USING MENTORING AND PROFESSIONAL DEVELOPMENT APPROACHES TO EDUCATE URBAN MATHEMATICS

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The article titled "Economic Time Bomb: U.S. Teens are Among the Worst at Math" in the *Wall Street Journal* on December 2004 bought to the nation's attention the critical issue of teaching mathematics to American students. The failure to retain and train qualified mathematics teachers has seriously affected the quality of mathematics teaching and learning in American schools. This dearth of qualified professional teachers contributes to the disappointing performance of American 15-year-olds on the Program for International Student Assessment (PISA). Policymakers and professional development programs, therefore, need to focus on improving the quality of high school mathematics teaching in order to diffuse this crisis.

In the middle of this crisis, the demand for new teachers is predicted to rise significantly in the next ten years. Based on the statistics from the US Department of Education, close to two million new teachers will be needed for the nation's schools districts (Brown, 2003). This situation toughens the needs of effectively training and retaining qualified new teachers in the next decade.

Teacher training begins in university and college settings where preservice teachers develop the necessary theoretical understanding about teaching practices and carry it over to where new teachers apply their theoretical learning in actual classrooms. Since the mid-1980's, the practice of mentoring has become an essential teacher training component at both the preservice and induction levels (Brown, 2003). More recently, teacher mentoring has become especially useful in supporting mathematics teachers' attempts to increase the mathematics performance of their students in the context of new curricula and evaluation systems.

Functions of Teacher Mentoring

Carver and Katz (2004) see mentors at the induction level as coaches, guides, teachers, and cheerleaders who help novices prepare for their first year, locate and adapt instructional materials, decipher teaching standards, and assess student learning. Although the teacher-mentoring relationship is seen as a powerful preparatory mechanism, such a relationship can be enacted differently to serve different goals. A survey of current theories of mentoring programs and relationships reveals that the mentor-novice relationship can function at three dynamic levels. The first tier is primarily focused on teacher retention within school districts, the second on fostering a professional community of learning among teachers, and the last on developing innovative classroom strategies to challenge larger social issues (social justice advocacy).

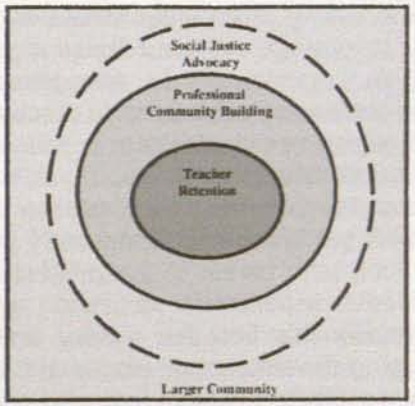

TABLE 1
Levels of mentor: mentee interactions

Teacher retention

The primary function of this relationship is motivated by the needs for recruiting and retaining new teachers. Driven by this urgent staffing need, mentor teachers are pressured to ensure that the new teacher stays in the system (Donahue, Bowyer, and Rosenberg, 2003). In such a relationship, on the one hand, mentors provide empathetic reflections on novices' experiences in the classroom and guide them to navigate the school district bureaucracy and

workplace. On the other hand, it provides the space for novices who are struggling to meet testing standards and provide adequate attention to their students to voice their frustrations and concerns. As Carver and Katz (2004) argue, underlying such a relationship by focusing on teacher retention is the presumption that the new teacher is capable of teaching effectively without any necessary support and critique to develop the necessary skills and knowledge for teaching.

This relationship becomes even more problematic if the mentor is not supported in naming and addressing key issues of learning to teach. In this case, the mentor would use his or her personal style as the benchmark for performance rather than referring to accepted professional standards. Bullough and Draper (2004) use a case study to illustrate that a mentor must be skilled at setting clear guidelines for the novice teacher and capable of locating and directly addressing problematic issues as they arise by linking theory to practice. Without these significant skills, mentors tend to emphasize their own personal teaching styles and straightforward adherence to teaching standards, rather than engaging novice teachers in critical thought and careful professional reflection.

The focus on teacher retention prioritizes the immediate goal of induction, yet it does not adequately prepare a new teacher for a long-term career in the profession. While the mentor provides indispensable motivation and guidance, this level of relationship between mentor and novice may ignore challenging developmental issues and fail to expand a new teacher's ability to think critically and creatively about their student's educational needs and personal challenges (Bullough and Draper 2004).

Professional community building

Loneliness and lack of experience can make the first years of teaching daunting for novice teachers. A professional community is assumed to provide new teachers with much needed respite and an interactive environment for reflection on their teaching experiences, school district policies, and local community concerns.

Another goal of the teacher mentoring relationship is to help the new teacher become a member of a professional

community. Brown (2003) defines such a teacher mentoring relationship as emphasizing the building of social relationships between the teachers during orientations and gatherings to foster a long-term productive relationship.

Teacher mentoring with a focus on community-building helps the new teachers quickly develop partnerships with mentors so that they together can share their experiences and advance their skills of analyzing pedagogy. It also allows novices to have substantial reflection on the theoretical underpinnings of practice by partnering with university faculty. In addition, it offers novice teachers opportunities for dynamic interaction within their immediate professional community. In short, as a close-knit community, novices, mentor teachers, and university faculty can help create a teacher culture that is grounded in continual learning.

Social Justice Advocacy

While constructive in reinforcing the current community practices and theories of learning and concentrating on novices' personal professional development, teacher mentoring emphasizing teacher retention and professional community building does not provide adequate support for teachers who wish to develop innovative teaching practices that address the particular needs of minority and disadvantaged students.

The current dearth in teachers of color further affects the skills and ability of colored students to excel academically. Therefore, there is a vital need to increase the number of minority teachers (Robinson, Paccione, & Rodriguez, 2003). It is assumed that these teachers can affect minority student interest in academic success positively by helping their students negotiate the disjuncture between their classroom and home experience and act as cultural interpreters and role models to both parents and students. However, multiculturalism alone does not provide effective strategies for these teachers to battle with social justice issues (Rodriguez, Mantle-Bromley, Bailey, & Paccione, 2003). The support is necessary for those who teach students with immigrant status, language barriers, learning disabilities, and those facing other social inequities,

to make meaningful theoretical and practical linkages in their classrooms.

Thus, training should focus on not only developing teachers' dedication to social justice and a professional community of learning but also on their ability to conduct much-needed reflection on social justice application in real classrooms. Such reflection should extend beyond the experience of individual teachers and consider the impact of their teaching strategies on their students and the larger community. The mentoring component of this training should become part of a supportive professional network that helps novice teachers promote social equity in their classroom through developing their ability to locate, understand, and advocate for social equity though teaching methodologies.

Transformative professional development

Thompson and Zeuli (1999) propose a transformative professional development approach for novice teachers to address the social justice needs. This approach helps create a high level of cognitive dissonance to disturb the equilibrium between novice teachers' existing beliefs and practices and their experience with subject matter, student learning and teaching in the new context. It fosters the increased performance among students by providing time, contexts and support for novice teachers to think and revise their thinking and develop practices consistent with their new understanding.

For such professional development programs to be effective, a mechanism focusing on transforming novices' beliefs and practices must be in place to provide the support in identifying issues relevant to their teaching, developing new understanding of the issues, changing practices inconsistent with their new understanding, and continuing the cycling for the further development (Thompson & Zeuli, 1999).

The next section will describe a mentoring program that is designed to address all three kinds of teacher mentoring functions using the transformative professional development approach. In addition, the structure of this program in light of three functions of teacher mentoring and the

transformative approach to professional development will be discussed.

The Mathematics, Science and Technology Enhancement Program (MSTEP)

MSTEP involves a partnership between a private university and a middle and a high school in the neighboring urban context. The schools were selected for the program because a large number of teachers within them had completed a graduate science and mathematics masters degree and teacher certification with the partnering university or had already been involved in action research under the guidance of university professors. Thus, these teachers had a good understanding of the university's teaching philosophy.

In addition, the program had a strong administrative support from these schools. Several of the administrators were either recent graduates of or current doctoral students in the university's programs and were highly committed to the success of MSTEP. The program coordinator/mentor was a retired principal with a Ph.D. in science and math, who spent 3-4 days in the schools working directly with novice teachers and teachers with 2-10 years teaching experience. The university professor working with the program had more than twenty years experiences in urban science/mathematics education, and taught all the mentors in the program when they were graduate students in their degree program.

The missions of MSTEP

MSTEP is developed following all three levels of teacher mentoring functions and simultaneously reflects the transformative professional development approach (Thompson & Zeuli, 1999). The mission of the program is to increase student performance in science and mathematics by providing induction support for novice teachers that intends to address the needs of teacher long-term retention, build a professional community in each school, and advocate for social justice in the urban classrooms.

Therefore, the primary goal of the program in the first year was to develop an effective partnership with the two low performing urban schools. In particular, it first, worked

with the schools to develop a plan for professional development and support for all of their mathematics and science teachers. Then as the improvement of science and mathematics teaching and learning occurred in these schools, it would replicate this model in other schools in the following years using a strategy that each program school should adopt a new school. Specifically, teachers in a program school would become mentors to novice teachers in a new school.

Functions of MSTEP

Teacher retention is usually seen as teachers' experienced successes with their current students and many would opt to stay in a particular school to continue refining their successful strategies. Teachers moved from the school systems for various reasons. Some did because they lacked a teaching certification and others moved because they had fewer years of teaching and were "bumped" by those from other schools who had longer service. In addition, some moved into administrative positions and then moved to better achieving schools or higher positions. However, MSTEP is designed to embrace that successful teacher's transit from one school to another in a hope that those successful teachers would mentor another cohort of teachers in a different school. Thereby, it holds a different conception of teacher retention that focuses on a teacher's stay in the teaching profession and exerts influences on other teachers in different school contexts.

MSTEP is also focused on building a professional community that features a series of team meetings including mentor and novice teachers, program coordinators, and school administrators. First, goals for developing core instruction skills and using test score data to facilitate the assessment and instruction were established. These goals included using hands-on invest-igations for science, using technology in mathematics teaching, and analyzing test data for all teachers to improve teaching practice.

MSTEP is also designed to empower both mentors and novices as social justice advocates to bridge the sub-cultural gaps within the minority communities that they serve and develop intra-cultural communities to support their

student's learning and achievement. More than 80% of the teachers and students in the two schools were minorities and within each school, there were wide ranges of social, cultural, and ethnic differences. MSTEP encouraged all the teachers to address issues related to their lack of understanding of the culture of students in their classrooms and engaged them in helping students make the complex and often tenuous link between the culture of their homes, the culture of the streets, and the culture of the mathematics classroom.

A transformative professional development approach

Constant with the transformative professional development approach (Thompson & Zeuli, 1999) model, MSTEP exposed both mentors and novice teachers to new content and pedagogy with the intent of challenging them to improve their learning to teach and then increase overall student performance in their classrooms. Furthermore, the program also provided time, contexts, and support for teachers to think and revise their thinking and allowed them to develop practices that are consistent with their new understandings.

The Structure of MSTEP

MSTEP developed activities relevant to mathematics teaching and learning that provided a multifaceted support system for the teachers. Prior to the start of the program, the district conducted an assessment to determine the professional development expectations of mathematics teachers, which found that these teachers requested training in using calculators in teaching, using test data to improve achievement, and about learning robotics and action research.

Workshops were conducted to provide a framework for teachers to develop practices consistent with their new understandings. A university professor and two consultants conducted calculator workshops that focused on hands-on activities with novice mathematics teachers. During and after the workshops, these novices started to revise their curriculum to include the use of the graphing calculator with the assistance of their mentor.

A whole day workshop was offered for all the novice teachers in the schools to introduce a data analysis model,

"Data Not Guesswork," developed by Jenkins and Reddick (2003). Then the novices were assisted by their mentors to implement the "data not guesswork" strategies in their classrooms.

One mathematics teacher was sent to attend a summer training program on integrating robotics into the curriculum. The teacher introduced the program to others who used the curriculum with students who recently participated in a statewide robotics competition. Other teachers enrolled in a graduate level classroom-based action research course and used the results of their research to improve teaching and learning. These teachers then disseminated their findings at regional and national conferences.

Issues and Future of MSTEP Implementation

Mentoring is effective when used as part of professional development. However, it requires long-term commitment on the part of the school and the university. Often years of effort could be eroded by the exit of a an administrator or a teacher. Three recurring problems revolve around the MSTEP implementation. They were teacher turnover, the substantial time needed to build relationships, and the trust building required among different parties.

The first two years of implementing MSTEP have been very rewarding. The program is now firmly embedded in the schools and has withstood the departure of a major administrator. During the next academic year, MSTEP will be expanded to four schools, with the long-range plan of doubling the number of participating schools each year. This expansion will eventually allow teachers to move within the school district without having to leave the program.

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