Other ______________

Gender:

☐ Male ☐ Female

Age:

- ☐ Under 25
- ☐ 25–34
- ☐ 35–44
- ☐ 45–54
- ☐ 55 or over

ITEMS to ORDER/MEMBERSHIP DUES

Qty	Item (details online)	Unit Price	Total Price
___	Source Book: Supporting Improvement	$25*	$ ______
___	Monograph: Future Basics	$10	$ ______
___	NCSM Membership Pin	$ 2	$ ______
	MERCHANDISE TOTAL		$ ______
	* P/H: $6 each Source Book		$ ______
___	Year(s) of Membership Dues	$85	$ ______
	TOTAL AMOUNT OF PAYMENT		**$** ______

Availability of products and prices subject to change without notice.

* Postage/Handling Only Source Books require a payment for postage/handling: $6 each for 1-5 copies sent to destinations in the U.S. and Canada. Contact NCSM for a quote on larger orders and/or other destinations.

PLEASE RETURN THIS FORM TO:

NCSM
Member and Conference Services
6000 E Evans Ave Ste 3-205
Denver CO 80222

CONTACT INFORMATION

Phone: (303) 758-9611
Fax: (303) 758-9616
Email: ncsm@mathforum.org
ncsmonline.org

NCSM Tax ID #39-1556438

METHOD OF PAYMENT

Visa MasterCard Check/Money Order (U.S. funds only)

Credit Card #______________Exp. Date ____/____

Cardholder Name ______________

Cardholder Signature ______________

> NCSM DOES NOT ACCEPT PURCHASE ORDERS <


To make a difference,
you only need to begin
with one starfish.
Which starfish will you choose?

National Council of Supervisors of Mathematics
9373 S. Prairie View Drive
Highlands Ranch, CO 80126

Presorted Standard
U.S. Postage
PAID
Brockton, MA
Permit No. 301

LEADERSHIP IN
NCSM
40th Anniversary
MATHEMATICS EDUCATION