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Start at Square One

Which Way Will You Effect Change in Our Profession?

NATIONAL COUNCIL OF SUPERVISORS OF MATHEMATICS

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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

Practices Worthy of Attention:
Improving Secondary Mathematics Teaching and Learning

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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.

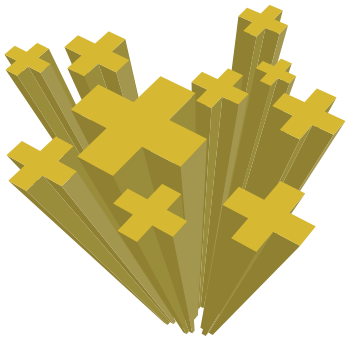
Raising student achievement through academic intensification requires changes in the attitudes and practices of administrators, teachers, and students. In summer bridge programs, students learn about the value of academic effort and build peer and teacher relationships that will support them throughout 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.

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