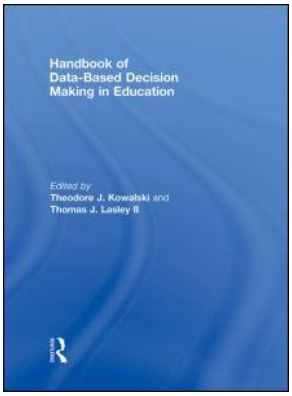

Handbook of Data-Based Decision Making in Education

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Collaborative Inquiry and Data-Based Decision Making

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21

Collaborative Inquiry and Data-Based Decision Making

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Introduction

The educational reform movement and demands for public accountability have placed increased pressure on K-12 educators to help students perform on national, state, and local tests. Teachers and students are currently facing an onslaught of tests and assessments designed to judge whether or not they are making adequate yearly progress (AYP) in increasing student achievement. At the surface level, student data are gathered to meet the requirements of the federal, state, and local legislation and policies. At a deeper level, the increasing use of data to make decisions reflects a shift in the professional roles of educators. The focus on student test scores has forced educators to become more data driven as they attempt to analyze test scores and make decisions about curricular and instructional changes that will help students learn. The educational reform movement "broadened expectations for professional practice" calling for K-12 educators to be more than mere implementers of the policies and practices determined by others, and rather to be leaders responsible for school improvement (Kowalski, Lasley, & Mahoney, 2008, p. 3).

To some extent, the schools have become overwhelmed with data. State assessments, district assessments, school assessments, and classroom assessments have all led to more data than schools can easily manage. To help manage all these data, schools need to develop the capacity to conduct evaluations and assessments for data-based decision making (King, 2002; Kowalski et al., 2008). The purpose of this chapter is to describe a model of collaborative inquiry that is designed to engage educators in data-based decision making. Through the model, collaborative evaluation communities (groups of educators) use evaluation processes to facilitate data-based decision making in schools. Teachers typically do not have expertise in evaluation and therefore it is critical for university educators who have expertise in evaluation to respond to this need through professional collaborations with schools. Traditionally, collaborations have focused on developing teachers' ability to engage in action research or reflect on classroom practice; however, there is a need to go further and help teachers and schools begin to engage in a broader schoolwide evaluation of programs.

Numerous researchers have noted that educational growth can be optimized when teachers are supported by other education professionals (Darling-Hammond, 1997;

Fullan, 1993; Robb, 2000; Routman, 2000; Sarason & Lorentz, 1998). Unfortunately, the structures that support these types of professional long-term collaborations among educators still evade many K-12 teachers (Long, 2004). The daily work of classroom teaching does not typically promote collaborative inquiry. Teachers are so consumed with a wide variety of problems and concerns related to teaching and learning that they often do not have time in their schedules to develop meaningful working collaborations either with other teachers in their own building, or with outside groups such as university and community institutions. Teachers tend to have very little time during the day to work with other teachers, plan lessons as a team, or even talk with their colleagues (Peak, 1996).

Professional structures that engage teachers and university personnel in joint investigations create opportunities to share expertise and build interdependence in understanding instructional issues within a particular context (Elmore & Burney, 1999; Fullan, 1993; Little, 1999; Sarason & Lorentz, 1998). Furthermore, collaborations that stimulate teacher inquiry, reflection, and data-based decision making have all been shown to be powerful tools for influencing an individual's beliefs and theories of teaching and learning (Bissex, 1994; Cochran-Smith & Lytle, 1993, 1999; Huffman & Kalnin, 2003; Kalnin, 2000). To improve student achievement, Sarason (1996) urges districts and universities to create opportunities for partnering that move across current hierarchies. He concludes, "Teachers cannot create and sustain contexts of productive learning for students if those contexts do not exist for teachers" (pp. 253–254). Collaborative efforts that engage individuals across schools and universities in a shared evaluative process of data gathering and analysis not only give teachers a voice but can also lead to sustained improvements in learning.

However, collaborative efforts have not traditionally been used to engage teachers in inquiry by means of program evaluation. It is quite rare for teachers to engage in inquiry regarding schoolwide issues (Chval, Reys, Reys, Tarr, & Chavez, 2006). Action research and reflection are more common in the schools, and these are certainly worthwhile activities, but we would argue that there is a need to move teachers toward considering broader, more schoolwide evaluation of their work. Program evaluation has traditionally been deemed the realm of the district administration—not the realm of teachers' work. Also, teachers have not historically participated in systematic evaluation of educational issues as true partners (Henson, 1996). This leaves teachers with little or no voice in the questions that are considered, the data that are collected, or the way in which the data are analyzed and interpreted. We would argue that it is imperative for teachers to participate in collaborative inquiries using evaluation processes to develop the capacity for data-based decision making. Participating in these collaborative inquiries can help teachers become what Kowalski et al. (2008) describe as "evidenced-based decision makers" (p. 256). They contend that evidence-based decision makers not only know how to implement decisions, but also know how to examine school and classroom environments in a broader sense. Evidence-based decision makers "are not just looking at state test scores and standardized tests. They are looking at school, teacher, and student factors that might influence these scores" (p. 256). In this chapter we describe a unique model of collaborative inquiry that has been used to engage teachers in broader, more schoolwide program evaluation. Such efforts focused on program evaluation are rare and

this chapter provides a unique case study of the impact of such efforts on developing teachers' ability to engage in data-based decision making. As participant observers, we studied how participation in a collaborative evaluation community (CEC team) affected teachers. In the following section we describe the link between collaborative inquiry, program evaluation, and data-based decision making.

Collaborative Inquiry and Evaluation to Build Capacity for Data-Based Decision Making

Individual teacher inquiry, reflection, and data-based decision making in the form of teacher research projects have been shown to be powerful tools for influencing an individual's beliefs and theories of teaching (Bissex, 1994; Cochran-Smith & Lytle, 1993; Kalnin, 2000). Noffke (1997) establishes that teacher research projects have personal, professional, and political purposes and benefits for teachers. Although individually conceptualized inquiry efforts may have substantial benefits for a teacher's learning and decision making, critics raise questions about whether such projects have any systematic impact on school change efforts (Elmore, 2000). Elmore claims that if teachers do not move toward collaborative designs addressing whole-school or district issues, their work will amount to no more than "playing in a sandbox" (Elmore, 2000). In contrast, professional structures that engage teachers and other educational personnel in joint inquiries create opportunities to share expertise and build interdependence in understanding educational issues within a particular institutional context (Elmore & Burney, 1999; Fullan, 1993; Little, 1999; Sarason & Lorentz, 1998).

A number of barriers have been noted to establishing data-based decision making as a feature of school culture, one of which is the lack of collaboration among educators when engaged in inquiry (Kowalski et al., 2008; Popham, 2006). Approaching inquiry from a collaborative, team-based approach potentially addresses the organizational structures in schools that have hampered school change efforts. Sarason (1996) urges districts and universities to create opportunities for collaboration that move across current hierarchies in order to improve student achievement. He concludes, "Teachers cannot create and sustain contexts of productive learning for students if those contexts do not exist for teachers" (pp. 253–254). Elliott (1991) specifically identifies inquiry-based efforts as critical to restructuring roles:

> Action research integrates teaching and teacher development, curriculum development and evaluation, research and philosophical reflection, into a unified conception of a reflective educational practice. This unified conception has power implications inasmuch as it negates a rigid division of labour in which specialized tasks and roles are distributed across hierarchically organized activities. (p. 54)

Engaging teachers in long-term collaborative inquiry coupled with participation in program evaluation can help schools build the capacity for data-based decision making. Kowalski et al. (2008) suggest that building this capacity involves four dimensions:

(1) proficiency generating data—the degree to which principals, teachers, and support staff are prepared to conduct assessment and related research,
(2) proficiency using data—the degree to which principals, teachers, and support staff are prepared to apply assessment outcomes to important decisions,
(3) resource adequacy—the degree to which principals, teachers, and support staff have access to data, time, equipment, and technical assistance.
(4) cultural acceptance—the degree to which principals, teachers, and support staff share values and beliefs supportive of data-driven decision making. (p. 17)

The Collaborative Evaluation Communities in Urban Schools Project (CEC Project) described in the following sections illustrates how these four dimensions of data-based decision making can be developed in schools.

Collaborative Evaluation Communities in Urban Schools

We received funding from the National Science Foundation to develop the ongoing CEC project. The purpose of the project is to help teachers in urban schools build assessment and evaluation capacity by engaging in long-term inquiry related to curriculum, instruction, and student learning in mathematics and science. The project provides a unique structure for immersing K-12 teachers, mathematics and science educators, and graduate students in the evaluation process in an attempt to improve teachers' capacity to use data and engage in continuous improvement through data-based decision making.

The CEC project provides long-term collaborative experiences in diverse settings as a means of developing the evaluation capacity of both K-12 schools and graduate students. The key concept behind the CEC project is that by immersing teachers in the evaluation process we can help build evaluation capacity and bridge the gap between district evaluation efforts and the teaching and learning of science and mathematics. Teachers need assistance in deciphering and understanding data to change practices and one way to do so is through a collaborative evaluation community.

Collaborate evaluation efforts between K-12 schools and universities can provide unique infrastructure developments that serve the needs of the schools by enhancing their evaluation capacity. Other forms of collaboration such as teacher inquiry, reflection, and data-based decision making have all been shown to be powerful tools for influencing an individual's beliefs and theories of teaching and learning (Bissex, 1994; Cochran-Smith & Lytle, 1993; Kalnin, 2000). Huffman and Kalnin (2003) reported that when science and mathematics teachers engaged in collaborative inquiry, they not only changed their instructional practices, but also began to make schoolwide changes. In their study, teachers also reported that the collaborative process helped their school engage in continuous improvement and to use data to make decisions. The CEC project provides professional growth activities for science and mathematics teachers. By engaging teachers in the evaluation process we are assisting school districts in the development of an evaluation culture designed to

support teachers in the continual examination of programs with the ultimate intent of improving educational opportunities for all students.

One of the challenges in creating collaborative evaluation communities is organizing the wide variety of participants so that they can successfully achieve their goals. The goal is to involve all of the participants in significant and worthwhile evaluation activities. The participants come to the evaluation process with different expertise and background knowledge, along with different expectations and goals. The challenge is creating and sustaining a collaborative evaluation community that can bring these diverse views together in a way that is productive and useful for everyone. The key to sustainability is to design collaborative evaluation communities that serve the needs of the schools while at the same time serving the needs of faculty and graduate students. This means we must engage in evaluation that serves the everyday teaching and learning needs of science and mathematics teachers, while at the same time engaging in program evaluation that can address larger evaluation issues across schools. In her work with evaluation capacity building in schools, King (2005) highlights five key activities that, when implemented over several years, are important to developing a culture for evaluation. Among these activities are:

(1) creating an evaluation advisory group,
(2) beginning to build a formal evaluation infrastructure,
(3) making sense of test scores,
(4) conducting one highly visible participatory inquiry, and
(5) instituting action research activities.

(King, 2005, p. 90)

The CEC project employs activities similar to those which King used.

The Inquiry Cycle in Collaborative Evaluation Communities

The overview of the CEC given above provides insight into how the collaborative inquiry model operates. The formation of teams of participants is central to the collaborative nature of the CEC project. CEC teams comprised of teachers, school administrators, district personnel, graduate students, and university evaluators are established at schools to immerse participants in the process of evaluation. The CEC project uses an inquiry cycle developed by the National Research Council (NRC, 1999) to engage participants in the ongoing process of evaluation (see Figure 21.1). The cycle begins with a collaborative examination of student achievement data at the national, state, and local levels involving input from university evaluators, K-12 personnel, and science, technology, engineering, and mathematics (STEM) graduate students. Following the initial exploration of existing achievement data, CEC participants consider how the data might inform the evaluation of mathematics and science programs in the school district. The first two steps in the process are designed to help participants explore data and to think about the implications of the data for their own district. Exploring data typically produces many questions and serves as an excellent starting point for the evaluation process.

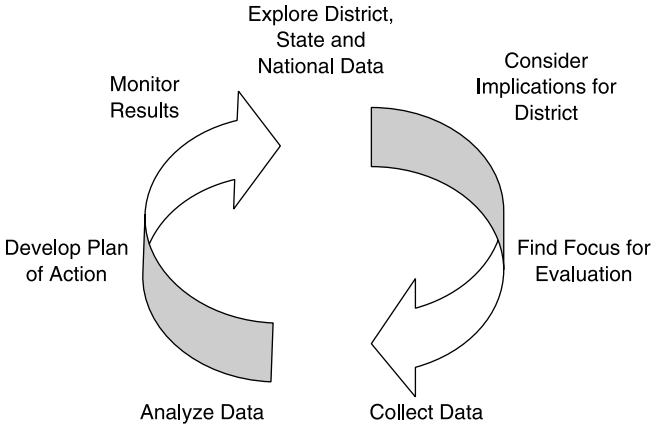

Figure 21.1 Inquiry cycle.

In the next step CEC participants establish a focus for an initial evaluation. Participants are asked to identify broad issues related to student achievement in mathematics or science drawing upon the data exploration from the first two steps of the inquiry cycle. Reflections on the issues lead the CEC participants to create evaluation questions that can serve as the focus for their upcoming investigations. The selection of focus areas is followed by the development of an initial evaluation plan to guide data collection and analysis. The next two steps in the inquiry cycle immerse the CEC participants in data collection and analysis. This involves developing data collection instruments and data analysis procedures that CEC participants use to answer the evaluation questions in their plan. The procedures used by the CEC teams in these two steps contribute to ECB by beginning to establish the infrastructures necessary for sustainable inquiry and evaluation in schools.

Based upon what is learned from the initial data collection and analysis, communities develop specific action plans to address the problems they identified. The action plans require continuous monitoring, more data collection, and analysis. This in turn typically leads to more questions, more data collection, and more analysis. In the end the process will help establish a continuous improvement cycle that can help the collaborative evaluation communities use evaluation as a tool to create change in their schools and empower the teachers to become leaders in their schools. The inquiry cycle we have described includes aspects of the evaluative inquiry process promoted by Parsons (2002) and reflects the working definition of evaluation capacity building (ECB) provided by Stockdill, Baizerman, and Compton (2002) emphasizing the importance of the "on-going, open-ended, and emergent nature of EBC work—sustaining evaluation and its uses" (p. 13).

A Case Study: The CEC Project in an Urban Elementary School

The elementary school described in this case study is located in an urban community situated in an industrial area of the city. The school serves approximately 300 students of which 58% are of Hispanic descent and 38% are of African American

descent. Additionally, 89% of the students come from economically disadvantaged households. Of the 16 regular classroom teachers at the school, six were interested in participating on the CEC team along with the instructional coach and the principal. After the school was selected to participate in the project, the team of six teachers, the instructional coach, and the principal attended an organizational meeting conducted by the authors. The meeting served as a forum to begin the partnership between the school and university partners and to launch the inquiry cycle. In the following sections, we describe the progress of the CEC team through the phases of the inquiry cycle and present the results of the case study established through analysis of critical incidents.

Phases One and Two: Examining National, State, and District Data and Considering Implications

A kick-off meeting was held during an after-school time frame to accommodate the teachers' schedules. The session was organized by the university partners with the purpose of providing an overview of the CEC project and to begin the first phases of the inquiry cycle together with the school team. During the small group session the following goals of the CEC project were shared:

(1) create collaborative evaluation communities to examine teaching and learning of mathematics and/or science;
(2) use evaluation and assessment data to inform mathematics and science instruction and curriculum development; and
(3) engage in collaborative evaluation as a means of improving student achievement in mathematics and science.

The university partners then shared national data from the Trends in International Mathematics and Science Study (TIMSS). It was evident to the team that students in the United States have been outperformed by their counterparts in other countries. The question of why this might be occurring was raised. A presentation of findings from classroom video analysis research conducted by Stigler and Hiebert (1999) was shared through a short video clip. Stigler and Hiebert found that how students were taught and what they were taught were the predominant factors contributing to differences in student achievement. These results demonstrated for the teachers that the curricular and instructional decisions they make in their classrooms can have profound implications for student learning.

Next, the university partners presented state and district mathematics and science student test results from previous years. The team noted that the district test results in mathematics had improved slightly since the district had implemented a standards-based mathematics curriculum at the elementary level [*Investigations in Number, Data, and Space* (TERC, 1998)]. However, student achievement at the district level continued to fall below the state averages, highlighting the work that could be done to improve student mathematics achievement in the district. After examining the student data, the CEC team chose to focus on mathematics achievement.

Phase Three: Find a Focus for Evaluation

The CEC team agreed to meet every other week following the initial session in an effort to move forward in the inquiry process before the end of the school year. During the second group session the team generated potential factors that might contribute to student mathematics achievement that could become central to the evaluation inquiry process. The factors identified were discussed by the group to further clarify the meaning of each issue, particularly within the context of the school. The significance of the session became apparent as the team recognized several common issues that emerged through the discussion of mathematics teaching and learning. The issues the team found most important related to the recently adopted standards-based curriculum series that the teachers in the school were using for instruction. Specifically the team was interested in:

(a) curriculum alignment with state mathematics standards,
(b) pacing of instruction,
(c) instructional practices of teachers as they use the curriculum,
(d) teachers' mathematical knowledge of content contained in the curriculum, and
(e) curriculum alignment with the state mathematics assessment.

Consideration of curriculum alignment with the state mathematics assessment focused on two distinct aspects: (1) the mathematics content of assessment items and (2) the format of the assessment items (i.e., multiple choice). The emphasis on assessments in the discussion was particularly important to the school personnel as the state was preparing to implement a new mathematics test for elementary Grades 2 to 6. The teachers shared their concerns about low student scores on the state assessment and how important it is to increase student scores in ultimately increasing overall achievement. The teachers had the perception that one area of weakness for their students was computations, but there was a lack of evidence to confirm this belief. One teacher commented, "If our students truly have the depth of understanding number sense that *Investigations* supports then they would do well on the computation problems." She went on to say, "I don't think that every teacher in the school understands the connection between the activities, investigations, or games found in *Investigations* and concepts like number computations"; the other teachers in the group agreed. However, these perceptions were based on opinions without actual data. The CEC team decided to focus on gathering data related to instructional practices and curriculum alignment with assessments as the major areas for the evaluation work of the first inquiry cycle. The next few sessions were devoted to the development of a curriculum and instruction survey for teachers at the school and the examination of state assessment expectations.

Phase Four: Collect Data

The CEC team chose to focus on better understanding mathematics curriculum, instruction, and assessment, including: what was being taught in each grade; how

topics were being taught; and how student learning was assessed at both the classroom level and through the annual state mathematics test. Few school districts have data about the instructional techniques used by teachers in their schools. As a starting point this team found it important to first understand not only how mathematics was being taught but also how the curriculum and their instruction aligned with the state mathematics standards and the state test before they could initiate change. As the teachers began to engage in the data collection process they needed more one-on-one assistance from the university partners to refine their data collection instruments and begin to implement the evaluation plan.

The first Phase Four session began with the university partners sharing samples of surveys they had used in their own research to address instructional practices, teacher self-efficacy for teaching, and confidence with particular mathematics content and processes. The university partners challenged the group with the task of reviewing the surveys and modifying items for use in a survey designed specifically for the school. Analysis of field notes from this session revealed that some of the teachers were hesitant about the task and actually began to question the value of surveying teachers in the building. A couple of the teachers were vocal about not wanting to do something that would not be useful in their own classroom. One teacher made it clear that she did not want to spend time creating a survey, she just wanted to work on something that she could use with her students in her classroom. The teachers' desire to focus on concrete issues related directly to their daily classroom work is not unique to this school. Cuban (1992) identified a common dilemma to building professional communities for systematic educational inquiry was the differences in the way teachers and researchers view the work. Cuban found that teachers wanted to pursue research in areas that seemed to have implications for the concrete tasks of their classrooms, while researchers were interested in implications of broader aspects of educational programs. Similarly, the CEC teachers began to question the value of conducting a survey because they believed that they already knew what they were doing in their own classrooms for instruction. The principal and the instructional coach commented that while teachers might know what happens instructionally in their own classrooms the school had little data about the instructional practices of all teachers in the school. The principal reminded the group that improving the mathematics program in the school was "larger than one teacher's classroom" and gathering data about these issues was important to the school as a whole. We encouraged the teachers to think about how collecting instructional practice data would provide a baseline for future comparisons and might also lead to a greater understanding of instruction in the school. As a result, the group refocused on its belief that understanding instruction in the school is an area that influences student learning of mathematics. As the session ended, teachers returned to their focus on instructional practices and agreed on the value of surveying teachers in the school. They made suggestions for how survey items could be modified, changed, and created to benefit the inquiry process at the school, particularly by adding items that asked teachers about the curriculum. The university partners agreed to gather information on the new state mathematics assessments and to draft a survey instrument for the teachers to review at a future meeting.

Subsequent sessions were devoted to revising the survey, reviewing the changes in

the state mathematics assessment, and to revisiting the broader issues and questions guiding the CEC inquiry cycle at the school. The teachers at the school completed the survey that was created by their colleagues and university partners. In an effort to continue to build trust among the university and school partners, the survey responses were anonymous. The CEC team determined that it was not necessary to connect responses to particular teachers because the focus of the evaluation was on the instructional practices of the teachers in the school collectively. During this phase the university partners also met with the district elementary mathematics coordinator who knew the latest information and changes related to the new state assessments. It was decided that data about the new assessments would be used by the CEC team in the data analysis phase of the inquiry cycle.

Phase Five: Data Analysis

The mathematics teaching and learning survey developed by the CEC team for the teachers at the school comprised items related to the mathematics curriculum, teacher efficacy, instructional practices, assessment practices, student learning outcomes, and teacher confidence with their own mathematics knowledge and understanding. The composition of the survey was consistent with a questionnaire, Inside the Classroom Mathematics Teacher Questionnaire, used by Horizon Research Corporation in a national study of mathematics instructional practices (Weiss & Pasley, 2004). Alignment between the CEC mathematics and teaching survey and the Inside the Classroom Mathematics Teacher Questionnaire helps establish validity of the survey. The teachers in the school completed the survey anonymously during a professional development session. The process was unique because the teachers were responding to the survey as a means of gathering data for their own inquiry and evaluation of the mathematics teaching and learning at the school. The survey request came from the partnership formed through the CEC project, which included teachers, rather than as a mandate from district administration or outside researchers.

For the purposes of data analysis, response frequencies were examined by the CEC team during a group session in which the results of several items materialized as relevant to the current inquiry process. It was clear from the responses to items related to the curriculum that teacher perceptions about the curriculum varied widely among teachers in the school. The divergent views of mathematics curriculum and teaching were quite intriguing to the team. While a majority of the teachers believed that their curriculum is better than traditional textbooks for helping students understand mathematics concepts, more than a third disagreed. When asked if the curriculum is better than traditional textbooks for teaching students about computation, a majority of the teachers either *disagreed* or *strongly disagreed* but more than a quarter of the teachers either *agreed* or *strongly agreed.* The responses from teachers were nearly equal between *agreeing* and *disagreeing* that the students learn mathematics better by using the curriculum and on whether or not teachers would prefer to use a different curriculum. Analysis of the opinions about instruction items showed that most of the teachers did *agree* that they had the ability to effectively

teach mathematics. However, it is notable that none of the teachers felt strongly about this ability.

Group discussion related to the frequency distribution of responses to several questions about student learning, teacher assessment of student learning, and instructional practices led to an emphasis on the issue of assessment. For example, a majority of teachers in the school generally *agreed* that they are effective at embedding assessments into mathematics lessons but more than a quarter did not believe this to be true. Most teachers indicated that they use assessments embedded in class activities, as well as observations and questioning to assess student progress at least once or twice a week. However, more than 90% of the teachers reported that they never or rarely (a few times a year) used short-answer tests (e.g., multiple choice, true/false, fill in the blank) to assess student learning in mathematics. This result was significant to the work of the CEC team because the new state mathematics test consists of all multiple-choice items to measure student achievement. Analysis of the survey responses also indicated that a majority of the teachers in the school never have another colleague observe their students' academic performance or review their students' test scores. Consequently, the school partners wanted the plan of action to include adding common grade level embedded assessments into lessons from the curriculum that more closely align with the format and content of the state mathematics test.

Phase Six: Plan of Action

After the data analysis in Phase Five of the CEC inquiry process a plan of action was initiated by the CEC partners. The group decided that the plan of action for the first CEC inquiry cycle would be to write multiple-choice assessment items for teachers to use as embedded assessment throughout the school year while using *Investigations in number, data, and space* (TERC, 1998). The intent for these mini-assessments was to provide teachers with a means for gathering regular student assessment data aligned with the curriculum and the state mathematics standards.

Before writing the mini-assessments at each grade level the CEC team chose to study the new state test guidelines. With the assistance of the district elementary mathematics coordinator, the team participated in an analysis of the state mathematics test information and item analysis for Grades 3 to 5. The team reviewed the standard indicators from the state mathematics standards that would be assessed and considered the number of items that would be included for each standard indicator per grade level. Standard indicators that might not be assessed at an earlier grade level but that would be assessed in subsequent grades were also included in the analysis at each grade level. Therefore the partners considered standards indicators for grades K-5 in their review.

The teachers used released items from the National Assessment of Educational Progress (NAEP) and TIMSS as models for constructing multiple-choice items specifically aligned with units in their curriculum. Items written were then shared with the CEC partners at a follow-up session. The school and university partners discussed each item and evaluated the alignment with the intended standard indicator. The evaluation of items as part of the process of creating mini-assessments was

significant because it helped the group establish a common understanding of how assessment items would be written. Once the CEC group had determined guidelines for writing items, pairs of teachers took responsibility for a grade level and began writing mini-assessment items to accompany specific units in the curriculum. The mini-assessment development work was undertaken by teachers during the summer with the mini-assessments to be implemented the following school year.

Phase Seven: Monitor Results

Continuous data analysis is a key component of building assessment and evaluation infrastructure in schools. The seventh phase of the inquiry cycle requires monitoring results of previous inquiry. The CEC team analyzed data from the mini-assessments to monitor student learning throughout the school year. One challenge faced by the CEC team was encouraging implementation of the mini-assessments schoolwide. During the first inquiry cycle described in this case, the use of mini-assessments was limited to the teachers (grade levels) involved in the project. The CEC team developed assessments for third, fourth, and fifth grade *Investigations in number, data, and space* (TERC, 1998) units but only third and fourth grade students completed mini-assessments during the first year. Even the teachers involved in the project struggled to embed the mini-assessments into their instruction, finding that some units passed without the administration of an assessment. To assist the teachers, the university partners worked collaboratively with the teachers to create databases that made recording and monitoring the assessment data more systematic. The databases contributed to increased infrastructure in the school for data collection and analysis. One positive outcome of the first cycle through the inquiry process is that teachers began meeting with each other to analyze results from the mini-assessments and collectively review students' academic performance. By the end of the first year of the project, the CEC teachers were committed to finding ways to ensure that all unit mini-assessments would be taken by students during the next school year and they were exploring options for including more teachers in the school in systematic analysis of mini-assessment data. On the survey of mathematics teaching and learning developed and administered by the CEC team the previous spring, more than 80% of the teachers in the building reported that they *rarely* or *never* engaged in this type of professional activity.

These collaborative evaluations of student learning led to changes in mathematics instruction and school programs across grade levels. For example, in the fall of 2005 the CEC team scored and analyzed results of a fourth grade mini-assessment on number sense and computation. Through item analysis, the team discovered that a majority of the fourth grade students were not able to successfully compute numbers represented as monetary values for the purpose of solving simple and complex problems. Discussions about these results focused on ways in which teachers can strengthen student understanding of number sense, particularly the representation of money. Field notes from the CEC team's work session captured the essence of the discussion including teacher comments such as, "We are doing so much surface teaching and we are not going deep enough with the concepts of number sense."

Another teacher concluded, "We have to build the bridge between the concepts in the curriculum and the representations of the concepts on the assessments." A third teacher added, "We also have to do the same thing between the manipulatives or concrete models and the concepts." As a result, changes in classroom practices were undertaken. At the first grade level, teachers in the school added three days to their instructional sequence for extended student exploration with multiple representations of the concepts of addition and subtraction of numbers. The students' work focused on computing monetary values and the connections between actual money, mental computations, and paper-pencil computations. The fourth-grade teachers engaged students in an analysis of the problems missed on the mini-assessment and incorporated additional experiences computing with money. The CEC team evaluations also led to the initiation of a schoolwide positive behavior support activity that involved students across all grade levels in using numbers represented as monetary values. The activity incorporated rewards for positive behavior in the form of earning "school money" during the last two months of school and the opportunity to spend money earned at an ice cream sundae reward party. As part of the activity, students recorded the money they earned, completed order forms for sundaes with various toppings, and calculated the amount owed, spent, and change received. This long-term activity engaged students in developing computational skills and understanding of numbers represented as monetary amounts.

Case Study Results

In a case study of her work with a large suburban school district, King (2002) acknowledged the challenges of building the capacity of schools to conduct and use evaluation for improving programs. Among the challenges are helping participants value the process of evaluation, the long-term time commitment for change to occur, and stimulating reflections on the evaluation process that lead to meaningful revisions in evaluation activities. As a result of her work in schools, she suggested the following aspects of effective evaluation capacity building:

(1) creating an evaluation advisory group,
(2) beginning to build a formal evaluation infrastructure,
(3) making sense of test scores,
(4) conducting one highly visible participatory inquiry, and
(5) instituting action research activities.

(King, 2005, p. 90)

In our work on the CEC project we have employed several of King's suggestions. For example, the CEC team serves, in part, as an evaluation advisory group; we have begun to build evaluation infrastructures through activities and products of the team (i.e., mini-assessments, schoolwide database for recording assessment data); the CEC team has examined test scores and made connections between those data and instructional practice; we have completed an initial collaborative inquiry focused on curriculum and assessment alignment (the inquiry cycle described in the narrative

above). To make the collaborative inquiry more visible to other teachers in the school, the CEC teachers led two professional development sessions for the entire school during the first-year inquiry. The first session was structured around involving teachers at all grade levels in scoring and analysis of fourth-grade student mini-assessments. The second session extended the initial analysis of assessment data by having the teachers at all grade levels contribute to mini-assessment revisions. These two sessions not only made the work of the CEC team more visible, but they also began to broaden the evaluation work beyond the teachers on the CEC team. These sessions represent a good beginning for building the evaluation capacity of the school but any significant change at the school level will require a long-term partnership and continued collaborative evaluation activities. Through this case study we investigated how teachers on the CEC team were affected by their participation after one year of collaborative evaluation activities. The CEC project has not been exempt from challenges but the unique collaborative model we used to facilitate evaluation and assessment capacity building of urban elementary mathematics teachers has helped us face those challenges and influence the teachers in subtle yet significant ways. Critical incidents analysis of the qualitative data gathered during the first year of the project confirmed that our evaluation and assessment capacity-building efforts effected teachers through:

(1) better understanding of the link between curriculum and instruction;
(2) increased attention to the use of assessment to monitor student learning; and
(3) enhanced awareness of the mathematics program across grade levels.

Better Understanding of the Link Between Curriculum and Instruction

When the collaboration began, teachers seemed to relinquish responsibility for student learning to problems they perceived with *Investigations in number, data, and space* (TERC, 1998). They viewed the curriculum as something they had to use, but they did not believe that it was the best resource for the students in their classrooms. The focus of their discussions about the curriculum did not include the ways in which they could use *Investigations in number, data, and space* (TERC, 1998) to promote student learning but rather why using *Investigations* limited learning for students in their classes. This was evident through comments such as, "*Investigations* assumes students will have prior knowledge that our students just don't have," and "We usually have to move on to a new investigation before the students have time to understand the content because of the pacing guide (the timeline suggested by district leadership)." Initially, teachers did not discuss instruction in depth. When we asked about their instruction, the responses indicated that teachers did not believe that discussing instruction was relevant to the collaborative evaluation work. One teacher's comment was representative of the group's view: "We use *Investigations* so we already know what we are doing for instruction." It is important to note that these perceptions existed before teachers had the opportunity to actually participate in evaluation activities. At this point in the process, we were still helping teachers determine a focus for investigation.

After the teachers had actively participated in the evaluation process by (a) creating instruments for gathering data (i.e., mathematics teaching and learning survey and mini-assessments), (b) using those instruments to collect data from their colleagues and from students, and (c) examining the data as a group, our discussions about curriculum and instruction began to change. The teachers started to recognize and publicly acknowledge gaps between the curriculum, the state mathematics standards, and classroom instruction. For example, item analysis of the mini-assessments provided a context through which teachers could target specific areas (number sense, computations with monetary values) where they could take action through instruction. Having student data that they gathered and analyzed gave the teachers concrete examples to reflect on and discuss in meaningful ways. These student data differed from student data obtained from external sources (state tests, tests developed by national publishers) because the teachers had been involved in the decisions about what and how to assess mathematics learning. Now the CEC team teachers were not looking outside their classroom to explain student performance but rather considering improvements to their own classroom practices. During a focus group session in May 2006, a teacher summarized this by saying, "The mini-assessments definitely helped show areas for improvement. We could ask ourselves . . . Was it [the particular mathematics concept or skill] in *Investigations*? Was it missing from *Investigations*? Did I just miss it instructionally?" The teachers as a group were also more knowledgeable about how the curriculum could be a tool to guide their instruction rather than the device that defined their instruction. One teacher stated, "We all know that *Investigations* has gaps [areas that are not well aligned with state mathematics standards] and in the past we didn't have time to think about them, now I am more aware of them." Another teacher added, "Time is such a factor so in that way it [the evaluation inquiry process] shaped instruction because we looked at what could be cut out of a unit and what could be built upon in *Investigations*. I am more aware of *Investigations* and it made me more aware of my instruction and why I was using instruction."

Increased Attention to the Use of Assessment to Monitor Student Learning

The ways in which teachers viewed the topic of assessment evolved as the CEC team progressed through the inquiry cycle. The teachers' early discussions about assessment highlighted the concerns that many educators have about improving external test scores. The teachers wanted help to find ways to raise student test scores and questioned the alignment of *Investigations in number, data, and space* (TERC, 1998) with the state mathematics assessment. The notion that tests scores reflect overall student learning was not part of these early discussions, the main concern was increasing scores. At one meeting in an attempt to move the discussion beyond the emphasis on poor test scores, the principal reminded the group that scores in the school had been on the rise. We asked the teachers what they would credit for the increase and the response was "test prep" beginning two months before the test.

Discussions about the topic of assessment shifted to how assessment could be used to monitor student learning when teachers started writing mini-assessment items for

Investigations units at third, fourth, and fifth grade levels. First, the teachers were concerned with writing items in a multiple-choice format that would measure the key mathematics topics of a unit. Once the CEC team had actual student-completed mini-assessments to score and analyze, teachers' concerns focused on item analysis. The teachers used the results to discuss implications for instruction and student learning. As we described through the example of number sense and money in the narrative, the teachers began to connect assessment to instructional changes they could make to improve student learning. A teacher noted, "I created homework based on what the students did or did not understand." The teachers on the CEC team also increased their capacity to write and revise assessment items enhancing the value of the mini-assessments at the classroom level. The teacher's additional statement illustrates this change: "Now I know how questions [assessment items] are developed from standards and benchmarks, not simply by modeling off practice tests [tests from external sources]." This shift in thinking about assessment is a positive change for the teachers on the CEC team but this same value for classroom assessment has not yet transferred to other teachers in the school. A future goal of the CEC team is to expand the use of mini-assessments beyond the teachers on our team. The team plans to set aside several professional development times during future school years in which all teachers in the school score and analyze mini-assessments. The CEC teachers will serve as leaders, helping other teachers realize the benefits of collaborative evaluation activities such as the use of mini-assessments data to drive instruction.

Enhanced Awareness of the Mathematics Program Across Grade Levels

When the CEC project began, teachers had a general idea about the mathematics program at grade levels other than their own. They had spent time in the past looking at the state standards for all grade levels and had some knowledge of the *Investigations* units across grades. However, teachers had not been active participants in gathering data about multiple aspects of the mathematics program at the school. The collaborative evaluation activities were structured to guide teachers through a process of examining aspects of the mathematics program based on data they helped collect and analyze. As university partners, we wanted to involve the teachers in evaluation activities beginning with the first meeting. At the same time, we understood the importance of giving the teachers time to share their perceptions of the mathematics program with each other. We purposefully tried to help the CEC teachers balance between spending time focusing on concerns (some of which they could change and some of which they could not) and taking action through evaluation activities that could lead to positive changes. Through the process, teachers began to have increased awareness of both the mathematics program and of their colleagues' practices. One of the CEC teachers on the team teaches elementary students music, and her statement during the focus group illustrates this change: "I have more respect for my colleagues. I have a better understanding of how to help kids learn math. Now I know how important math vocabulary is and I can use math vocabulary in my classroom."

Having a variety of teachers on the CEC team was important to stimulate awareness of the mathematics program across grades. The combination of primary teachers, intermediate teachers, and even a fine arts teacher on the team enabled us to have cross-grade level discussions. It was common during meetings of the group for a teacher to respond to a colleague's contribution to the discussion by saying "I didn't know that was something the fourth graders do" or "I could do that same thing with my students." As one teacher summarized, "I've learned how I can support learning at other levels. I'm a primary person but now I can see how my instruction builds up to the intermediate grade levels." Another teacher concurred: "While we tried to do that in the past where we looked at standards at every grade level, it wasn't to the depth that we have this year. When we helped write assessment items for the fifth grade we could understand what fifth grade math is like." The increased awareness of the mathematics program across grade levels has and will continue to add depth and meaning to the collaborative evaluation activities.

As the CEC project progresses, we will continue to study teachers' instructional practices, attitudes, and beliefs as part of the evaluation CEC inquiry process. The group has discussed the importance of observing each other's classrooms to gather data and provide meaningful professional feedback to colleagues. Monitoring the results of collaborative inquiry typically leads to new questions and enhances the focus of program evaluation. As the CEC partnership continues to meet on a regular basis to discuss issues related to mathematics teaching and learning we will repeat the CEC inquiry process, in effect building a culture for sustained evaluation and assessment of educational programs in the school.

Discussion

In this chapter we described a collaborative inquiry model that was used to develop a partnership between university mathematics and science educators and urban schools. Through this collaborative inquiry model we were able to help develop capacity for K-12 teachers to make data-based decisions. The most powerful aspect of the process was that teachers themselves were equal partners in the evaluation process and decision making regarding their mathematics curriculum, instruction, and assessment. It was a bottom-up approach, rather than a top-down mandate from the district administration. This empowered the teachers to push for change, and in some ways, gave the teachers more credibility with their colleagues in the schools. They were able to take a leadership role in the schools and move toward using evidence to develop shared values and norms and to use the evidence to change practice. By participating as true partners in collaborative evaluation activities, a level of trust was created that helped teachers feel comfortable confronting aspects of their practice that could be improved. The teachers on the CEC team work in the demanding environment of an urban school in an era of public accountability. It could be argued that many of the changes the teachers made were things they should have been doing before the CEC project began. The reality is that what we know about effective mathematics teaching practice is not always part of teachers' day-to-day work (Weiss & Pasley, 2004; Weiss, Pasley, Smith, Banilower, & Heck, 2003). In

addition, focusing on evaluation and data-based decision making is not traditionally considered part of teachers' job duties. The collaborative inquiry partnership established through this project provides a model that others can follow to help teachers improve programs in important and meaningful ways.

It is important in the fields of mathematics and science to build new cultures in schools for conducting and using results of inquiries (Chval et al., 2006). A system for school-based inquiries should be "one in which more research is motivated by practice; one in which changes in school practice are motivated by research; and one in which findings are expediently fed into the system, considered, and acted on" (Chval et al., 2006, p. 163). Collaborative investigations that focus on program evaluation and data-based decision making can help the field build an effective culture for integrating research and practice. The unique model for collaborative evaluation utilized through the CEC project has improved the teachers' ability to collect and analyze schoolwide data, facilitated collective examination of student assessment results, involved teachers in the evaluation of school and district mathematics and science programs, supported teacher analysis of instructional practices, and built infrastructure for data collection and analysis in the schools of the project.

The Collaborative Evaluation Communities model is a means of helping to create professional structures that can move beyond typical teacher inquiry or classroom-based action research and move toward addressing whole school and district issues. Sarason (1996) has urged school districts and universities to create opportunities for partnering, and the CEC project provides a unique model for creating such collaborations. The CEC partnership can break down the barriers to collaboration faced by schools and universities, it can help teachers develop the capacity to engage in data-based decision making, and it can help us work toward the ultimate goal of ensuring that all students achieve in mathematics and science.

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