The Mathematics Educator
2010, Vol. 20, No. 1, 52–55

Book Review…

Mathematics Education at Highly Effective Schools That Serve the Poor: A Book Review

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Richard S. Kitchen, from the University of New Mexico (UNM), has a long history of work in the mathematics education field focusing on issues of equity, diversity, and multiculturalism in the classroom. Most recently, Kitchen acted as lead researcher on a project initiated in August 2002 with fellow UNM colleagues, Julie DePree, Sylvia Celedon-Pattichis, and Jonathan Brinkerhoff, which explored the characteristics of nine public secondary schools (grades 6-12) that have demonstrated high achievement while serving high-poverty communities. Their book, *Mathematics Education at Highly Effective Schools That Serve the Poor*, presents some of the results of this research.

The nine schools participating in the study had won a larger national competition, the Hewlett-Packard (HP) Company's High-Achieving School Initiative (HAS). These schools received an HP Wireless Mobile classroom (including laptops, a digital camera, and instructional delivery software), a cash award of $7500, classroom technological support provided by UNM, and professional development opportunities for teachers. Applications from 231 schools from 32 states, the District of Columbia, and Puerto Rico were initially submitted, but only 88 schools were eligible for the competition. Their applications were reviewed by the UNM research team and HP.

Eligible schools demonstrated a free or reduced lunch rate of at least 50% and a sustained exemplary academic achievement for at least three consecutive years. Furthermore, the schools had the technological infrastructure necessary to support an HP Wireless Mobile Classroom. As well as meeting these basic requirements, the 88 finalists provided information about their schools, such as demographic statistics on student race and ethnicity, teacher experience and education, and an analysis of testing data comparing their schools with others in the same state and the nation. The schools supplied additional characteristics that they felt contributed to their success, such as administrative and parental support, faculty-student ratios, and extra academic support.

Telling the stories of these nine winning schools allowed the researchers to discuss "characteristics as identified by teachers, students, and administrators that distinguished their schools as highly effective in mathematics" and the "teachers' beliefs and knowledge (conceptions) and practices about mathematics curriculum, instruction, and assessment" (Kitchen, DePree, Celedon-Pattichis, & Brinkerhoff, 2007, p. 167). Their goal was to provide a picture of highly effective schools and to determine shared characteristics that might be missing from ineffective schools. Throughout the stories, Kitchen et al. provided detailed examples of specific strategies these schools use that allow traditionally underserved students the chance to receive and use the educational opportunities they need to succeed at high levels in mathematics. This work is important for practitioners, students, and teacher educators in that it helps improve understanding of features that help mathematics educators better serve *all* students.

Research Findings

The researchers used qualitative methods to identify major patterns and themes that characterized the participating schools. Evidence from school- and classroom-level data included interviews with teachers, administrators, and students, an administrator survey, and classroom artifacts. A classroom observation instrument was used to collect quantitative data that could determine the extent to which students experienced reform-oriented instruction. Using an iterative coding process with the qualitative data, the research findings were first grouped into three major themes: "(a) high expectations and sustained support for academic achievement, (b) challenging mathematical content and high-level mathematics instruction that focused on problem solving and sense making (as opposed to rote instruction), and (c) the

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importance of building relationships" (Kitchen et al., 2007, p. xiv). During analysis, the researchers identified areas related to each major theme. In order for a theme or related area to be included in the analysis, it had to be found in at least two teacher interviews at more than half of the participating schools.

For the second theme of challenging mathematical content and high-level instruction, the researchers explored five related areas: the prioritization of problem solving, the completion of an Algebra I equivalent by 8th grade, students' mathematical communication and engagement in inquiry, mathematics curriculum as a work in progress, and preparation for success on standardized tests while teaching beyond the test. Of the major themes, I will focus on how the book describes this second theme of challenging mathematical content and high-level instruction, and, in particular, its related area of the prioritization of problem solving.

Most of the participating schools had the goal of preparing their students to be successful on state and national tests, and the teachers purposefully structured their mathematics curriculum to prepare their students to be successful on these standardized tests. However, standardized tests did not determine the mathematics curriculum and instruction, and this is evident in teachers' decisions to develop students' critical thinking and problem solving, going beyond skills-based curriculum and instruction. Evidence from the interviews convincingly shows how the teachers go beyond test preparation.

In addition to these similarities, Kitchen and colleagues discussed the differences between schools in terms of the teachers' use of skills-based instruction and their focus within lessons on mathematical problem solving. Using data from lesson observations and interviews, the researchers concluded, "the focus at the highly effective schools was teaching a challenging mathematics curriculum that developed students' critical thinking capacities through problem solving" (Kitchen et al., 2007, p. 163). However, even though all the schools are considered to have such mathematics programs, some schools are more aligned with a standards-based curriculum and pedagogy, while others rely more on skills-based instruction. This variation makes it clear that there is no single way to be successful.

In working to understand the relationship between skills-based instruction and problem solving, the researchers deduced that the teachers at the schools had to be flexible in their philosophical orientations about the nature of mathematics. This conclusion is particularly interesting because it could be seen to contradict other literature concerning teachers' beliefs about the nature of mathematics. Specifically, in the reviewed book there are quotes from the teachers indicating that some of the teachers have a linear view of mathematics. In linear (sequential or hierarchical) learning, students move from lower- to higher-order cognitive tasks. Since higher-order cognitive tasks are more complex, they require deeper content understanding. Understanding of mathematical concepts evolves from simple, disjoint ideas to complex, connected ideas: Before students are able to tackle more advanced topics they must have mastered prerequisite, basic skills. When teachers hold this view, student-teacher interactions usually focus on empirical and procedural issues instead of critical thinking (Raudenbush, Rowan, & Cheong, 1993). This view can create issues with teaching critical thinking and problem solving in the classroom. Specifically, teachers with more traditional views, i.e. linear, are more likely to think that higher order thinking tasks are not appropriate for all students. For example, Zohar, Degani, and Vaaknin (2001) found that one of the major factors in teachers' decision to not use critical thinking-based learning with low-achieving students is the belief that higher-order thinking is inappropriate for these students. This belief is directly related to the teachers' views of teaching and learning. Therefore, there seems to be a contradiction between what the teachers who seemed to hold a linear view of mathematics believed and how they taught, since they still implemented problem solving in their classrooms.

Fortunately, the authors clarified this issue by discussing how the three dominant characterizations of mathematics knowledge (instrumentalist, Platonist, and problem solving) are not mutually exclusive. That is to say, the teachers utilized skills-based instruction as well as problem solving in their classrooms. They believed that both were necessary for success in secondary mathematics. Though all teachers professed to value problem solving in interviews, some teachers displayed a teaching style more closely aligned with standards-based instruction, by using higher levels of mathematical analysis and discourse. Others continued to emphasize drill-focused pedagogical strategies. Kitchen et al. explained these inconsistencies by reminding the reader that the teachers' primary goal was to do whatever necessary to serve the needs of the students. The teachers must have flexible philosophies

allowing them to use many different instructional techniques.

In attempting to account for variation in teachers' focus on problem solving, Kitchen and his colleagues presented differences between the schools that could impact teachers' pedagogical decisions. In each of the nine schools, teaching and learning was a primary value in the school culture. Administrators and teachers thought seriously about discipline and "a majority of the schools had discipline policies reinforcing the notion that learning was the top priority and obstructing the learning of others was a serious offense" (p. 148). In three of the participating schools, students signed a contract in which they agreed to strict behavioral norms. These schools had longer school days, mandatory Saturday classes, and summer school. Teachers committed to extended workdays, extra tutoring time, Saturday classes, and summer school, as well as being available by phone to students after hours. The discipline policy and support services promoted the goal of positively impacting student learning and achievement. These components of the schools allowed the teachers to commit to supporting the students in learning challenging mathematics, including critical thinking and problem solving. All of the teachers in the study felt that problem solving was an important component of successful mathematics instruction, but outside influences caused them to implement particular pedagogical strategies to varying degrees. Hence, though there was some contradicting evidence between teacher intentions and their actions in the classroom, the researchers did a good job of explaining these differences and showing why they could have occurred. This added to the strength of the study and provided additional support for some of Kitchen's previous findings (Kitchen, 2003).

Comparison to Other Research

Teacher Support Structures

In one of Kitchen's earlier studies, he looked at teachers' abilities to implement standards-based curriculum in their classrooms. Through work with secondary teachers in a summer institute, Kitchen found that "teachers' overwhelming workload served as the primary barrier to reforming their classroom practices and implementing innovative instructional strategies" (Kitchen, 2003, p. 3). The teachers did not have the time or energy they needed to develop new ways of teaching. They did not have support from administrators, colleagues, or parents. Therefore, the fact that the highly effective schools in the present study have both administrative and parental support, as well as cooperation among teachers, lends more credence to the conclusion that these types of support increase the likelihood of a school being effective.

Indicators of Effectiveness

Kitchen and his colleagues' definition of effective schools is restrictive. The participating schools needed to show "sustained exemplary academic achievement, particularly in mathematics, over a minimum of from 3 to 5 consecutive years across a variety of indicators" (Kitchen et al., 2007, p. 22). The indicators included high scores on standardized tests as compared to other schools in their district, state, and nation; standards-based curriculum and instruction; use of alternative assessments; and a high percentage of students matriculating in advanced placement courses. Other research focusing on schools serving the poor use different indicators to evaluate school success.

As an example, Boaler and Staples (2008) did a longitudinal study of three schools that all shared a common characteristic of retaining a committed and knowledgeable mathematics department. Teachers at one of the schools, Railside, used a reform-oriented curriculum focusing on conceptual problems and mixed ability group work. Student achievement data showed that the Railside students started at statistically significant lower levels than the other schools. However, after two years, the student achievement data showed a statistically significant difference in favor of the Railside students. Nevertheless, the Railside students did not fair as well on the state standardized tests as the other schools. The authors believed that this had to do with cultural and linguistic barriers on such assessments.

The reason this work is of interest is that Railside would not necessarily be considered for Kitchen's study because the students did not perform well on standardized tests. However, the students at Railside had a more positive attitude towards mathematics, did better on curriculum-aligned tests, and had a smaller achievement gap between students of different ethnic and cultural groups. Furthermore, the Railside teachers showed many characteristics prevalent in Kitchen's study such as holding high expectations for students and providing challenging, standards-based curriculum. Therefore, it is important that the readers acknowledge the diversity of schools in the United States that do successfully serve diverse populations. Kitchen's sample represents only a particular set of

"highly effective schools serving high-poverty communities across the country" (Kitchen et al., 2007, p. 165) satisfying a specific set of criteria set by this particular research team. Fortunately, the authors recognized this limitation and urged readers to consider investigating other schools located in less affluent communities to see if the findings from this study hold in other contexts.

Conclusions

Kitchen and his colleagues' study set out to identify significant characteristics that contributed to the success of secondary schools serving high-poverty communities. The researchers also explored teachers' beliefs and practices related to mathematics teaching and learning. The results of their analysis provide the reader with numerous examples of effective strategies, such as high expectations for students, support for academic achievement, challenging mathematical content, and high-level instruction. They found that, as long as teachers and administrators were committed to doing all that was necessary to help their students learn deep mathematical ideas and achieve at high levels, their students would deliver.

This book is a powerful example of how schools can attend to traditionally marginalized populations effectively when they are committed to serving and understanding the needs of their students. Kitchen and his colleagues did a wonderful job of providing evidence of the characteristics present in the schools, as well as pointing out and discussing possible discrepancies and limitations of their findings. Anyone in the mathematics education community, including teachers, administrators, students, and teacher educators, will find the description of these schools useful in furthering their thinking about how to become an effective teacher or school. With the U.S. student population becoming more diverse, but the teacher pool becoming more homogeneous, Kitchen et al.'s work is especially timely for the mathematics education community.

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