THE PROCESS AND IMPACT OF IMPLEMENTING PERFORMANCE

STANDARDS IN MATHEMATICS

by

SAMUEL OBARA

(Under the Direction of James W. Wilson)

ABSTRACT

The goal of this study was to investigate a middle school coordinated implementation of the Georgia Performance Standards (GPS), a standards-based curriculum using Connected Mathematics Project materials (CMP) and a mandated accountability system. The CMP is judged to be a middle school mathematics curriculum consistent with the GPS. A case study was constructed with sixth-grade teachers and their mathematics coach in one school in Georgia.

Several themes emerged in relationship to the implementation process. First, teachers' collective participation in the exploration of the GPS, the selection of the CMP materials, a summer professional development workshop specifically tied to the use of CMP materials and the in-school professional development had some impact on the perception of the teachers' need to change. The presence of the mathematics coach on site—running the in-school professional development, attending lessons of some teachers and giving them feedback—did support teachers in dealing with new content to teach, adapting to new methods of teaching, working in groups, adapting to multiple ways of assessing students, and learning how to use new curriculum materials. The study suggests that in dealing with teacher beliefs and practices, teachers benefit from a long-term professional development that targets content and pedagogical knowledge.

Some elements of the accountability system—for example, pretests and postests—can be used by the teachers to make instructional decisions. Also, the study indicates that involving teachers at all stages of the implementation process can foster unity among them, which can promote collaboration and reflection. It also indicates that when selecting curriculum materials, the kind of students that are targeted should be considered, especially when they have limited English reading ability. All these dynamics of the implementation process draw attention to the importance of the mathematics coach being on site.

The study identifies both common and individual concerns and issues with respect to these influences. It underscored the importance of teamwork, collaboration and having the mathematics coach on site in bringing about a new vision of the school mathematics program.

INDEX WORDS: Achievement, Curriculum, Middle grades, Reform in Mathematics Education, Accountability, professional development, Collaboration,

Reflection, Implementation, Standard-based mathematics curriculum, Mathematics coach, Beliefs, Georgia performance standards, Connected mathematic project,

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DEDICATION

To my wife, who encourages me daily; and to my kids, Esther and Zachariah; and to my beloved parents Zachariah Obara and Esther Nyaberi, and to my adopted parents Lee and Peggy Linston.

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CHAPTER 1

INTRODUCTION AND OVERVIEW

The need to reform mathematics teaching in compliance with recommendations of the *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989) has been an issue for some time in the United States. Efforts to equip teachers with what they need have been tried through professional development and creating resource books with the aim of making the vision of the NCTM Standards a reality. With the reform efforts in full swing, research on adoption and implementation has also followed, aiming to identify the dynamics of teacher change. Teachers, teacher educators, and other stakeholders (parents and the community) in education have expended considerable time and effort to develop curricula that will make the implementation of standards-based curricula successful. Not only the implementation of the curriculum is a challenge for administrators, but teachers are also faced with challenges when the stakeholders get involved and get to know what the children are going to learn. This study reports some of the dynamics that exist as a district experiences the implementation of a standards-based mathematics curriculum and the Georgia Performance Standards.

Historical Background

> Public concern about how well U.S. school children are learning mathematics is abundant and growing. The globalization of markets, the spread of information technologies, and the premium being paid for workforce skills all emphasize the mounting need for proficiency in mathematics. Media reports in inadequate teaching, poorly designed curricula, and low test scores fuel fears that young people are deficient in the mathematical skills demanded by society. (Kilpatrick, Swafford, & Findell, 2001 p. xiii)

These concerns and issues have been a part of educational discussions for many years. Cornett (1995) noted that:

> It is not too much of a stretch to say that a decade of effort to reform teaching began on June 16, 1980 when *Time Magazine* hit the stand with this in-your face—cover headline: 'Help! Teachers Can't Teach!' (p. 26).

Cornett found that rewarding good teaching did not improve student learning. Much of this debate fueled and deflected criticism towards colleges of education; specifically, that academic rigor was absent in their programs and recommended that strict requirements for teacher certification be enforced (Southern Regional Education Board, 1985). Studies have found that "the best and brightest were not remaining in teaching" (Cornett & Gaines, 1994; Kennedy, 1990; National Commission on Excellence in Education., 1983). Two questions are of interest for those who remain in public education: "What knowledge do teachers need to teach so that students learn mathematics with understanding?" and "What knowledge do teachers need to help them recognize that it is important to modify their instruction to facilitate student understanding?"(Vance & Schlechty, 1982).

The history of education in the United States has included a struggle to reform school mathematics for a long time. The effort to reform mathematics instruction has been an issue of great debate and controversy. Kilpatrick (1997) identified three reform efforts. The first was the "Chicago movement," which began in 1903 when E. H. Moore called for "the unification of pure and applied mathematics." As expected, this effort did not pass without challenge from conservative mathematicians like David Eugene Smith. He believed the two should be kept separate because he believed applied mathematics had no place in secondary classrooms. By 1923, the call for a unified curriculum had "shifted to Grades 7 to 9 and away from Grades 10 to 12," (Kilpatrick, 1997, P. 955) with the aim of targeting school dropouts at the end of grade 9 to enable them to have a wide range of mathematics (National Committee on Mathematical Requirements, 1923).

From the early 1950s to the late 1960s, the second wave of reform, "new math," was fueled by the need to have high school students well prepared for college mathematics (Kilpatrick, 1997). The challenges of the twentieth century created the urgent need that students get into the market with a sound knowledge of pure and applied mathematics as soon as possible (Fey, 1978). It was suggested that topics such as logic, modern algebra, and probability and statistics be part of the curriculum in secondary school (College Entrance Examination Board. Commission on Mathematics, 1959). By 1977, the public was concerned about the effectiveness of the new curriculum. These concerns were articulated by Morris Kline's (1973) book, *Why Johnny Can't Add*, which strongly opposed the new math reform movement. According to Kilpatrick (1997), Kline had been involved earlier in a less strident presentation about new math.

> Kline and 64 other mathematicians offered a more measured critique — essentially arguing that anyone attempting reform needed to link school mathematics more closely to its history and to concrete applications and not to make it so abstract and formal that future nonmathematicians would be turned away. (p. 956)

Kline concluded his book with a note that for any curriculum reform to succeed, it "should be diametrically opposite to that taken by the new mathematics" (p. 144). In spite of all the criticisms about the new math, there were reports that students' computational skills had improved greatly (Carpenter, Coburn, Reys, & Wilson, 1975).

The sense of urgency that existed in the 1960s for new curriculum materials created a feeling that all things were possible. It later became apparent that much was overlooked. Reformers overlooked a number of necessary actions: Meticulous attention was not given to the development of new curriculum materials, professional development was not carefully thought about so as to prepare teachers to handle the new curriculum materials, and finally the reformers overlooked the need to convince "both the public and the mathematics education profession that change was needed" (Fey, 1978, p. 343). Because of a lack of professional development, the new

math reform had very little change in teachers' classroom practices. With all that said, the new math reform made a contribution in that it raised the momentum among citizens to look for a better curriculum that could better serve the needs of the United States.

The Chicago movement and the new math movement were debated at all levels with the aim of improving mathematics teaching in the United States. Unfortunately, neither had much impact on teacher change (Fey, 1978; Price, Kelley, & Jonathan, 1977). Price, et al, (1977) noted that:

1. If there are indeed declines in mathematics test scores, only a small decline can be attributed to "new mathematics," since little "new mathematics" has actually been implemented in the classroom.
2. Elementary teachers who specialize as mathematics teachers are a little better trained and have a more positive attitude towards mathematics teaching than teachers of self-contained classrooms. They seem to make more use of the concepts and processes of modern mathematics programs.
3. If increased funding and additional help have been available in the schools of lower socioecomomic status represented in this survey, these apparently have not resulted in great changes in teaching methods. (p. 330)

The third reform movement has been "standards-based curriculum," which was formulated in the 1989 National Council of Teacher of Mathematics (NCTM) *Curriculum and Evaluation Standard for School Mathematics* (Kilpatrick, 1997; Senk & Thompson, 2003). Since its founding in 1920, NCTM has been giving support in reform movements. Kilpatrick (1997) aptly phrased it, "Two decades ago, however, it began to play a more active role as a national voice for teachers, in part as a response to the widely perceived failure to change school

mathematics during the new math era" (p. 957). The knowledge that American students were not performing well on assessments of mathematics on international comparisons was of great concern (McKnight, Crosswhite & Dossey, 1987; National Commission on Excellence in Education, 1983). *A Nation at Risk* (National Commission on Excellence in Education, 1983) and National Research Council (1988) recommended that requirements for high school graduates be increased. The reports also recommended that instructional programs for both college bound and non-college-bound students be designed to be challenging, with higher standards for all students. The 1989 NCTM Curriculum and Evaluation Standards stated goals and content of school mathematics for all students. The following five goals are clearly articulated: "(1) that they learn to value mathematics, (2) that they become confident in their ability to do mathematics, (3) that they become mathematical problem solvers, (4) that they learn to communicate mathematically, and (5) that they learn to reason mathematically" (NCTM , 1989 pp. 5-6).

The NCTM curriculum and evaluation standards reasoned that if students are given the opportunity to experience what is outlined in the standards, they will gain mathematical power (Lappan & Theule-Lubienski, 1994; NCTM, 1989). The idea of mathematical power is "what it means to be mathematically literate both in a world that relies on calculators and computers to carry out mathematical procedures and in a world where mathematics is rapidly growing and is extensively being applied in diverse fields" (Grossen, 1996). Because of changes in society, schools have no option but to change their curriculum to keep the pace at which society in changing.

One of the main challenges facing the implementation of any mathematics curriculum change is professional development. "It is necessary to attempt to understand the processes

involved as teachers make changes in their previous ways of teaching mathematics to accommodate the transformation advocated" (Wood, Cobb, & Yackel, 1991 p. 589). Richardson (1994, 1998) refutes the notion that "teachers don't change." She cites cases from different places to indicate that teachers actually change all the time. There exists the notion that teachers resist change, that change is painful, and that therefore, they prefer to hold on to their ways of teaching that they are used to and that make them feel comfortable (Duffy & Roehler, 1986; Fullan & Stiegelbauer, 1991). This view was prevalent at least into the early 1990s. Many people, including teachers, hold the view that teachers are reluctant to change. The root source of this view is that teachers are generally left out of the reform process. Morimoto, Gregory, and Butler (1973) pointed out:

> When change is advocated or demanded by another person, we feel threatened, defensive, and perhaps rushed. We are then without the freedom and the time to understand and to affirm the new learning as something desirable, and as something of our own choosing. Pressure to change, without an opportunity for exploration and choice, seldom results in experiences of joy and excitement in learning. (P. 255)

Similar sentiments were also voiced by Klein (1969), who noted that research on change has been conducted "from the perspective of those who are the change agents" (p. 499) without taking the teacher into consideration. It is high time that the teacher's perspective also be considered if learning about change is to be better understood. Change takes time, and it must be voluntary. Teachers try things over and over again to see which fits most into their endeavor, and sometimes the teachers reject certain activities because they feel they don't work (Richardson, 1990, 1994). Garet, Porter, Desimone, Birman, and Yoons (2001) concluded

> that sustained and intensive professional development is more likely to have an impact, as reported by teachers, than is shorter professional development. Our results also indicate that professional development that focuses on academic subject matter (content), gives teachers opportunities for "hands-on" work (active learning), and is integrated into the daily life of the school (coherence) is more likely to produce enhanced knowledge and skills. (p. 935)

In addition, collaboration between teachers and supporting each other can contribute to teacher change (Lloyd, 2002). Teachers can collaborate by sharing their successes and by being supportive (Bay, Reys, & Reys, 1999; Kilpatrick, Hancock, Mewborn, & Stallings, 1996).

To support teachers' implementation of a standards-based mathematics curriculum, it is important to have a curriculum that is aligned to the NCTM standards. Textbooks have a significant influence on curriculum reform and are an important element in curriculum implementation (Valverde, 2002). "The textbook continues to be a major influence on the classroom; in many cases it still effectively determines the curriculum. How textbooks are written and selected for classroom use is, therefore, of paramount importance in curriculum development" (Howson, Keitel, & Kilpatrick, 1981, p. 61). In 1992, the National Science Foundation (NSF) funded 12 school mathematics curriculum projects "to develop comprehensive "standards-based" curricula" (U. S. Dept. of Education, 2001). Of the 12, 5 were middle school projects: Connected Mathematics Project (CMP), Mathematics in Context (MiC), MathScape, Math Thematics, and the Middle School Mathematics Through Application project. A major challenge was to explore how teachers might be prepared so they could execute the implementation of new curriculum materials. A significant part of the solution is professional development, which a number of studies have suggested can have a positive effect on teacher change (Borko, Davinroy, Bliem, & Cumbo, 2000; Lappan, 1997) . For professional development to be effective in bring about teacher change and the implementation of new materials, it needs to emphasize the mathematics knowledge teachers need for a new curriculum and emphasize working with curriculum materials.

National initiatives have parallels at the state level. The state of Georgia has carried out similar initiatives geared towards improvement of the educational system of its citizens. In 1985,

the Quality Basic Education Act (QBE) was passed by the Georgia legislature as a bold plan geared towards improvement of education in the state. The act called for a statewide uniform curriculum, which came to be the Quality Core Curriculum (QCC) (Georgia Department of Education, n.d.b). In contrast to past reform initiatives, this one had full support from the legislature of the state of Georgia. Every school in Georgia was required to implement the curriculum as directed by the legislature (Mizell, 1999).

As outlined in the QBE, the Georgia curriculum clearly specified what students are expected to learn at all levels and in every subject. Subsequently the curriculum was aligned with the the Criterion Referenced Competency tests for grades 1-8 (CRCT) and the Georgia High School Graduation tests (GHSGT). The state curriculum was a guiding document for teachers, students, and parents in terms of the expectations at each grade level.

The QBE recommended that the Georgia Department of Education (n.d.a) constantly review and give feedback to make the QCC specify what is expected of Georgia graduates. Revisions of the QCC were implemented between 1985 and 2000.

> In September 2001, the Georgia State Board of Education requested an audit of Georgia's Quality Core Curriculum. Phi Delta Kappa conducted the audit and found that in several areas the curriculum lacked rigor and was inadequate to guide teaching and to ensure common expectations for all students. It not only lacked depth and could not be covered in a reasonable amount of time; it did not even meet national standards. The audit found that it would take 23 years — not 12 — to cover the topics included at anywhere near the level of depth necessary for real learning to take place. Shallow standards forced our teachers to guess what they should teach and to hope that what they were teaching was what would be tested. Inevitably, teachers used the curriculum document not as a guide for quality instruction but as a reference to mention in lesson plans and then put back on the shelf (p. 1).

Fueled by the audit report, teams of teachers, state and national experts, and consultants worked together to develop the Georgia Performance Standards (GPS). They examined curricula of other states (Michigan, Texas, North Carolina) and countries (e.g., Japan) that were ranked

higher in performance. Also, national organizations such as the NCTM were consulted for their input. “The most noticeable difference between the former and the new curriculum in mathematics for Georgia schools is the use of performance standards. A performance standard has four components: a content standard, illustrative tasks, examples of student work, and a commentary for teachers” (Georgia Department of Education, n.d.a, p. 1).

There are features in the GPS that make it different from the QCC. The GPS goal was to take fewer topics but to go into things in much more depth. With the QCC teachers were asked to cover so much material that one could not go much in depth on any topic. Teachers were unable to cover all the concepts the state required of them. There was also inefficiency in the curriculum, with the excessive number of topics in the QCC, depth was sacrificed leading to repetitions of the same topics. One advantage of the GPS is that with a smaller number of topics there can be significant topics covered in the GPS where as the QCC tended to cover many topics with superficial examples. The GPS is trying to bring meaning into mathematics, by bringing in a real life approach to look at situations and saying, “What mathematics do we need to know?” The GPS emphasizes more student use of manipulatives, more group work, and more ties to real world situations.

Another aspect on the GPS is that it uses the integrated approach whereas the QCC taught topics in isolation. For instance the GPS emphasizes bringing everything together and using whatever mathematics is necessary to solve significant and rich mathematics problems and making connections to the real world. There is an integration of algebra, number and operations, geometry, statistics—so there is more meaning and more depth. With the QCC, the emphasis is on what the teacher did—like I covered this material I taught this concept—but with the GPS, because it is standards based, the emphasis is on what the students are learning.

Purpose and Research Questions

This study was about the implementation of the Georgia Performance Standards using the standards-based curriculum materials (Connected Mathematics Project) in the context of the accountability system in one middle school in Georgia that recently replaced its traditional curriculum with the Connected Mathematics Project (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2002). The goal of the study was to understand the simultaneous implementation of Connected Mathematics Project materials and the Georgia Performance Standards. The study examined a school implementing new standards and implementing new curriculum materials while at the same time continuing to operate a mandated accountability system.

This study is significant because it provides an opportunity for stakeholders in the curriculum to reflect on the work done and for teachers to reflect on changes in their practice as a result of the new curriculum. Examining the reflections from the standpoint of the researcher can be very crucial because "teachers who claim they have totally revamped their instruction may, when observed, appear to be teaching in a rather traditional fashion" (Kilpatrick, 2000, pp. 28-29). This brings up the issue of curriculum evaluation, which Mewborn (2003) states is "complex" because of the need for careful planning in executing worthwhile evaluation.

> Just as the curriculum had not been widely perceived as something to be "developed" until the middle of the [twentieth] century, with the advent of the curriculum development project, so the need for an explicit, formal evaluation of the curriculum did not arise until people began to ask whether the project had been worthwhile. The job of curriculum evaluator, like the job of curriculum developer, is a twentieth-century invention. (Howson et al. 1981, p. 182)

Examining teacher experiences may open a window for discussion on teachers' practices from both the teachers' perspective and the researchers' perspective and may reconcile the two. This examination can be of value to both classroom practices and future research. Additionally, it

may become a resource for in-service teacher education or curriculum development projects that contribute to the body of knowledge for mathematics education (LeCompte, Preissle, & Tesch, 1993; Polettini, 1995).

The present study can be of value to school districts and principals as they consider the implementation of a new curriculum. It may offer suggestion on effective professional development practices for districts and principals to implement. The principals and school districts may use the findings from the study to evaluate their curriculum. This study can also provide information concerning the new curriculum that can be accessed by parents and other policy makers (Bay, Reys, & Reys, 1999).

> The purpose of a study can be executed by the use of research questions, which
>
> describe relationships sought or tested; facts discovered, proved, or disproved; and constructs or concepts generated. They also spell out exactly where, with whom, and how a study will be carried out. Careful specification of what the initial questions investigated were constitutes a succinct summary of what the researcher intended to do or actually accomplished in the study. (LeCompte, Preissle, & Tesch, 1993, p. 37).

Research questions enable researchers to make theoretical assumptions, which tend to outline why things happen the way they do. Additionally, research questions influence the research design in terms of how, where, and when data collection will be done (Miles & Huberman, 1994).

The need for understanding the process of implementing of the Connected Mathematics Project and Georgia Performance Standards, in the context of an accountability system, shaped the following research questions for this study:

1. How does the mathematics coach see the summer professional development activities, and how did it affect teacher practice? How do the three teachers see the summer

professional development activities, and how do they think it affected their teaching practices?

2. How does the mathematics coach perceive the accountability system in the school district, and how does she interpret the Georgia Performance Standards in mathematics? How do the three teachers perceive the accountability system in the school distinct, and how do they interpret the Georgia Performance Standards in mathematics? How do these interpretation affect the mathematics coach's practice (decisions about professional development activities)? How do the interpretations affect teacher practices?
3. How does the mathematics coach see the ongoing district-wide, Connected Mathematics Project professional development activities, especially those for which she is responsible, and how do the three teachers respond to them? How does this professional development affect teacher practice?

Research questions may be redefined and revised during a study (Maxwell, 2005). Factors such as "problems with access to, and expectations of, populations and subsets may result in alteration of research questions." (Preissle & LeCompte, 1984 p. 64)

Definitions of Terms

Standards-Based Curriculum

According to Sinclair (1995), "a standard is a level of quality or achievement, especially a level that is thought to be acceptable. It is something used to measure or estimate the quality or degree of something, for example, how good a piece of work is" (p. 1421). In education, *standards* refer to a body of knowledge and competencies that characterize quality education. A standards-based

curriculum is a reform curriculum that is designed in agreement with recommendations of the *Curriculum and Evaluation Standard for School Mathematics* (NCTM, 1989).

Professional Development

Professional development programs prepare teachers or administrators to have certain skills and knowledge so as to enable them to execute required tasks well. Professional development encourages and supports teacher change. It has the goal of enabling teachers and administrators to make appropriate decisions about the education of their students and to implement those decisions.

The Connected Mathematics Project

The Connected Mathematics Project is an funded effort of mathematics educators, mathematicians, and teacher educators at Michigan State University who between 1991 and 1997 developed a middle school curriculum for Grades 6-8. The goal of the CMP curriculum is having students gain mathematical power: "The philosophy of CMP is one that embraces the belief that it is not possible to separate the influence of what is taught from how it is taught (Lappan, et al, 1998 p. 7). The materials were published by Prentice Hall (Lappan, et al., 2005). Operation of teacher workshops has been an activity of the project.

Accountability System

The reform movement that has engulfed the educational communities uses the term *accountability* in many different ways. Some have come up with their own definition, whereas other agree that there is no consistency in its use (Kuchapski, 1998; Ouston, Fidler, & Earley, 1998). Newmann, King, and Rigdon (1997) explain accountability from a historical point of view as the relationship between those who provide the services and those who have the

authority to reward, punish or replace them. Rothman (1995) came up with a definition that is more adaptive: “Accountability is a process by which school districts and states (or other constituents such as parents) attempt to ensure that schools and school system meet their goals” (p. 189).

CHAPTER 2

REVIEW OF LITERATURE

Educational reform is needed if mathematics outcomes for students in schools in the Unites States is to improve. In order to reform education, teachers must change their classroom practices. Yet, teacher practices are difficult to change for many reasons, one of which is related to the intransigence of teacher beliefs. Studies have shown that if teachers are treated as autonomous and have opportunities to collaborate and be involved in reform initiatives and professional development opportunities, they can and will change their pedagogical practices. Along with use of an appropriate curriculum, professional development is a key component for promoting teacher change. Moreover, "many politicians and policy makers today link school accountability and school performance" (Newmann, King, & Rigdon, 1997, p. 41). For that matter, school districts have started to held schools accountable for what they teach with the aim of improving student performance.

In this chapter, I present a synthesis of the literature on the implementation of curriculum within accountability systems. The professional literature, which played a significant role in this study, is organized in the following sections: (1) teacher change, (2) teacher collaboration, (3) professional development, (4) the role of curriculum materials in reform, and (5) accountability systems.

Research on Teacher Change

In the Unites States, the 1989 NCTM *Curriculum and Evaluation Standards* provided guidelines on the types of curriculum that can empower students mathematically and stressed

changing teaching practices to reach that goal. The 1991 NCTM Professional Teaching Standards notes that for teachers to be mathematically proficient, they need to be proficient in:

1. Selecting mathematical tasks to engage students' interests and intellect;
2. Providing opportunities to deepen their understanding of the mathematics being studied and its applications;
3. Orchestrating classroom discourse in ways that promote the investigation and growth of mathematical ideas;
4. Using, and helping students use, technology and other tools to pursue mathematical investigations;
5. Seeking, and helping students seek, connections to previous and developing knowledge;
6. Guiding individual, small group, and whole-class work (p. 1)

It has been claimed in a number of professional journals that professional development can have positive results on teacher change (Borko, Davinroy, Bliem, & Cumbo, 2000; Lappan, 1997). Factors that contribute to teacher change are the following: teachers beliefs and practices, teacher learning, and teacher involvement and autonomy

Teacher beliefs and practice

For the purpose of this study, *belief* is taken to mean "all the matter of which we have no sure knowledge and yet which we are sufficiently confident of to act upon and also the matters that we now accept as certainly true, as knowledge, but which nevertheless may be questioned in future" (Dewey, 1933, p. 6). To realize the goals of teacher change, it is imperative that teachers' beliefs be taken into consideration.

The vision outlined in reform curriculums has necessitated changes in traditional teaching methods and practice. Baroody and Coslick (1998) stated, "Teachers typically teach the way they were taught. If taught by the lecture-drill method themselves, they tend to equate teaching with telling students information and grading their worksheets" (p. xiii). Lloyd (2002) states that "bringing about such dramatic changes in mathematics instruction demands that teachers possess beliefs about mathematics, learning, and teaching that depart significantly from school mathematics tradition" (p. 149). Main challenge facing teachers is they did not experience mathematics problem solving skills and learning mathematics conceptually either when they were students or as teachers. When they are asked to teach materials that call for such experiences, it is often a struggle on the part of teachers (Grant, Peterson, & Shojgreen-Downer, 1996)

Teachers' beliefs about the nature of mathematics (central beliefs) and classroom practice (peripheral beliefs) are closely related, but the nature of the relationship is complex and confusing (Cooney & Shealy, 1995; Green, 1971). These are due to discrepancies that exist among findings in the research literature. Thompson (1992) indicated that "teachers' conceptions of teaching and learning mathematics are not related in a simple cause-and-effect way to their instructional practices" (p. 138). Ernest (1988) observed the following factors to be key in classroom practice:

1. The teacher's mental contents or schemas, particularly the system of beliefs concerning mathematics and its teaching and learning;
2. The social context of the teaching situation, particularly the constraints and opportunity it provides; and
3. The teacher's level of thought processes and reflection. (p.1)

These factors contribute greatly to the teacher autonomy that can lead to teacher change. The social context of teaching — composed of the values, beliefs, and expectations of parents, teachers, and administrations — plays a significant role in this discrepancy within the research literature. Central beliefs are strongly held and are not easily changed, whereas peripheral beliefs can be changed without necessarily changing the central beliefs (Bruning, 2004; Green, 1971).

Beliefs about mathematics play a significant role in the ways that teachers implement curriculum reform in their classrooms. Ernest (1988) noted that, "Teaching reform cannot take place unless teachers' deeply held beliefs about mathematics and its teaching and learning change" (p. 1). Mathematics is not simply what is produced by pen and paper, but it is ideas that come out of it. Beliefs influence practice in significant, albeit subtle, ways. Teachers' instructional practices in some cases tend to reflect characteristics of teachers' patterns of behavior. "In some cases, these patterns may be manifestations of consciously held notions, beliefs, and preferences that act as 'driving forces' in shaping the teacher's behavior" (Thompson, 1984, p. 105). In other cases, the patterns may be manifested unconsciously as a result of teachers' experiences that have contributed to the evolution of teachers' beliefs over time. Thompson (1992) had the following to say:

> For example, Lynn, whose view of mathematics was best characterized as instrumentalist, taught in a prescriptive manner emphasizing teacher demonstrations of rules and procedures. Jeanne, on the other hand, viewed mathematics primarily as a coherent subject consisting of logically interrelated topics and, accordingly, emphasized the mathematical meaning of concepts and the logic of mathematical procedures. Finally, Kay, who held a problem-solving view of mathematics, emphasized activities aimed at engaging students in the generative processes of mathematics. (p. 134)

The disagreement about the relationship between beliefs and practice is far from over (Richardson, 1994). In recent literature, there are two notions about the relationship between belief and practice and its influence on teacher change. One suggestion is "that teachers change

their beliefs after they change their practices and are able to see that these new practices positively affect their classroom and students" (Richardson, 1994, p. 90). Another notion suggests that one has to change beliefs first before changing one's practice (Richardson, Anders, Tidwell, & Lloyd, 1991).

As noted by Fullan (1985) and Guskey (1986), teachers change their beliefs after changing their practices. They disputed the model that suggested beliefs influence practice, a model based on the work of theorists such as Lewin who derived their ideas from psychotherapeutic models whose assumptions may be inaccurate Guskey (1986). below), considers "three major outcomes of staff development:" teachers' classroom practice, their beliefs and attitudes, and change in these beliefs and attitudes (see Figure 1.

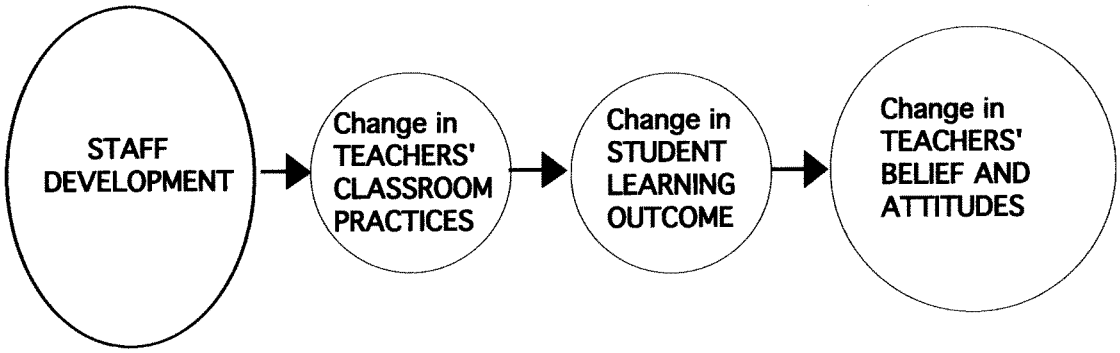

Figure1: A new model of teacher change (Guskey, 1986, p. 7)

This model suggests that staff development plays an initial, significant role in teachers' practice in that it equips the teacher with "new material or curriculum, or simply some modification in teaching procedures or classroom format" (Guskey, 1986, p. 7). Guskey illustrates his point with the use of teachers in their classrooms and noted that "a teacher who has been constantly unsuccessful at helping students from an educationally disadvantaged background attain a high standard of learning is more likely to believe that they are incapable of

academic excellence than a teacher who has experienced success in teaching these students (p. 7). Guskey's conclusion has also been supported by a study done by Bolster (1983).

The second model suggests that changes in beliefs precede changes in practices (Richardson, Anders, Tidwell, & Lloyd, 1991). The study used a "constructive perspective on teachers' cognitions that suggests that teachers are knowing beings and that this knowledge influences their actions; knowledge, then, forms a system of beliefs and attitudes which directs perceptions and behaviors" (pp.561-562). That suggests that what the teacher believes very much shapes his or her classroom practice. For instance, a teacher may want students to develop mathematical understanding of a given topic by encouraging classroom communication. But the nature in which classroom discourse plays out, will depend on what kind of beliefs the teacher has concerning mathematics. To explore more of what influences what, other factors need to be considered, Richardson, (1994) "suggests that the process of changing beliefs and practice is interactive; that is, depending on the types of changes and the teachers themselves, the process may begin either with changes in belief or changes in practice" (p. 90). These findings are also supported by Ernest (1988). The issue of belief and practice should be discussed in light of other factors. But still the relationship between belief and practice remains complex and confusing. In addition to teacher beliefs and practice, teacher learning also play a significant role towards teacher change.

Teacher Learning

To bring about change in the classroom, there is a need to prepare teachers as "agents of change" (Smylie, Bay, & Tozer, 1999). As Lappan and Theule-Lubienski (1994) noted, "Teaching is a very complex endeavor, not reducible to recipes or algorithms. Good teaching may look very different in different classrooms" (p. 250). Standards and assessment are not the

answer to what goes on in the classroom although they do expose vital issues. On the other hand, Cooney (1994) summed up the concerns about the state of mathematics education by asking, "What kind of knowledge do teachers need to become effective teachers of mathematics? What sorts of experiences are needed by teachers to acquire this knowledge?" (p. 608). The challenge for mathematics teacher educators is how to educate teachers so that they can acquire this knowledge. The NCTM standards outlined what encompasses a meaningful task, namely one that creates classroom discourse; enables problem solving by creating the necessary environment for learning, communication; and reasoning; and empowers teachers to reflect on their teaching and student learning (NCTM., 1991).

In their search for the kind of knowledge that is required for effective teaching, Lappan and Theule-Lubienski (1994) compared three domains of knowledge, as illustrated in Figure 2, that they believe articulate the need to understand the domain "in order to educate teachers so that they can integrate these forms of knowledge into an effective instructional program" (Cooney, 1994, p. 609) as shown in the Venn diagram (Figure 2) which indicates that teachers need to be in the intersection area of the three domains of knowledge for effective teaching. But, unfortunately, the three domains of knowledge are usually taught in isolation and it is left for the student teachers to figure it out through their teaching experiences.

In an attempt to make these domains of knowledge clear, Shulman (1986b), outlined seven domains of teachers' knowledge: knowledge of subject matter, pedagogical content knowledge, knowledge of other content, knowledge of the curriculum, knowledge of learners, knowledge of educational aims, and general pedagogical knowledge. Shulman's work on pedagogical content knowledge has had a great impact on mathematics education (Cooney, 1994).

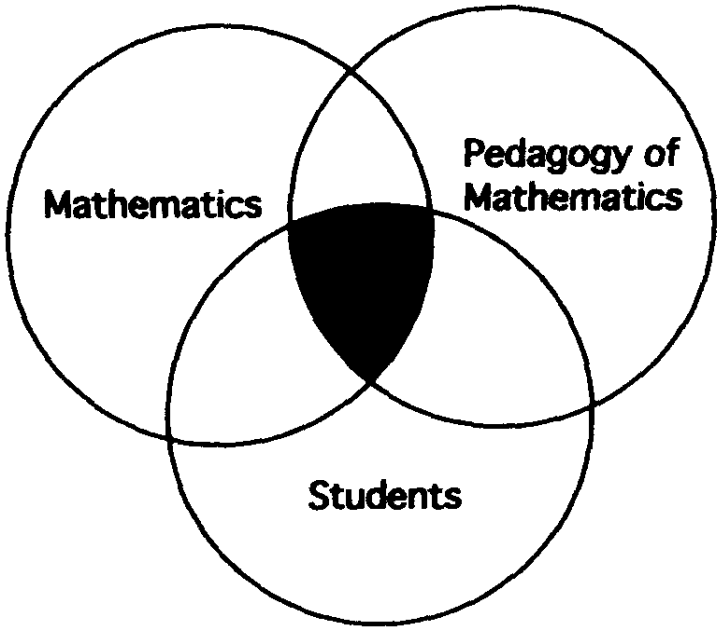

Figure 2: Domains of knowledge (Lappan & Theule-Lubienski, 1994, p. 253)

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In recent times, a substantial amount of research on teacher knowledge has concentrated on mathematics content, that is accounted for by the number of courses completed in college (Carpenter, Fennema, Peterson, & Carey, 1988). Shulman (1986a) defined subject matter knowledge as " that comprehension of the subject appropriate to a content specialist in the domain" (p.26). Research shows that there is no correlation between the number of courses a teacher takes in college and his or her students' achievement (Carpenter, et al 1990). This does

not mean that subject matter knowledge is not important. Research by Leinhardt and Greeno (1986) and Smith (1995) found that subject knowledge is very important in teaching and a lack of content knowledge will make "teachers have difficulty teaching certain areas because they themselves lack sufficient understanding about them" (Kennedy, 1990, p. 4). Teaching teachers about pedagogical behavior will be futile if teachers do not have subject matter knowledge (Lampert, 1988).

Recent research indicates that teachers' content knowledge and pedagogical content knowledge plays a significant role in how teachers teach and evaluate content (Ball, 1988; Ball & McDiarmid, 1988; Shulman, 1986a, 1986b) . Manouchehri and Goodman, (1998) also noted that teachers must know about content and pedagogical knowledge if the implementation of standards-based projects is to succeed.

Research on reflection has received great attention as a means of teacher learning. It is imperative to note that "learning to pay attention in teaching, learning, and research matters"(Rodgers, 2002b, p. 231). Watching students learn, analyzing the situation, and responding "intelligently" as Dewey, (1933) called it, is crucial in teacher and student learning (Rodgers, 2002a). A key to effective teaching is to slow down teachers' thinking about their teaching and shift the thinking towards their students' learning. (Chazan, 2000; Rodgers, 2002b). Through reflection, teachers are able to tell if their beliefs and practices agree (Thompson, 1992).

Teachers can reflect on their work in many ways, including writing about their instruction or students, and reviewing their classes. "…good reflective teaching is both democratic and self-critical (Zeichner & Liston, 1996 p.77).

Ross (1989) outlines the main goals of the reflective process:

1. Recognizing an educational dilemma,

2. Responding to a dilemma by recognizing both the similarities to other situations and the unique qualities of the particular situation,
3. Framing and reframing the dilemma,
4. Experimenting with the dilemma to discover the consequences and implications of various solutions, and
5. Examining the intended and unintended consequences of an implemented solution and evaluating the solution by determining whether the consequences are desired or not (p. 1)

To attain the goals of reflective process, the tools that contributes to teacher learning include such things as action research, journal writing, and teacher collaboration (Calderhead & Gates, 1993; Castle & Aichele, 1994; Zeichner & Norffke, 2001). A number of issues are still unresolved in relation to reflection in teacher education. The main challenge facing the educational community lies in transferring the concepts of reflective teaching into practice. Questions such as: What is the process of growth in developing reflection? What is the relationship between 'personal' knowledge and 'public' knowledge?, How do we accommodate professional growth and emancipation? How do we accommodate reflective practice in schools? How do we reconcile concerns with assessment with concerns for reflection? How can we allow for individual differences in learning to teach? (Calderhead & Gates, 1993, pp. 2-3). Ball, (1994) points out that enough has not be written on what teachers might reflect on. Most of the reflection has concentrated on classroom instruction; less attention has been given to teacher reflection on external factors that might have an impact on instructional practice.

Teacher Involvement and Autonomy

It is evident in the literature that for teacher change to happen teachers need to be involved in decision-making. "Professional autonomy is fostered through making choices and decisions, setting goals, reflecting on teaching practices, exchanging points of view with others, and engaging in dialogue with others on relevant educational issues" (Castle & Aichele, 1994, p. 5). It is very important that teachers be a part of the equation; that is, they should be part of the agenda, focus and opportunities available. "In the name of professional autonomy, many argue that teachers should determine the shape and course of their own development" (Ball, 1994 p. 10). On the issue of autonomy, Ball (1994) brings up dilemmas in which teachers set their own agenda for professional development. There is a likelihood that their current vistas may override curriculum goals. Similar dilemmas were raised by Calderhead and Gates (1993) in determining the "relationship between 'personal' knowledge and 'public' knowledge" (p. 3) in light of reflective teaching. It is not "to suggest that the views of others, or the rules and policies established for teachers, should be ignored by teachers" (Fenstermacher, 1994 p. 38).

What is very critical in determining whether a teacher is autonomous is how he or she attends to the rules and policies. By complying and accepting the rules and policies consciously, such a person is considered autonomous. When a teacher decides to disobey, careful scrutiny is needed to determine why he or she is acting in that manner. Those who obey for the sake of obeying without giving a reason are not considered autonomous.

> It is often quite easy to determine the difference between a person's simple adherence to a rule and a person's decision to obey a rule. When asked, "Why did you do that?" the person responds, "That's the rule here." This answer does not tell you anything about the person's autonomy; the answer to the next question: "Why are you following this rule?" Someone who has given the matter little or no thought will respond that she is following the rule because it is the rule, or that is the way things are done here, or there really is not any other way to do such things. The autonomous person will respond with reason for following the rule (Fenstermacher, 1994 p. 39).

A teacher's sense of autonomy determines how he or she interprets reforms. Teachers should be seen not just as instruments of policy but as partners of change (Prawat & et al., 1992). With time and opportunity, teachers as agents of change can change their practices, and this will happen with support from colleagues. As teachers engage in changing their practices, they should be seen as collaborators, not just instruments of change. They should be involved as much as possible in decision-making about the kind of curriculum materials to be used and other issues related to the implementation process of a curriculum. This may have a great impact on teachers' attitudes and their changing their practices.

Teacher Collaboration

In the Kilpatrick et al. (1996) study, one of the participants had this to say:

> I think it's a matter of having colleagues here, all of whom are willing to try something and share their successes and be supportive. I'm not sure that I would have done any of this [curriculum development work] in my old school where we had so little time to discuss anything with each other. In most schools, teachers work in their own little rooms. They do all these wonderful things maybe, but they rarely share them with anybody. The idea of sharing materials is really foreign to most teachers, especially in public schools. There are a lot of reasons for that. I don't really think it's selfish. It's a matter of never having a common time they can meet. After teaching five or six classes, the last thing they want to do is have a meeting. (p. 225)

Collaboration between teachers promotes sharing experiences and supporting each other, which is very important as they strive to change (Bay et al., 1999; Lloyd, 2002). Collaboration promotes accomplishment, self confidence, willingness to take risks, and persistence in a given task, which lead to changes in one's practice (Ball, 1996). It is imperative that teachers find time, or that time is made for them to collaborate. Professional literature shows that teachers who have been very successful in their careers have the habit of finding time to collaborate. They find time to reflect on their "practices, collaboratively design materials, and inform and critique one another (Raywid, 1993, p. 30).

"There is a ceiling effect to how much we can learn if we keep to ourselves" (Fullan & Stiegelbauer, 1991, p. 17). Fullan and Stiegelbauer define effective collaboration as a combination of personal mastery and group mastery that plays on each other to produce good work. Examples of collaboration such as dialogue, visiting classrooms, sharing students' work, and sharing lesson plans are very useful in promoting change (Bay, Reys, & Reys, 1999). The act of sharing is a key to long-term goals of teacher change. A study done on teachers' beliefs after participating in a teacher enhancement project by Hart (2002) found that teachers expressed their opinion of collaboration and its contribution to their professional development. The teachers voiced their approval of collaboration in comments such as, "the time with other colleagues was invaluable, the collegiality allowed me to see outside the loneliness of the 'one teacher' classroom and the modeling of strategies and working with other teachers was rejuvenating" (p. 170).

Collaboration can bring to light new perspectives that otherwise might not have been discovered about a teacher's practice. For instance, Smith (1995) noted that sometimes teachers are not aware of their practices until they are told, or watch themselves in a video. Sometimes teachers have two beliefs that are opposing about the teachers role in a classroom. In such cases, collaboration among teachers can relieve such conflicts to enhance teachers' practice in line with outlined reforms.

An important point to note concerning collaboration is that collaboration does not mean consensus. Productive collaboration is characterized by disagreement accompanied by mutual trust, shared goals, responsibility, and accountability among participants (Fullan, 1993; Smylie & Hart, 1999). Schrage, (1990) elaborates:

> One of the most persistent myths about collaborations is that it requires consensus. This is emphatically not so. Collaborators constantly bicker and argue. For the most part, these arguments are depersonalized and focus on genuine areas of disagreements. (p. 159)

Trust in each other is vital in terms of making progress in teacher change in a social context. Trust cultivates the culture of social support and feedback among members in the social group (Bakkenes, 1996), and lack of cooperation can hinder implementation of a new curriculum (Bay, Reys, & Reys, 1999).

Professional Development

The implementation of standards-based curriculum comes with a set of demands on and expectations from teachers. Teachers are teaching new content, adapting to new methods of teaching, working in groups, adopting to multiple way of assessing students, and learning how to use new curriculum materials. A number of teachers, both in pre-service and in-service, have not experienced the kind of expectation a standards-based curriculum brings. Therefore, professional development is important in supporting teachers facing the challenge. Oftentimes, educators have a narrow view of what professional development entails: "Many teachers and school administrators regard professional development as special events that are restricted to 3 or 4 days during a school year" (Guskey, 2000, p. 14). On the other hand, some educators view professional development as enrolling in graduate courses, obtaining advanced degrees, and earning higher salaries. According to Guskey (2000), "Contributing to this narrow view are policies that require teachers and school administrators to accumulate a certain number of professional development hours or credits each year in order to retain their jobs and professional certification" (p. 14).

Professional development is defined as "those processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might, in turn,

improve the learning of students" (Guskey, 2000, p. 16). Furthermore professional development is an intentional, ongoing, and systemic process.Education reform initiatives that are now being implemented across the country have made the study of the role of professional development necessary. The No Child Left Behind initiative stresses the need for high quality professional development (U.S. Congress, 2001).

In recent times, researchers, research agencies, teacher associations, educational organizations, and U.S. Department of Education have come up with a list that outlines the characteristics of effective professional development (Guskey, 2003a). Guskey (2003b) analyzed 13 different lists that characterized effective professional development and concluded that the lists "vary widely and that the research that supports them is inconsistent and often contradictory" (p. 748). Nonetheless, he argues, "we need to seek agreement on criteria for effectiveness, along with clear descriptions of contextual factors" The following section details some of the qualities of effective professional development.

Enhancement of teacher's content and pedagogical knowledge

There is a general consensus that what teachers know greatly contributes to how much students will learn and do in the classroom, and there is general consensus on the kind of knowledge that is critical to ensure students learn what they are supposed to (Fennema & Franke, 1992). In a discussion of teachers' knowledge, Fennema and Franke (1992) outlined what comprises teacher knowledge: knowledge of mathematics, knowledge of mathematics representation, knowledge of students, and general knowledge of teaching and decision-making. The main question is "What kind of knowledge do teachers need to enable them to teach mathematics with understanding?"

For teachers to implement reform initiatives, they need to be well-versed in their subject area to be able to "communicate basic knowledge and to develop advanced thinking and problem-solving skills among their students" (Garet, Porter, Desimone, Birman, & Yoon, 2001, p. 916). This requirement brings up the question "what makes professional development effective when the focus is teacher knowledge?" It is still unclear whether increasing teacher knowledge leads to student achievement. Most publications indicate that "helping teachers to understand more deeply the content they teach and the ways students learn that content appears to be a vital dimension of effective professional development" (Guskey, 2003b, p. 749). A good number of teachers emphasize memorizing fact without engaging students to have a deeper understanding of the subject matter (Garet, Porter, Desimone, Birman, & Yoon, 2001)

Provision of sufficient time and other resources

Educators need time and resources to enable them to understand facts, reflect on student work, and try new approaches to teaching (Guskey, 2003b; Thompson & Zeuli, 1999; Wenglinsky, 2000). High quality professional development requires sustained support to improve mathematical instruction and hence mathematical proficiency in students: "This support requires the provision of time and resources" (Kilpatrick, Swafford, & Findell, 2001, p. 12).

Borchers, Shroyer and Enochs (1992) conducted an empirical study to investigate the effectiveness of increasing teachers' content knowledge and its role in helping teachers incorporate technology into their teaching. In the study, both qualitative and quantitative data was collected for analysis. The findings from the study found that the new knowledge acquired through long-term professional development improved their teaching. According to Guskey (2003b) "while effective professional development surely requires time, it's clear that the time must be well organized, carefully structured, and purposefully directed" (p. 749).

Promotion of collegiality collaboration and reflection

Another characteristic of effective professional development is the promotion of collegiality and collaboration. Collaboration among colleagues promotes sharing of instructional materials and provides them opportunity to discuss their instructional strategies (Garet, Porter, Desimone, Birman, & Yoon, 2001). Collaboration techniques such as dialogue, classrooms visitation, sharing students' work, and sharing lesson plans enable change (Bay, Reys, & Reys, 1999). Collaboration and reflection can promote change by enabling other teachers to see events from different perspectives (Smith, 1995). On the other hand, collaboration can promote revolt, which can hinder change just as well as it can promote it (Little, 1990). For collaboration to work in implementation of curriculum, it must be "structured and purposeful, with effort guided by clear goals for improving student learning" (Guskey, 2003b, p. 749)

Professional development should be school- or site-based.

School-or site-based professional development provide teachers the opportunity to try what they have learned in their classroom. Giving teachers this immediate opportunity after the workshop tends to promote effective professional development. On-site development strategies also allows professional development personnel to assist whenever possible. But studies by Corcoran, Fuhrman and Belcher (2001) indicated that when professional development is school- or site-based, teachers indicated no interest in trying something new, rather, they wanted to do only what they had already been doing. As a result, " a carefully organized collaboration between site-based educators, who are keenly aware of critical contextual characteristics, and district-level personnel, who have broader perspectives on problems, seems essential to optimize the effectiveness of professional development" (Guskey, 2003b, p. 749). This means that

teachers as much as the school or site based are very important — teachers need to be supported to make the professional development effective.

Impact on teacher belief and practice

Professional development is regarded by many as a means of changing a teacher's knowledge, beliefs or practice: "Most teachers are motivated to participate in professional development programs because they wish to become better teachers and they believe that their students will benefit" (Clarke, 1994, p. 43). Professional development programs that support teachers in changing their beliefs or practice about mathematics tend to be very crucial in curriculum implementation (Thompson & Zeuli, 1999).

The characteristics that are effective in curriculum implementation are complex. It is unwise to select a specific list as the core list most likely to promote effective curriculum implementation. Still, by agreeing on the criteria for effectiveness and providing clear description of important contextual elements, according to Guskey (2003b), "we can guarantee sure and steady progress in our efforts to improve the quality of professional development endeavors". (p. 750)

There are specific professional activities or programs used in professional development such as group seminars, workshops, and summer institutes: "Workshops, courses, institutes and seminars are structured opportunities for educators to learn from facilitators or leaders with specialized expertise as well as from peers" (Loucks-Horsley, 1998, p. 86).

According to Wiltz (2000), "Group seminars, or small discussion groups, support cooperative reflection between teachers, expose interns to new perspectives, help them develop professional relationships, and allow time for them to expend and deepen their reflective analysis of everyday occurrences" (p. 1). Seminars are conducted with the aid of an expert in the area to

be discussed. Sometimes, guest speakers are invited to facilitate discussions in the group, which may address issues of pedagogy, content knowledge, beliefs, and practice. Seminar dialogue can encourage teachers to interact and share ideas. Collaboration among members and reflection on their beliefs and practices can be discussed and be examined by others, which can enable others to contemplate ideas from other perspectives (Zeichner & Klehr, 1999).

Workshops are an important activity for professional development. Workshops contribute to teachers' knowledge, encourage collaboration, and promote deeper understanding of theories in education. Teachers need support in continuing to learn content: "many of the teachers are not knowledgeable in their content area or in content pedagogy" (Orrill, Brown, Erbas, Glazer, & Umberger, 2001, p. 2). Workshop personnel (experts) can provide continued support for teachers to learn what they need to use in their classrooms. "Workshops and seminars, however, tend to be offered for shorter periods of time and address more discrete learning goals, such as learning to use a particular set of lessons or try new assessment *strategy"* (Loucks-Horsley, 1998, p. 86).

Summer institutes are important professional development programs aimed at improving teacher's instructional skills: "In particular, attention and funding have been focused on the need for increased subject-matter content knowledge" (Jones & Holder, 2001, p. 18). Summer institutes promote collaboration and reflection among participants. In the institutes, experts are invited to run the program, and enough time is provided to the participants to interact among themselves and the teacher educators (Loucks-Horsley, 1998). Summer institutes are usually held for several weeks to enable participants to focus deeply on a given topic.

For the purpose of improving student learning, professional activities or programs, including workshops, group seminars, and summer institutes, have been the key to professional development: "These professional development sessions usually occur outside of the classroom

and often bring together educators from different locations for a common experience and learning" (Loucks-Horsley, 1998, p. 86). Therefore we can sum it up by saying that the most effective professional development activities are those that enhance teachers' content and pedagogical knowledge, provide sufficient time and other resources, and promote of collegiality collaboration and reflection. Professional development should be school- or site-based and impact teachers' beliefs and practices. These activities can be done through group seminars, workshops, and summer institutes, workshops, courses, institutes and seminars

Role of Curriculum Materials in Reform

The definition of curriculum, according to a number of studies, has been of concern and offers challenges for developing one with universal standards. Sometimes, curriculum is defined to mean syllabus and text, which is a narrow definition. Howson, et al (1981), notes that

> Curriculum, therefore, must mean more than syllabus – it must encompass aims, content, methods and assessment procedures. One cannot truly talk, then, of a 'national curriculum' for it depends upon individual teachers, their methods and understanding, and their interpretation of aims, guidelines, texts, etc. (p. 2)

Kilpatrick (1996) defined curriculum as: "an amalgam of goals, content, instruction, assessment and material" (p. 7). Curriculum material refers to those resources that teachers and students use to enhance the learning and instruction of mathematics (Trafton, Reys, & Wasman, 2001).

In the United States, the most important curriculum material that determines the teachers' practices is the textbook. Ball and Cohen (1996) note that "commercially published curriculum materials dominate teaching practices in the United States" (p. 7). What is a mathematics textbook? In recent years, textbooks do not come just as a single unit; they come as a set of items. The package contains: books, booklets, work cards, and worksheets. The package is meant to support teachers and play a great role in teachers' instructional practices. Textbooks are usually considered in updating a curriculum as a way of making curriculum uniform in a given

setting; on the other hand, textbooks determine a curriculum. (Ball & Cohen, 1996; Howson, Keitel, & Kilpatrick, 1981). Teachers use textbooks for guidance and sometimes depend on them in making instructional decisions. Teachers use textbooks to plan their lessons in terms of time and class organization to enhance cooperative student learning.(Lloyd, 1999).

Textbooks are closely related to classroom instruction and play a vital role in mathematics education. They list topics and subtopics to be covered, assignments to be completed, and class activities to be explored by teachers and students (Borko, Davinroy, Bliem, & Cumbo, 2000). Textbooks have played a significant role in curriculum reform and are the key to the implementation of a new curriculum. As Valverde, (2002) puts it, textbooks "are intended as mediators between the intentions of the designers of curriculum policy into operations that teachers and students can carry out" (p. 2).

A study by Edwards (1995) using the University of Chicago School Mathematics Project (UCSMP) material with seventh and eighth-grade students investigated the impact of curriculum material on the development of cooperative learning and change in teachers' practices in two middle schools. The results of the study found that teachers changed their instruction practice as a result of using the materials:

> These teachers' daily interactions with the innovative textbook and materials, their students, and their students' reactions to the materials required them to interpret the innovation on a regular basis. This may well have provided a source of continuing perturbation in their understanding of their own practices, and the resolution of any such perturbation may well have resulted in changes in instructional practice (p. 7).

In this case, the textbook played a great role in changing teacher practice in their classrooms. Since many teachers depend heavily on textbooks, developers of innovative curriculum need to use that dependence to foster implementation of curriculum reform. Changing teacher's beliefs

or practice takes time and effort; having a way that can foster change should be encouraged and supported (Wilson & Cooney, 2002).

In a similar study, Cohen and Hill (2000) found that receiving professional development in conjunction with the new curriculum enhanced the innovative practices of teachers and diminished their traditional practices. Similar observations were also noted by Reys, Reys, Barnes, Beem and Papick (1997) who stated that curriculum materials foster professional development. Teachers grow professionally as they experience the standards-based curriculum material because the standards-based curriculum encourages collaboration, which promotes sharing experiences and supporting each other as teachers change their practices (Bay, Reys, & Reys, 1999).

Other studies by Heaton (1992) and Remillard (1992) have come up with contrary findings that curriculum material may not lead to teacher change. Remillard noted the following about a participant teacher:

> Jim's view of the state's reform consists of changes that he can make to his current curriculum and teaching strategies, with focus on applications, without making major changes in his pedagogical practices or beliefs about mathematics, teaching, and learning. (p. 179)

Heaton again noted that textbooks had a minimal role in teachers' practices.

The contrasting findings can be explained by studying the role of belief and practice in teacher change. For Jim's case, his practice and beliefs contributed greatly to his view of the textbook. One should note that curriculum materials can have a great impact on teacher learning. The way their influence plays out depends on the nature of the materials used. On the same point Remillard (2000) suggests "that materials most likely to foster teacher learning are those that engage teachers in these processes" (p. 331).

Also, other studies by (Collopy, 2003; Manouchehri & Goodman, 2000; Remillard, 1999) indicated that recent research concerning how teachers interact with and use curriculum is limited in that " researchers do not know whether and what teachers learn through the use of curriculum materials written to support teacher learning without additional and ongoing professional development" (Collopy, 2003, p. 289). Findings from the three studies, suggest that curriculum materials do not always enhance or support teacher learning. By examining the case studies given in the three studies, we can assert that innovative curriculum materials may not have a significant impact on teacher learning unless teachers are supported through long-term professional development. Therefore, based on research in this area, it can be asserted that textbooks may contribute to change in teaching if teachers are supported through professional development activities. Other than the curriculum materials and their role in the reform movement, other factors such as an accountability system are very important and need careful attention.

Accountability System

Other than focusing on issues related to reform movements, teachers are also faced with federal and state governmental policies that require them to be accountable for their students' performances as outlined in the No Child Left Behind act of 2001. As a matter of fact, there is general agreement within the American public that schools should be held accountable for student performance (Johnson & Immerwahr, 1995). Therefore, school districts and states have a right and responsibility to ensure students are doing what they are supposed to do. This responsibility and how it plays out at different local and state levels is an issue of contention. But there is a general consensus that the issue of delivering education is not to be shouldered by an

individual school but rather by a concerted effort of the whole system that allows the school to operate and funds its operation (Newmann, King, & Rigdon, 1997).

Due to the high dropout rate of students from disadvantaged backgrounds and low achievement among children (National Commission on Excellence in Education., 1983), external agents (districts, states, parents etc) have become concerned about students' performance in K-12 settings. In response, the federal and state government has established policies geared towards improving student performance. The main question that arises is: will creating such policies (accountability) lead to improvement in student performance? A comprehensive school accountability system constitutes at least the following four aspects.

- Information of performance (tests)
- How judging is done to measure/determine student achievement of within a school and between schools.
- The consequences attached to performance student
- The agency that gets the performance information, makes judgment and distributes rewards and sanctions (Newmann, King, & Rigdon, 1997).

One should ask, how would these factors improve performance? "The assumption is that teachers will try harder and become more effective in meeting goals for student performance when the goals are clear, when information on the degree of success in available, and when there are real incentive to meet the goals" (Newmann, King, & Rigdon, 1997, p. 43). This theory seems to offer very compelling explanation for better student performance. But, there are three issues that have not yet been resolved:

- Implementation issues
- Organizational capacity

- Internal accountability.

In the study by Newmann, King and Rigdon, (1997) found that external accountability is a challenging issue and difficult to implement. Twenty-four schools participated in this study and

> the authors found that strong accountability was rare; that organizational capacity was not related to accountability; that schools with strong external accountability tended to have low organizational capacity; and that strong internal accountability tended to reinforce a school's organizational capacity (p. 41).
> .

But this does not mean that external accountability system should be done away with. What it suggests, precisely, is "efforts of external agencies to strengthen accountability should pay increased attention to stimulating the kind of internal accountability that we found linked to organizational capacity" (p. 63). In another study by Hanushek and Raymond, (2005) findings indicated that the accountability system of the 1990s had a positive impact on student achievement. The study showed that the achievement gap between White and Hispanic narrowed, but the same was not evidenced between Blacks and Whites. The writers concluded that there is no one answer that can lead towards increased student performance. In another study Fuller and Johnson, (2001) found "that there have been important academic gains, especially for children of color and children from low-income homes in Texas" (p. 280) as a result of accountability system. The authors notes that one should not conclude that Texas system is perfect, but rather, know that "accountability system deserve more rigorous study by all those who are concerned about the education of children of color and children from low-income homes" (p. 281).

One old accountability system initiative documented with fascinating findings is that of Kalamazoo School System, Michigan in the early 1970s (Kalamazoo schools, 1974). The system was very complex and used "standardized achievement tests administered in both fall and spring, criterion-referenced tests developed by teachers, performance objectives, teacher peer ratings,

student ratings of teachers, parent rating of teachers, and teacher self-ratings" (Patton, 2002, p. 17). This system drew a lot of attention across the nation. The American School Board Journal asserted: "Take it from Kalamazoo: a comprehensive, performance-based system of evaluation and accountability can work" (Kalamazoo schools, 1974, p. 32). Basically, the education official used questionnaires with standardized items. They also provided a closed questionnaire which required teachers to state if they agreed or disagree with the system. Findings from the closed questionnaire indicated that teachers were very opposed to it, it did not help them be more effective, and it had the effect of demoralizing them.

On the other hand, a study by Powers, (2003) explored factors that contribute to school performance for two urban school districts using the California mandated Academic Performance Index (API). The findings in this study indicated that policy makers should think very carefully in terms of what to use to measure school performance. Factors such as socioeconomic status of the school, teacher training and experience play a pivotal role in school performance.

So far I have discussed the literature on teacher change, the role of curriculum material, collaboration, professional development, and accountability systems. These are all pillars towards understanding of the implementation process of the new curriculum and the Georgia performance standards in Tabaka Middle School, Georgia. Teachers can be supported to change by a system that is also changing. Teacher beliefs and practice are critical issues in teacher change. Collaboration among teachers enables teachers to try something new and be able to share with others. Through collaborations, teachers can support each other and even try new approaches to teaching and learning.

Textbooks play a crucial role in the process of teacher change in those teachers who depend heavily on textbooks. Having textbooks aligned to a desired curriculum will play a significant role in teacher change and the implementation process of the new curriculum. In this study, the main goal is to identify challenges to teachers and other related people in the district as they go on with the implementation of a new curriculum.

CHAPTER 3

METHODOLOGYAND RESEARCH DESIGN

Design of the Study: A Qualitative Approach – Case Study

A qualitative approach as a method of research is used to address specific goals and questions (Maxwell & Loomis, 2002). As Maxwell (2005) puts it, "The strength of qualitative research derives primarily from its inductive approach, its focus on specific situations or people, and its emphasis on words rather than numbers" (p. 22). Maxwell describes five goals that make qualitative research suitable:

1. Understanding the meaning, for participants in the study, of the events, situations, experiences, and actions they are involved with or engage in. This means, in qualitative research, one is not only concerned about the kind of event and behaviors that takes place but also how the participants in a study make sense of the events and behaviors and how these events and behaviors impact the participants' behavior. This approach is what is referred to as interpretive approach (Bredo & Feinberg, 1982; Maxwell, 2005).

2. Understanding the particular context within which the participants act, and the influence that this context has on their actions. One thing that makes human beings unique in comparison to other animals is that we have the ability to talk. The qualitative researcher seeks to understand the social and cultural context within which the participants live and uses observation, interviews and other related artifacts to understand the context and actions that emanate from the participants (Bogdan & Biklen, 2003).

3. Identifying unanticipated phenomena and influences, and generating new, "grounded" theories about the latter. Qualitative research is very adaptive, open and flexible — a characteristic that enables the researcher to change the design during the process. This characteristic can enable a researcher to create new theories to explore.

4. Understanding the process by which events and actions take place. Patton (2002, p. 159) stated that "a focus on process involves looking at how something happens rather than or in addition to examining outputs and outcomes" when conducting qualitative research. This statement does not imply that qualitative research has no interest in the outcome, but rather it means that qualitative research places more emphasis on the process that leads to the outcome (Maxwell, 2005; Patton, 2002).

5. Developing causal explanations. Qualitative research has greatly contributed to the research field in that it offers explanation about how event x leads causing y. That is to say, what is the process that "connects x and y" (Maxwell, 2005, p. 23). We need to note that "the importance of context as integral to causal processes, and the role of meaning and interpretive understanding in causal explanation—all issues for which qualitative research offers particular strengths" (Maxwell, 2004, p. 8).

In designing this study, I was interested in understanding the implementation process of the Connected Mathematics Project (CMP) material and the Georgia Performance Standards (GPS) in the context of the accountability system at Tabaka Middle School (pseudonym) in north central Georgia. Therefore, as I examined the implementation process of my participants, I focused on how they made sense of the implementation process and what impact it had on them. I also investigated the role of professional development, both during the summer and during the school year, and what impact it had on the implementation process. In this chapter, I describe the

selection process of participants, participants and research context, data collection, data analysis, and research issues.

Participant Selection

Selection of a case or cases is one of the most challenging aspects of doing case study research. Although important, selection should not be merely based on convenience or accessibility as a means of getting data (Yin, 2003a), although accessibility and convenience are important considerations. Well developed reasons as to why a given case was chosen should exist. As a first criterion, a case or cases with contrasting outcomes for cross-case comparison might be chosen (Yin, 2003a). A second criterion is that a case is chosen to enable the researcher to "maximize what we can learn" (Stake, 1995, p. 4). Finding a case in which the researcher can easily work with the participants and participants willing to engage in candid conversation is important (Yin, 2003b).

The stated criteria played a vital role in selecting the participants. The initial population was five sixth-grade teachers who were involved in the initial preparation of the implementation process. At the start of the first semester of implementation, another teacher joined the team. Of the six teachers, one was teaching an intensive English acquisition and academic preparatory program for students with limited formal schooling and for older students needing specialized GED or diploma services. In this program, they used the Spanish version of CMP. Since this program was unique and for a specific set of students, I decided to exclude that teacher from the group of participants.

I was left with five participants who intended to participate in the study; however, one of the five had issues that I thought were of concern. He was not part of the team when preparation for the implementation started. He had not participated in choosing the curriculum material, and

he had not participated in meetings geared to educating the teachers about the Georgia Performance Standards. But the issue of major concern was that he had not participated in a major summer institute that the other four teachers had attended. Because of these concerns, I decided to exclude him from the participant list.

The following characteristics were the main ones that made the four remaining teachers the best candidates for my participation list:

1. All four teachers participated in the selection process of the CMP material. They were given the opportunity to shop around various curriculum materials and chose the CMP. This experience was critical to the implementation process and was, therefore, a primary consideration.
2. All four of the teachers were involved in the second meeting that focused on the "unpacking" of the GPS. In this meeting, the team discussed each standard in detail to clarify objectives and clear up any misconceptions.
3. All four teachers attended a one-week intensive summer institute on how to use the CMP materials.
4. The four teachers had divergent views about the implementation process. Some embraced the idea and others (one of them in particular) opposed. I thought this dichotomy would be interesting for contrasting outcomes for cross case comparison. The teachers also had various levels of academic achievement and come from diverse cultural background.
5. The four teachers were willing and excited to be part of my project. They assured me that they would do anything necessary to help me in all aspects. One of the four

teachers was the mathematics coach and ran the in-school professional development. Therefore including her on my participant list was important.

Participants and Research Contexts

Tabaka Middle School (a pseudonym), came into the limelight from the Bush administration as a school that successfully implemented the No Child Left Behind initiative. The school population is 21% White, 3% Asian, 49% Hispanic, 2% Multi-racial and 25% African American.

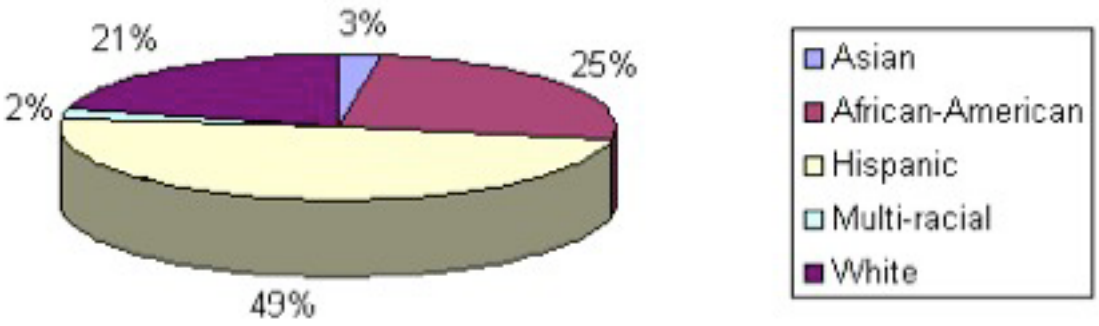


Figure 3: Distribution of students by ethnicity in Tabaka middle school

Eighty percent of the students were eligible for free or reduced meals. The school operate on a block schedule. They had a student uniform dress code to which student were expected to adhere. The mission statement of the school said that the school intended to provide quality opportunities for all students to advance their intellectual, physical, emotional, and social potential. Students were expected to obey the rules and to be dedicated to their schoolwork. Teachers are also expected to run their classes effectively by using effective programs and enforcing classroom rules.

I investigated three teachers and an instructional coach who attended the summer institute in preparation of implementation of the GPS and the standards—based curriculum. All of them

were female, with various teaching and educational experiences. Bochere, the mathematics coach, was a PhD graduate from the research institution in one of the southern states (all names are pseudonyms). She was hired by the school district to initiate the implementation of the GPS, guide the teaching staff, carry out in-school professional development, construct tests and test rubrics, be a mentor to other teachers, and also teach some classes. She had taught at Tabaka for 2 years. She was assigned to teach eight-grade mathematics, but she could co-teach with any of the sixth-grade teachers whenever necessary. Nyanchoka was a teacher with 20 years teaching experience. She had taught mathematics in various schools around the state and had been at Tabaka for 5 years. Moraa had taught for 2 years, joining the teaching profession after working as a secretary for 17 years. Kemuma had taught for 8 years at the current school, meaning that she was the participant who has been at Tabaka middle school longest.

Data Collection

Data were drawn from multiple sources, which include audio-recorded structured interviews, video-recorded classroom observations, field notes, and teachers' materials (tests, quizzes, lesson plans, etc.). The following procedures were used in the data collection.

Interviews

The participants attended a summer institute for five day for 9 hours a day at Michigan State University. The goal of the institute was to educate teachers in how to use and implement CMP materials. After the conclusion of the institute, I scheduled a 1-hour individual interview with each of the four teachers on August 5, 2005 (see Appendix B for the interview protocol). The interviews focused on their experiences attending the summer institute. I decided to conduct the interview within a week after their summer institute so that I could capture as much as possible from their experience. The interview for the three teachers are the same in structure but

slightly different from the one with the coach. This difference occurred because, in addition to attending the institute to learn about CMP materials, the coach teacher had to play a leadership role.

Three weeks later, which was2 weeks into the semester at Tabaka middle school, I schedule a second interview for the three teachers and the mathematics coach. The interviews were on August 24, 2005. The interviews were about the district accountability system (see Appendix B). The interviews investigated what the three teachers thought about the accountability system and its impact on the implementation process. Similarly, I used the same interview protocol for the three teachers, but the one for the mathematics coach was slightly different so as to gather information that specifically addressed her as the instructional coach. The mathematics coach responded to questions that addressed her directly and also questions about the three teachers.

I scheduled the third interview for the three teachers and their mathematics coach on November 3, 2005 (see Appendix B). I gathered data about the participants' perception of the materials after using them for some months, the barriers teachers faced in using the materials, and if they had supplemented any of the materials. I also gathered data concerning their feelings about the in-school professional development/planning time and what they thought had produced. I investigated what the teachers thought was the reaction from students concerning the CMP materials. The third interview focused on issues that came out of my classroom observations. All interviews were audio-taped and transcribed with participants' permission. In my interview transcripts, I will use abbreviation **B** for Bochere, **N** for Nyanchoka, **M** for Moraa, **K** for Kemuma and **R** for the researcher.

In-school professional development/planning time observation.

The teachers agreed to be videotaped during the in planning time by signing a consent form. I attended five sessions (August 10, 2005, August 18, 2005, August 29, 2005 September 8, 2005 and September 9, 2005) that were conducted in the afternoons. In these meetings, the teachers talked about challenges they face, what went well and what did not, and they planned together their lessons. Moraa was asked to write a lesson plan to be shared. I noted that the mathematics coach initially moderated the meetings but eventually the participants became self-driven.

Classroom Observations and Videotaping

Classroom observations are an integral part of my study. Through these observations I validated information that I had gathered through interviews and during the in-school professional development/planning sessions run by the mathematics coach. Therefore, classroom observations helped me get a sense of the teachers' collaboration as well as understand the teachers' classroom management practices, teaching styles, and assessment practices. Additionally, classroom observation helped me understand challenges the teachers faced when implementing the CMP materials — challenges that were referenced in the interview transcripts. I also used the observations to investigate the statement made by all three teachers: "I am going to be standing back more, watching them learn, and be there to answer their questions". This statement is very important in understanding the impact of attending the summer institute and the in-school professional development.

A participant-researcher rather than just an observer. I observed the three teachers from the start of the CMP unit "Prime Time" to its end. I also observed part of the second unit, "Bits and Pieces I." At the same time, I videotaped classroom observations to help me capture more

details I might not notice during the exercise. Just as Jacobs, Kawanak and Stigler (1999) note: "Video data provide the kind of detailed permanent real-time records of behavior that enable researchers to detect patterns and to code a variety of characteristics reliably within and among the tapes" (p. 723). I used one mobile video camera. To make sure the sound was good, I used an external microphone that was stationed at the teacher's desk. When I moved around the room, I disconnected the external microphone and used the camera's microphone. I wanted to capture what students were doing in their school groups or when a teacher was in the group discussing something. The revolving camera worked very well because not all students had signed the consent form to be part of the study, and I could not use a stationary camera because I was taking care not to capture any student whose parent had not signed the consent form. Those students who had the consent forms sat in one section of the classroom to make it easier for me to videotape them. Teachers were very helpful in doing this. For the reason that not all students signed consent forms and not at the same time as well as the group learning strategy that teachers learned during the summer institute, it was difficult to have a permanent classroom arrangement.

I did not experience any technical problems videotaping the classroom, and all videotaped cassettes came out with high quality resolution and sound. I videotaped Ms. Nyanchoka in the third period, Ms. Moraa in the fourth and Ms. Kemuma in the fifth period for eight weeks. My presence initially had raised curiosity about me among the students. The teachers did a good job of introducing me and explained why I was present and why I wanted to videotape the class and why that required a consent form to be signed by their parents. Some students thought they were going to appear on television and therefore really wanted to be on camera.

During the classroom observation, I also took field notes. Field notes are important because they "contain the observer's own feelings, reactions to the experience, and reflection about the personal meaning and significance of what has been observed" (Patton, 2002, p. 303). Since some of the teachers preferred not start videotaping until they felt they were ready, field notes helped me to capture some of the episodes that I thought were significant.

Written Artifacts

Written artifacts I collected included samples of student notebooks, assignments, lab sheets, quizzes, tests, notebook quizzes, supplementary resources, and revision materials. The artifacts provided crucial information about what the teachers used in their classes to teach and assess the students.

Data Analysis

The audio-recorded structured interviews, video-recorded classroom observations, field notes data analysis were guided by grounded theory approach (Glaser & Strauss, 1967). "The methods consist of systematic inductive guidelines for collecting and analyzing data to build middle range theoretical frameworks that explain the collected data" (Charmaz, 2000, p. 509). The method assumes that the process of data collection, cording and analysis are done simultaneously to generate or discover a general theory. Theory is grounded in the data. I conducted three sets of interviews with four participants: three teachers and the coach-teacher.

After I finished the interviews, I was faced with a decision either to transcribe them myself or have somebody else do it. I chose to transcribe them myself and the experience has been very rewarding. I had much to learn about my research habits by transcribing my own interviews. After transcribing my first interview, I noted mistakes I had made, in particular, cutting off the interviewee and forgetting important information. I also asked the same question

repeatedly. The first phase of data analysis involved open coding. In order to execute this step, I read the transcripts again and again. I gave the same transcript to two colleagues of read. Their feedback helped a great deal with the coding process. I began by coding line by line (Strauss & Corbin, 1990).

I developed and wrote open codes in the margins of the transcript and later transferred them to a word document to make my analysis easier. I used open codes to illustrate the important points that were captured in the interviews, field notes, and videotapes. Two colleagues acted as peer reviewers and helped me review "these codes, comparing and contrasting them to identify the common features among them, in order to cluster them into conceptual categories" (Harry, Sturges, & Klingner, 2005, p. 5).

After finding conceptual categories, I began to discover relationships and started finding relationships in particular between categories. Writing memos really helped me establish these relationships in that I was able to develop initial themes and their relationship to each other. To make sure my memos were not misplaced inside the codes, I dedicated a separate notebook to them. Memos that I wrote were different in many ways. Some were very short notes, whereas others were well-elaborated explanations of what I needed to do. For instance, I wrote a memo concerning certain information that I realized was missing and needed following-up. While doing this research I discovered that writing memos can happen anytime. I wrote my memos on the bus, in bed, and sometimes in the gym. I could pick up a piece of paper and quickly note what came to mind as I was going through the categories. I gathered themes concerning:

1. How does the mathematics coach see the summer professional development activities, and how did it impact teacher practices? How do the three teachers see the summer

professional development activities, and how do they think it impacted their teaching practices?

2. How does the mathematics coach perceive the accountability system in the school district, and how does she interpret the Georgia performance standards in mathematics? How do the three teachers perceive the accountability system in the school distinct, and how do they interpret the Georgia performance standards in mathematics? How do these interpretation impact mathematics coach practices (decisions about professional development activities)? How do the interpretation impact teacher practices?
3. How does the mathematics coach see the ongoing district Connected Mathematics Project (CMP) professional development activities, especially those she is responsible for, and how do the three teachers respond to them? How does this professional development impact teacher practices?

I continued to make memos. I also organized my field notes and video tapes and invented codes that I compared and contrasted to develop conceptual categories.

After I established the relationships between categories, I started to ask myself What my study is all about? I needed to find the core categories that would enable the theory to emerge. I went through all my memos, adding what I thought might be missing. I finally justified my theory through data analysis.

Research Issues

My role in this study was to understand the process and impact of implementing a new curriculum and Georgia Performance Standards in the context of the accountability system. Trustworthiness or validity is an issue that needs attention when designing a research as well as collecting data. The issue is:

> How can an inquirer persuade his or her audience (including self) that the findings of an inquiry are worth paying attention to, worth taking account of? What arguments can be amounted, what criteria invoked, what questions asked, what would be persuasive on this issue? (Lincoln & Guba, 1985, p. 290).

In building trustworthiness of a research project, the following eight verification procedures are useful: prolonged engagement and persistent observation, triangulation, peer review and debriefing, negative case analysis, clarification of researcher bias, member checking, rich/thick description and external audit (Glesne, 1999; Lincoln & Guba, 1985).

In my study I observed my participants for 8 weeks. During this time, I built a good working relationship with my participants to a point at which they could share freely their feelings. On the other hand, Lincoln and Guba, (1985) note that "prolonged engagement also requires that the investigator be involved with a site sufficiently long to detect and take account of distortions that might creep into the data" (p. 302). The fact that one is a stranger can result in overreaction by the members of the group. Other than spending a lot time with my participants, the mathematics coach played the role of a broker in creating a bridge between me and the other three teachers. This relationship enabled me to get candid data for my study. Therefore negotiating a fieldwork relationship all through the research project is important (Bogdan & Biklen, 2003).

I collected data from multiple sources through observation, interviews, videotape data, and artifacts. "The use of multiple data-collection methods contributes to the trustworthiness of the data" (Glesne, 1999, p. 31). By doing so,confidence in the research findings is upheld. Using the multiple sources of data (triangulation) and the themes developed, I checked across different sources of data for consistence or contradiction.

I used peer review and debriefing in this study more so when coding my interview transcripts. My peers helped me write and review my coding and conceptual categories. The reflection and input that I received from my peers helped me refine my conceptual categories.

Another procedure that Lincoln and Guba, (1985) proposed is negative case analysis. Negative case analysis is "conscious search for negative cases and unconfirming evidence so that you can refine your working hypothesis" (Glesne, 1999, p. 32). In my research, I found instances during which I refined my hypothesis that the three teachers did not support the district accountability system. I refined this hypothesis by asking various questions that targeted the issue of the accountability system.

Clarification of researcher bias is one of the procedures that is listed as critical for trustworthiness. This procedure involves a reflection on one's subjectivity and the role it plays in research. The first bias that I bring into this study is due to my nationality and cultural background. I am a black male born and raised in a rural setting in Kenya. I am a minority in this country with limited knowledge about the American way of life. With this background and orientation, my perception and interpretation of certain issues is likely affected. The second bias that I bring to this study is that I was educated through the University in Kenya. I have some experience about the American education system through experiences in my master, doctorial programs, but still I do not have the experience of having gone through the system, which may also affect my perceptions. However, I believe that my prolonged engagement with the participants and the help of the mathematics coach greatly minimized my biases.

Member checking procedures are important for establishing trustworthiness. Glesne, (1999) explains that member checking is "sharing interview transcripts, analytical thoughts, and/or drafts of the final report with research participants to make sure you are representing them

and their ideas accurately" (p. 32). I have shared all my interview transcripts, as well as the preliminary findings, with my participants. By doing so, some issues have been clarified and others reinforced. I used member checking by giving the participants the first interview transcript in preparation for the second interview. In the second interview, some issues were clarified and others where reinforced. In this session, errors due to wrong interpretation were corrected and responses gave additional information needed to reinforce the interpretation. Researchers need to be cautious when using member checking because "member checks can be misleading if all of the members share some common myth or front, or conspire to mislead or cover up" (Lincoln & Guba, 1985, p. 314). In such situations, prolonged engagement and persistent observation can greatly help in shaping trust among the participants. For my study, the presence of the mathematics coach greatly helped sort out some of these ambiguities.

CHAPTER 4

RESULTS

The Summer Institute Experience

Bochere (Mathematics Coach)

In the one-week summer institute, there were 30 participants who came from all over the United States. Bochere registered for the institute program to help her understand the CMP materials and, at the same time, support the three teachers from her school. Bochere describes a typical day at the institute:

> B. We walked in and sat down with the group we were with the day before.
> R. The same group.
> B. The same group we were with the day before and then they usually did some kind of, you know, if we had a problem to think about the night before we had some discussion about that and then we got into groups. Everyday we changed a group.

As a mathematics coach, Bochere felt there was an expectation from the other teachers that she would lead the process, making the institute a great learning experience for all. A number of activities happened at the institute, Bochere noted that:

> B. We went through I guess one to two books. I guess two books a day.
> R. A day
> B. And they did. Obviously, we did not do every activity in every book but we did the majority. I think of all of the books, and each day we supposedly focused on a different aspect of Connected Math through launch, explore, summarize. So they spent, the two instructors spent time each day more focused on the aspect of the lesson trying to model it more explicitly, and we just worked through. We just did a lot of the problems in investigation that students would be doing.
> R. So this is what went on every
> B. Everyday.
> R. Everyday. Yeah, from one book to another.
> B. Yeah everyday (Bochere, 1st_Interview08/05/05, line 43-54)

At the institute, they were involved all day long. They started the day as early as 8.00 am and it ended at around 5.00 pm; basically, the participating teachers were the students.

> B. And we were basically the student, you know, learning and doing activities in these books and sharing and going up and presenting your solutions and your ideas.
> R. Okay.
> B. You're really just trying to model that — I guess that classroom environment (Bochere, 1st_Interview08/05/05, line 55-58).

The mathematics coach noted there were a number of ways they benefited by attending the institute. First, they covered seven out of the eight units of sixth grade CMP material. She noted that going through the units gave her familiarization of the materials, but it was not up to her expectations. Bochere had this to say:

> B. I knew because an expert told me, in our book rap, that what you do is work through several of the units. It turned out that we worked through seven of eight units. So I thought — I thought we gained familiarity with each unit. I thought we would be familiar with each unit. I thought we would gain more procedure in classroom management — how do you record-keep and how do you help create notebooks and how do you handle homework, which we didn't get. We got that because we asked teachers in our group.
> R. Uh um
> B. Um. What we did get was a lot of good discussion about the mathematics and some good pedagogical strategies. I think it was more about the model than strategies talked about. Yeah, I think initially we were, all four of us were wishing we could get questions answered. How do we manage the system of Connected Math?
> R. What do you mean manage the system of Connected Math?
> B. How do you keep a notebook? How do you do grades?
> How do you check it? When do you check it?
> How do you weight different things? How do you manage groups from all of those?
> There are issues in the classroom that, really, we didn't touch on. I think that is what we thought we wanted. Those are the kinds of questions we wanted to get answered when we went there. And our experience was much more mathematical and probably better than what we had expected (Bochere, 1st_Interview08/05/05, line 12-26).

Asked whether what she was saying really reflected the views of others teachers, or rather speculations, Bochere noted that she thought it was a general feeling from the talks they had on the way to the hotel where they were staying and also in the hotel rooms. They shared what they

did during the day about classroom issues and how great the activities were. In the hotel rooms, they discussed what they gained from interacting with other group members. This discussion provided the opportunity for Bochere to learn what experiences her three teachers had in interacting with the other members in their individual groups. Concerning what they gained from the activities at the institute, Bochere indicated that:

> B. I think for me the biggest insight I got was how important it is that we don't skip around in these books or just pick up a book or pick up an activity. Um, everybody will laugh whenever we say this, but the activities are so connected, so well thought out and the mathematics that comes out of it is amazing. But if you do not do these lessons in the sequences that they have developed you have really missed a lot of what was intended to be there. So I think we all saw that. I do not think that we realized how powerful those lessons were. Because what we had done previously was just look at one investigation in this book or one investigation in this book — we didn't have a chance to see how they were all rubbing together.
> R. Okay. Okay.
> B. And so that was. I was really glad that we did the mathematics, one, just to strengthen our own understanding, but two, to get that, to see how at the end you think, "Wow! I wish I could write lessons like that." (Bochere, 1st_Interview08/05/05, line 60-71).

The institute experience was a challenging time for Bochere. Wanting the three teachers to have a pleasant experience at the institute at the same time she concentrated on the activities at the institute was not an easy task. She was always concerned about her teachers; she wanted them to have a rewarding experience from the activities at the institute. Whenever she sensed that something was making them uncomfortable or that they felt so overwhelmed that they might not like the materials; she was very disturbed.

> B. Yeah I was just afraid that something would happen, and they would get turned off to it or say this is not what I signed up for or this is very overwhelming. I just wanted them to come back really excited about the curriculum.
> R. Uh Hum.
> B. And it was really hard work while we were there so I guess I was trying to make sure that they were happy and not being overwhelmed by the mathematics. By having a chance to really get in there and talk about it. It is kind of like with your own students.
> R. Yeah. Yeah.

> B. Except they are adults and my friends — but just wanting them to be challenged and wanting them to see how great the curriculum is but not wanting them to be challenged so much that they felt like they couldn't do it. Or they do not want to do it, and so I was just very aware not only of what I was doing but what each of them was, I just watched. We were barely in the same group any of us (Bochere, 1st_Interview08/05/05, line 81-93).

Asked if playing this role distracted her from the institute proceedings, she said that mathematically she felt confident because she had seen the activities before and enjoyed them. She was not learning the material for the first time. Having had earlier experience with the material enabled Bochere to act as a participant, a guardian and, at the same time, a hostess. She planned ahead of time where to eat for the day and made sure the group made it to the meetings in time. Bochere wanted everybody to have a positive experience at the institute. Bochere described her activities at the institute as making sure everybody was on time and making sure all their needs were taken care of.

One other role that the coach-teacher played was to emotionally support the three teachers. For one of them, this was the first trip out of the state and she really needed help because being away from home for the first time can be a very traumatic experience. This responsibility, for the coach-teacher, was a handful. She had to deal with a lot of issues ranging from her own needs to the needs of the three teachers.

Asked if attending the summer institute caused her and the other three teachers to change their planning, classroom management, teaching style, assessment practices, or degree of teacher collaboration, Bochere had the following to say:

Planning:

> I think planning we knew — we knew before we went we would meet a lot together to plan. Um, I think when we got there we realized how much support materials there are to help you plan, and they went all over that — the things that are in them, teachers' support materials to help you plan lessons. So I think we felt somewhat relieved to see all of those materials, you know, we had to do with learning focused stuff here, so we have the ideas and essential question and all that and, um, connected math materials. So planning

> — we were kind of grateful. You know we realized it was not going to be overwhelming (Bochere, 1st_Interview08/05/05, line 138-144).

Bochere noted that by attending the institute, it would save the teachers planning time, which could be devoted to focusing on the mathematics. Teachers devoting the time, talking about mathematics that students are doing and taking the discussion to their classrooms can greatly help the implementation process.

Classroom management:

Bochere noted that since she was not teaching any of the sixth graders, she might not have much to say but noted the three teachers learned a lot as the result of attending the institute. Asked if she did approach talking to the teachers about classroom management differently, Bochere said yes. For instance they met every Monday to talk about cooperative learning strategies. Asked if that was a new strategy as a result of the summer institute, she said:

> We all have been doing some of that. I mean sixth grade classroom is pretty much oriented around cooperative groups. So it is more of an urgency to talk about it among sixth grade teachers. I think things that sixth grade teachers are now doing in their classrooms — I really want some of the seventh and eighth grade teachers to go watch. So, that is one aspect of professional development for the rest of the faculty that I am excited about. We do not just have to talk about it. It is going on right down the hall and they can go watch it (Bochere, 1st_Interview08/05/05, line 154-155).

According to Bochere, going to Michigan had a great impact on the three teachers as far as classroom management was concerned. She noted that they were making big changes and she was trying to support that change. One of these changes as noted above is the use cooperative learning a consistent basis, the other is the management of a whole system of notebooks. "The management of a whole system of those notebooks is a big deal, and my sense is that people really like them. But that is really training students and us as teachers to think about classroom management in a whole different way" (Bochere, 1st_Interview08/05/05, line 185-187). She also noted that for some teachers, managing the system of Connected Mathematics was a big issue.

For instance, some teachers had a hard time letting students wrestle with the mathematics and figure it out without stepping in right away or giving too much help. Some teachers were ready to step in and direct them, step, step, step and move on to get the students ready for the CRCT.

Assessment practice:

The issue of assessment, which was a big issue at the school district, was not addressed at the institute. Concerns about grading tests, grading homework, giving pre-test and post-test, did not come up at all at the institute. The coach-teacher thought that the presenters should have had a session on how to do such things rather than concentrating only on the mathematics. This was a big concern for Bochere. Since CMP had been working on new versions, the publishers were not able to send the materials as needed. They managed to send student and teacher copies of the books, but no teachers' support materials were sent. Therefore it was the responsibility of the mathematics coach to come up with test materials for the pretest and posttest as those were required by the district. Since CMP was such a different curriculum, Bochere explained:

> I can't just do these criteria based, skilled-based problems. To get students ready for CRCT is a lot harder than it is to write assessment questions. Harder to get your head around what it will look like. How do I get out what students are learning — it seems so… I don't know that the word is, but we are doing this great activity and they are really coming to understand what it means to be prime and composite and the factors are what they have to do with that. So are we going to ask a question at the end? "Is 7 prime or composite?" that is just… So just trying to find good questions that come along side the investigations that we are doing is a challenge for all of us. (Bochere, 1st_Interview08/05/05, line 213-220).

According to Bochere, the assessment procedure would definitely change. The kinds of questions to be asked would definitely change to go hand in hand with the CMP materials, but she noted it was still too early to give detailed comments about the overall assessment plan.

Collaboration: Asked about collaboration, Bochere said that the teachers depend on each other very much, which they did not do in the past.

> In the past, teachers talked and shared ideas of things they have created but not like formalized meeting time where you sat down, and generating lesson plans together. Not teaching basically the same thing everyday so that you can come back and talk about it. That is very new but great! (Bochere, 1st_Interview08/05/05, line 235-238).

According to Bochere, the sixth grade teachers meet every week to plan and share their experiences. The lesson plan is shared among the three teachers and therefore teachers can present the same content at the same time.

After Bochere discussed the impact of the institute on planning, classroom management, assessment practices and teacher collaboration, she was asked: For these three teachers, what are your expectations of the impact on their teaching practices? Bochere felt that for Nyanchoka, the biggest challenge is the mathematics. She also noted:

> I think she has grabbed a whole of the whole classroom management strategies, and that is my sense in talking to her. I have not been in there. But my sense is that she is really using these groups, getting her students to talk — she is excited about that. But she has always had pre-vocal classroom, you know, always liked a free discussion and wanting students to share. So I think for her, she is going to have to get past the little mnemonics and tricks and things that she has used to help students remember procedure. I think the courses that she took this summer outside of connected math — she did the Algebra and the number sense course, the middle grade courses; I think that was the most wonderful eye opening for her. There is so much mathematics in the course, I think for her that will be the biggest thing (Bochere, 1st_Interview08/05/05, line 246-256).

But for Kemuma, Bochere said:

> I think she — to me it seemed like she is really into the mathematic part of it. She really appreciates it because she has been teaching, I think the longest. She really appreciates the connections that are built. So she is really able to look long term at a unit and I think for her this idea of allowing students to stay in a problem and carry that to the next one, to me I see that is what she is going to grab a hold on and focus on. It seems like she gets that part of it and really appreciates that part of it. So I expect to see — I expect to hear her talk about that, about the connections her students are making and the richness, of the mathematics (Bochere, 1st_Interview08/05/05, line 257-264).

On the other hand, for Moraa:

> …she is excited about the kind of conversations students are having with each other. She is amazed at the quality of answers she is getting in her class. So imagine that kind of

> community of conversation, dialogue would be a real focus for her. I think it is going to be a big impact (Bochere, 1st_Interview08/05/05, line 267-271).

Asked to talk how what she has said about the three teachers will impact what she decided to do for the in-school professional development, Bochere noted that she is overwhelmed by what she can do to support them, both individually and as a team.

> …this has been a really crazy busy week and I really, really want to get in there and see what they are doing and talk to them individually, find out what is going on— I hope that it is their experiences that they bring to our meetings that spark our conversations. That it is what they need and what they ask for is what I am able to provide them. Right now we do not have any materials. I feel so out of— but we will work it out! (Bochere, 1st_Interview08/05/05, line 273-279).

Finally when Bochere was asked what evidence she will use to understand the impact of their practices, she noted there will be many way to asses this:

> One is being in their classroom. Two, what they choose to share in meetings about what is going on and what is not going on what their concerns are. What they are able to offer to a group as successes. You know I mean I have seen accessing students at the end to see what they are doing and how they are grading, how they are going to assess when they have student work. How they choose to grade it and what they are looking for.

The experience for Bochere at the institute was very time consuming. She learned many things and at the same time played a role of a hostess. She was faced with many challenges at the institute to make sure the three teachers had a beneficial experience and, at the same time, learn something for herself. The institute challenges have also followed her to her school situation where she cannot get all needed CMP materials in time. The problem has compounded the complexity of the implementation process, and she is struggling to keep going, to keep high spirits, “which it seemed like some of the enthusiasm had started to wane” ((Bochere, 1st_Interview08/05/05, line 110-111).

Nyanchoka

Nyanchoka voiced sentiments similar to those of Bochere, the coach-teacher, in terms of what the daily activities were. Nyanchoka said:

> …we were introduced to a different book every day, a different unit, first day was prime time and every stuff that goes with that book, it was talking about fractions and factors and multiples. They gradually introduced that to us and we went through the book like the kid will go through the book. We did it step by step like a child will do it, which I'm supposed to do with my students when I get my books. The instructors where right there to tell you how to do it; the teachers' guide, followed right along with student guide, and they had the teachers' guide and we had we had student guide and we followed a long with our instructor and did everything they asked to do. There were activities that were hands on activities that came up in the lesson that we participated in and there was movement, we had to get up and move around and go up and demonstrate how we solved that problem — steps like that and everyday was like that. But each day we covered a different book (Nyanchoka 1st_Interview08/05/05, line 99 – 109).

The instructors arranged the participants into groups which kept on changing as they changed from one book to another. There were teachers from all over the US that were taking the institute, either implementing CMP for the first time or having used it for some time. She noted that it was basically a classroom setting with big tables to work on. The room was arranged in such a way that it was easy to move around and have conversations with other groups in the room.

According to Nyanchoka, the experience at the institute was great in many aspects. First, as she noted

> it was very interesting for me. It was also very exciting for me because… this trip altogether was exciting for me first of all. This trip was a very first for me in every sense of the world: having to fly was my first experience to fly in my whole life. Never flown before, that made it exciting right there. I have never been out of the state of Georgia; no, so that too was new for me — the entire trip was the first. So leaving the state of Georgia for the first time, being on the airplane for the first time was really interesting. Being in the airport for the first time was interesting because I have never been in the airport before. So going through that was interesting for me. So it was interesting, it was exciting — everything was the first. Never been a way from home, that was the first so you know I find it strange to be my age and never been a way from home but. (Nyanchoka 1st_Interview08/05/05, line 155 – 166)

Nyanchoka considers herself to be very traditional. Giving her students the rules of doing mathematics and moving on is much easier for her. But by attending the institute, she learned that it is important to back off from giving the rules to the students and let them figure out the mathematics, which she said is going to be difficult thing to do. Just as Nyanchoka said:

> I got a lot of stuff from going to summer school and learning about Connected Math. One is that I'm going to have to learn not to teach the rules to my children and let them figure it out by themselves. It is easier for me to tell the students how to do it and give the child the rules and move on. So that is going to be a challenge for me this year I know I'm going to have to back away from being the teacher (Nyanchoka 1st_Interview08/05/05, line 22-26).

Asked to comment about the summer institute activities and if they did change her assessment practice, teaching style, planning, classroom management, and teacher collaboration, Nyanchoka had the following to say:

*Assessmen*t: Nyanchoka noted that her methods of assessment would change. She used to assess her student by paper and pencil, but now she is going to assess by moving around the room and seeing what her students are doing and also giving the students opportunities to assess themselves. Nyanchoka said:

> …my students will be able to assess each other and say to themselves that, yes, they have developed skills, or, no, they have not developed skills because it is going to be a group type thing and group is something I don't do so that is going to be new this year — to put my students in groups and let them work together because I'm used to my children doing their own work individually. And I'm going to back away and allow them to work as a team. That is hard for me. (Nyanchoka 1st_Interview08/05/05, line 31-36).

As already noted, her assessment will involve classroom observation by walking around the room, seeing what students are doing and giving grades based on that. She will also take students to the board to solve problems and any student who skips a step, will loose points. Nyanchoka said:

> I will walk around and observe my students and will get a grade based on what they are doing for me. Whether it will be A or whether it will be F, but every kid in my classroom will get a grade based on how well she or he is performing in the classroom. So I'm excited about that. Also my students will be a teacher in my room. They will go to the front of the room, and they will have to demonstrate how to solve a particular math problem for me using manipulatives, and they will be assessed that way. And when I say they will be assessed that way because they will have to tell me step by step how to solve the problem and if they leave out a step, they will loose points. Because, they will have to walk me through it like I don't know how to do it. And they don't know what type of question I will throw at them, so they will have to be very prepared (Nyanchoka 1st_Interview08/05/05, line 332-343).

Teaching style: Nyanchoka noted that the experience at the institute would have a great impact on her teaching style. She claimed that she would utilize group work in her classroom, which is a drastic change from what she is used to. She liked having students do their work individually, and it was going to be a challenge for her to change. Another thing that she has gained by going to the institute was the appropriate use of manipulative materials. She did not like to use manipulative because her students used them to play with them, and the manipulatives seemed to distract from instruction. As she noted, " By putting my students in groups and letting my students use manipulatives I'm going to gain a better way of teaching" (Nyanchoka 1st_Interview08/05/05 line 52-53). She noted that among the sixth grade teachers, Moraa was very knowledgeable about the use of manipulatives and has used them in her classes, so to Moraa, it was not a learning experience. Nyanchoka would try to learn more from her. She reiterated that teaching by rules was much easier for her then using manipulatives, but she had no choice but to learn to be comfortable using them. As she put it:

> As far as my teaching style goes, yes, it will change, it will change a great deal and I know it will. Because it is no longer writing rules on the board, writing problems on the board and showing my students how to solve that based on the rule. I can't do that although that is what I want to do, because that is easiest for me, I have to pull away from that. To me to teach a kid to solve an integer problem you have to add 3 plus negative 4, I can give them a rule how to do it, a lot quicker than pull out manipulative and say this is

> how we do it, but that is where I have to go (Nyanchoka 1st_Interview08/05/05 line 245-255).

Nyanchoka felt that she did not learn enough at the institute to enable her to effectively use manipulatives in her classroom. She decided to take two classes at Pioneer RESA[1] to be able to use manipulatives when school starts. One class was called number systems of which she learned about the use of Base 10 blocks and algebra tiles, which she plans to use with her students. Basically, she believes that the RESA course she took over the summer helped her more than the summer institute. She said that the courses she took gave her the opportunity to learn how to use pattern blocks and their usage in solving fraction. Nyanchoka said:

> I feel like, if I have an opportunity to use things that I learned at these two classes that I took… it will make me a great teacher, it will make my students learn better and make my student excited coming to my classroom and that is what I want . Because I know when I took the classes and played with toys watching them help me solve a problem, was amazing and that is exciting. And figuring out for yourself was exciting, so that is what I want to do in my classroom. (Nyanchoka 1st_Interview08/05/05, line 319-325).

Planning: Planning, she said, would definitely change in that it will be a co-operative thing. She said that "every sixth grade-teacher that teaches sixth-grade students will all get to meet together and write our lesson plans as one lesson plan" (Nyanchoka 1st_Interview08/05/05, line 223-224). In the planning time, they would share ideas, which would be combined to form a lesson, which would be used by the three teachers. It will be a team effort, and they would be doing the same thing in every classroom. Therefore, according to Nyanchoka, planning would definitely change.

Classroom management: Nyanchoka believed that attending the institute did not change the way she handled the issue of classroom management. She believed that good classroom management

[1] Pioneer Regional Educational Service Agency (RESA) provides support, professional development, and courses that teachers can take during summer at a low cost. It is located at Cleveland, Georgia.

is characterized by firm rules that need to be followed to the letter. Any student who goes outside those rules faces consequences. Nyanchoka said that:

> As far as classroom management goes, no, because I'm a tough teacher, and I know I'm tough. I'm a very stern teacher, I'm a very strict teacher, and I run my classroom that way, it is my room, no body else's room it is my classroom. When you enter my classroom I expect you to act a certain way and my students know this from day one, no matter what I'm doing You enter my classroom, you act a certain way, you cannot perform a certain way in my classroom. So as far as classroom management goes, no, I have not changed any of that (Nyanchoka 1st_Interview08/05/05, line 233-244).

Teacher collaboration: Concerning teacher collaboration, Nyanchoka said it would change. They will plan together, work together as a team and support one another as much as possible.

Concerning what she thought other teachers gained, she was not sure. She said that, nobody was willing to share their experience at the institute because they were not free to make their feelings known, but she noted that maybe they also learned the same thing she did. Asked if there were such conversation when they were in their hotel rooms, she stated that such conversations did not exist. Asked to give her opinion of what she thinks will happen when they start using the materials, Nyanchoka said:

> I'm a little nervous about doing it, but I'm also excited about doing it. I'm really excited about the new things — it is going to bring life of my children as well as my self. As I told my students it is a learning experience for me, and it is going to be a learning experience for them. I'm excited, but I'm a little nervous; and I think my co-workers are very excited, but they are also nervous... As far as it goes, I'm really excited to challenge my students and hoping to make their minds wander that is what I'm looking forward to and watching their faces light up for the first time. Ooh, that is all that it is to it, because I know that is what I did what they introduced to us for the first time and we sat their and played with it. We used manipulatives and we solved the problems and then it was, like Ooh that is why that rule comes from there. You know, I'm hoping to do the same with my students —that light bubble turning on. That is what I'm hoping (Nyanchoka 1st_Interview08/05/05, line 68-76).

The experience for Nyanchoka at the institute was plentiful in spite of not getting all that she wanted. She said that it would be a mistake to think she did not learn anything at the

institute, but it should be noted that she also learned a lot from the two classes she took in the summer. Basically, she felt that her experiences at the institute and at Pioneer RESA complemented each other.

Moraa

The experience for Moraa at the institute was both similar and different to that of the other two teachers and the mathematics coach in many ways. She noted that her experience at the institute was great, and she would love to go back. She attended the institute as one of the sixth-grade grade teachers from Tabaka Middle School, which was starting to implement the Georgia performance standards. According to Moraa, a typical day at the institute was "when we came in, we sat down at a table. And then they gave us cards so we had to go to that card number table. So if I had 5 I went to the 5 table" (Moraa 1st_Interview08/05/05, line 59-60). They changed groups every day so as to meet other participants at the institute who were from all over the United States. Some of the participants were attending the institute for the first time and also using the CMP material for the first time, just like the three teachers and their mathematics coach from Tabaka Middle School, and some had previously used the materials but were there to learn about the updates of some of some of the books. "So they were there to learn about the updates. About the changes" (Moraa 1st_Interview08/05/05, line 85-86).

Their instructors handled them as if they were actual sixth-graders being taught the material. They "gave us insight on what the children are to do and also gave insight on how they are to read these books. If we know how they are to read them, we will be better equipped to teach them how to read them." (Moraa 1st_Interview08/05/05, lines 14 - 17). She noted that there was a lot of writing, which she greatly enjoyed since she has an endorsement in reading and loves to

write. She feels very confident using CMP materials: “the way they showed us it was easy to teach it. It is more student guided. Instead of giving them a formula, we give them manipulative to use and they retain it and they figure it out themselves. I love this stuff” (Moraa 1st_Interview08/05/05, line 31, 33-34). She noted that, in the institute she learned how to use the material and how to help the students use the materials. Her impression of what other teachers gained from the institute was varied. She thought that Kemuma “got on it very easy” (Moraa 1st_Interview08/05/05, line 45). But Nyanchoka “was a little more skeptical about it” (Moraa 1st_Interview08/05/05, line 47) but she has started getting comfortable with the materials. The way Moraa knows Nyanchoka is that when she gets comfortable with materials, she really enjoys using them. Moraa believes that the summer institute helped them all.

Concerning daily activities, the participants came in and were given a card that had a number of on it. The number indicated the table the participant was assigned to. That means if a participant had 3, then he or she had to look for table 3 and work with other members assigned to that table that day. This changed every day. This provided the opportunity for the participants to meet different teachers from all over the US who were also attending the institute. Some participants according to Moraa, were brand new in using the CMP materials, whereas others had used it for a year and come to learn more about the update is some books. Basically there were two presenters in the room who helped in the activity of the day. Moraa said: “The teachers that have used this before helped us to understand it better. Because they kept telling us that will only take you a day instead of two days. Or if you do this you can extend it out into different other subjects ”. (Moraa 1st_Interview08/05/05, line 94 – 96). These teachers, who had used the books for a year, shared with the rest what they liked about the materials and what they did not like. The majority of the things they did not like had been changed in the updated versions.

Moraa noted that the program at the institute was intense from 8:00 am to 5:00 pm. They had some breaks in between lessons, including a lunch break. They carried some work to their hotel rooms to review all they did during the day, having dinner at around 9:00 pm or 10:00 pm and going to bed.

In terms of what she gained by attending the institute, Moraa thought that was a lot. *Planning*: The mathematics teachers who attended the institute will now be planning together, and they have never done this before.

> M. Well, the planning, we are planning together. I have never planned with other people before. So we are planning together.
> R. You are planning together.
> M. We're going by their pace and guide
> R. Uh Huh
> M. We re doing all the stuff first to see... our planning may be a little different according to the classes because one class may go a little farther than the next class or one class may be a lot slower. (Moraa 1st_Interview08/05/05, line 148 – 155).

Teaching style: Moraa noted that she would start using groups in her classes. As I went to her class, she had arranged student chairs in groups of three. This is something she has not been doing often in the past. She noted having students in groups will greatly help her in terms of classroom management. She will be able to meet a group at a time instead of meeting one student at a time. Having group activities will enhance collaboration among students, which will help in managing the class. She also interpreted groups as a way of doing CMP activities, which contribute to classroom management.

Moraa was convinced that her teaching style would definitely change. It will be less lecture and more guidance, which she likes a lot. She does not see a problem adjusting to this new way of teaching. She will be using manipulatives more , but she said that she is very comfortable using them. As a matter of fact, Nyanchoka had noted that Moraa is very

comfortable when it comes to using manipulatives. She has used them her classes in the past, but the experience at the institute has inspired her to use them more.

Collaboration: "We are talking it out and planning it out as a whole group and we are going to come back and talk about what went right and what went wrong. What we would like to change. What she did and what I did" (Moraa 1st_Interview08/05/05, line 188 – 189). She also noted that by attending the institute, the sixth grade teachers developed a common agenda. They have developed a sense of working together and will use that for more collaboration.

Assessment: Moraa stated that assessment practices will definitely change. She will not be using the typical test that they used in the past. The assessment will be less grading on her part as compared to what she did last year. The grading will be much faster than the way she did it last year. She will be walking around the class, watching them what they are doing and grading them based on that.

Kemuma

Kemuma's experience at the institute was very rewarding more so for her colleague Nyanchoka. It was the first time for Nyanchoka to leave the state of Georgia, first time to fly airplane, her first escalator ride, it was all emotional, Kemuma said. Kemuma thought that by traveling together and being together at the institute, the four of them developed a bond, which she thinks will help them collaborate more. In their first day at the institute, they got into different groups and were like sixth-graders who were actually being thought the mathematics. Each participant was assigned to a group that could change each day. The participants were from different states who they had never met before. They were given problems in the group, worked it out, and compared answers with other groups in the room and then discussed it and came up with what "we felt was the answer that we needed" (Kemuma, 1st_Interview08/05/05, line 66).

The experience at the institute was overwhelming. They basically covered one book per day that enabled them to cover all books in a week. They started their day at 8:00 am, worked until 5:00 pm with short breaks in between. She said, "The whole time we were doing things of the book" (Kemuma, 1st_Interview08/05/05, line 115), which was overwhelming.

The case for Kemuma was different and similar in many aspects to the other three cases discussed concerning their summer institute experience. She did gain a lot by attending the institute. In her words:

> I gained from it a better understanding of what CMP is and how it works. It gave me a different view of math, where you do not give them an answer. They give you the answer. They can have more than one answer and they can arrive at more than one conclusion. You can get it more than one way (Kemuma, 1st_Interview08/05/05, line 7-10).

She specifically noted that she learned how to use CMP materials. The instructors were very instrumental in this experience but also, they learned a lot from other participants, Kemuma said:

> I believe that getting to work with other people that we did not know allowed us to see that we can think more than one way. Allowed us to go outside the box and do something differently. Like I said they had done this before so they could give us a lot of ideas . (Kemuma, 1st_Interview08/05/05, line 96-99).

As indicated by Kemuma, some of the participants had used CMP before and were simply coming to update themselves about the new version of the materials that was coming out. They were very resourceful and willing to help, She said:

> I remember one girl from New York. She joined up. She said e-mail me if you have a question. She had been doing this for ten years. It was great … And here we went into it never doing this before where they have. So I think we got a lot of good ideas from them because they had done it before ((Kemuma, 1st_Interview08/05/05, line 79-84).)

Kemuma also noted that she also learned some pedagogical ideas at the institute. They had an impact on her way of teaching. She noted that what she learned was a bit different from what she is used to. Kamuma said:

> There were several things that they did that I may not have thought about doing it that way. I know with their decimals they changed them to fractions first and then let them see that everything could be part of 100. Well, as decimals I do teach as part of 100 but I relate the two at the same time.

Not only did Kemuma learn the pedagogical aspects but she also learned to use groups in her classroom. This was the first time she has learned to use groups for the last 8 years in the teaching profession. She did put them in groups of three, and they remained that way except in time of doing tests and activities that did not lend themselves to a group approach. She noted that a group of three was ideal for the kind of student and number of she had in her class. Kemuma noted that having students in groups could foster classroom management, in which she noted that: "Classroom management is a big change because we have desks in groups now. I've never done groups before. We have groups of three and, of course, have not straightened up since they have been in here" (Kemuma, 1st_Interview08/05/05, line 138-140). When asked why three, she said, "With my numbers that is the best way it was going to work out. That way I can put a number on here and I am going to have a deck of cards and let them pull it out and there is where they go sit down" (Kemuma, 1st_Interview08/05/05, line 142-144).

Kemuma felt that other 3 teachers learned a great deal from the institute. It was a great experience for all of them. More specifically, they learned how to use CMP materials. They also learned that mathematics is not a matter of paper and pencil — students can work in groups rather than individually to come up with the answer. Kemuma noted:

> The other three teachers — I would say they did the same things. We were able to see things in a different point of view from what we started out with. So a different side of it rather than just — I know that when I went into teaching before I would go straight into the book and I would pull things here and there when I could but this gives me more of a wide variety, I'm feeling, of options as a teacher (Kemuma, 1st_Interview08/05/05, line 12-16).

Kemuma felt that the experience at the institute will have a great impact on her teaching. There are a number of areas she felt will be impacted:

Planning: Planning according to Kemuma, was going to change. They learned a lot of reasons why they should plan together, share ideas, materials, and time of planning. They have not been planning together in the past; it is going to be the first time. As Kemuma said:

> The planning, I would say. It is going to definitely change. Because we will definitely be planning together where before I may do something and somebody else might do something else. That's teaching the same subject but we honestly never planned together. We would just talk in the hallway. Where here we are going to actually be sitting down, planning together (Kemuma, 1st_Interview08/05/05, line 135-137).

Classroom management: According to Kemuma, she thinks learning to have students in groups will definitely impact classroom management. She noted that having them in groups would enable her to access them much more easily rather than moving up and down the rows. She can attend one group at a time and move on to another rather than working at individual level. She also noted that groups greatly help in that students can learn from each other, which does not happen most of the time with row settings.

Teaching style: Teaching style, according to Kemuma, is going to be the most challenging issue to face. She is used to teaching by being the one to give the answers, which is expected to change. As she said:

> Uh Hum, this going to be hard for me. I like to teach them how to do it and then we work together on it. And then in the test they show me how they learned — if and how they are going to be learning it. I am going to be more standing back watching them learn and be there to answer their questions. They are going to be more of the facilitator than I am. So that is going to be something that will definitely be getting used to. It will be different (Kemuma, 1st_Interview08/05/05, line 166-171).

Kemuma realizes that this is going to be a challenge but she is up for the task. She noted that challenging one's teaching style calls for a concerted effort that she is willing to make. She said

how excited she is and can't wait to start teaching. That is what she has been wanting to do, but she needed a push to do it, which has a availed it self now, she noted.

Assessment Practice: Assessment practice will greatly change according to Kemuma. The CMP expectation is different from what they have been using. She noted that the assessment would not be paper and pencil alone, but rather a teacher trying as much as possible to understand what the answer means. It will not be simply right or wrong answer but rather going deeper and rewarding students accordingly. They will be using rubrics, which is something they have not done before. Kemuma said: "I've noticed that we will be using a lot of rubrics. I've never used rubrics before. Not in mathematics. So that will be definitely something that will change. I will be using that" (Kemuma, 1st_Interview08/05/05, line 181-182).

When asked her to explain what grading rubrics are; Kemuma said:

> It's like where they answer a question to a certain degree they get so many points but if they leave off part of the answer they get less points. Okay, it is like grading it from the standpoint of a paper. From a good paper to a not so well written paper. So you get so many points for including this in a sentence and including this part and if they have half off it right they get so many points rather than say okay this one is right "check" and this one is wrong "x" and counting that for a grade. They get points assigned to it. It is going to be different for me. Big time difference (Kemuma, 1st_Interview08/05/05, line 184-193).

Asked if she liked this kind of assessment, Kemuma said that she has not yet used it, so she will wait and see how it will work out in practice.

District Accountability System and the Georgia Performance Standards

Bochere (Mathematics Coach)

The district accountability system is part of the statewide initiative geared towards improving student performance. When Bochere was employed at Tabaka Middle School, she walked into the district initiative of accountability and the implementation of the Georgia

Performance Standards. These comprise the culture in which the mathematics coach operates while executing her duties. She has now been working under these district initiatives for two years. Asked to describe the district accountability system, Bochere said:

> In this district; we implement a pre-post test system here in Tabaka City schools that is recognized by the governor of our state as a model of what other schools should be doing. Other Counties also uses pre-post test every nine weeks the same as we do, and the difference, from what I understand it to be, is the way we use the information that we get. I know how we use it, and I know how my superintendent says that other systems, too, have implemented some kind of pre-post test are using it, and they say here that we use it to support instruction and celebrate excellence or achievements or something. Celebrate excellence. That is what we use it for. Not a gotcha. That's their key phrase here. Like I caught you doing something wrong or you are a bad teacher because your students didn't perform well. So the emphasis is placed on that. Now when I got here Tabaka Middle School, although that was the culture that was explained to me, that was not the culture that I walked into. People were very — math teachers felt not comfortable about the pre and post test thing (Bochere 2nd _Interview08/24/05, line 7-21).

Usually, the pre-tests are given at the beginning of nine weeks. The district used Thinkgate© software to analyze the scores. The software grades the test and breaks down the scores showing how students did on each Quality Core Curriculum (QCC)[2] item. The software makes the data analysis for scores easy to interpret and use. Bochere puts it:

> So when we get pre-test scores back, we don't just get the score — we get a breakdown of how students did on each QCC. And we can look at that by class period, by grade level, by individual student. Anything you would want to know. You can see how many students missed number 5 and you can see not only how many students missed it but what the wrong answers that they put were. So you can know if there is a misconception. And then teachers get those scores and use those scores to make instructional decisions. Like if 90% of your students already know how to find the greatest common factor then you wouldn't spend as much time, focus, on that idea in the classroom as you would on something like students adding fractions with non-common denominations, where only 20% got it right. So that is how we use that kind of data to inform our teaching. Then at the end of nine weeks the students are post-tested over the same QCC's, So, and then a comparison is done obviously. That is the point of it. And those comparisons, they make bar charts that compare by class period how each teacher's students did pre and post. What happens then to those graphs is they get posted on the front wall of our school, so every teacher, you know, little 8 x 10 sheets of paper has each of his or her class on them showing pretest score and post test score so you can see gain. This is the part that

[2] The QCC is currently being replaced with the GPS.

> teachers probably still aren't so comfortable with. Last year they really weren't, because I think there wasn't a lot of trust in how the scores were going to be used and who was going to make what assumption about teachers based on these little bar graphs. So I worked really hard last year to advocate for teachers (Bochere 2nd _Interview08/24/05, line 30-50).

One way that the mathematics coach has tried to advocate for teachers is to put forth the case that the kind of graphs that are used in the hallway to display teachers' performance do not really explain what goes on in the classroom. But she has basically encouraged teachers to focus on aspects of the system they can use to make their teaching better because nothing can be done to change the system; it is there to stay. Tabaka Middle School was recognized by the state when it implemented the system; therefore, it has great political influence. Bochere noted that it is important for teachers to realize the system is not going away and since the teachers accepted jobs in the school district, choosing to work at the school in which they knew the pre and post tests were used, there is no choice but to accept it and make the best of it.

Asked to state the advantages of the accountability system, Bochere noted:

> I think having a pre-test to build from; I think it is a really good idea. I think it does — I mean I looked at my geometry I this morning and because I am getting ready to teach about triangles, 100% of my students answered the question correctly on which is scalene, Isosceles, you know so I don't need to go over that. I don't need to spend time on that.. So that is just a way that we use those scores (Bochere 2nd _Interview08/24/05, line 70-75).

Bochere stressed that it is important for teachers to know that at the end of nine weeks they are held accountable for teaching the material to the students. She noted that she thinks there is nothing wrong with telling teachers that they will be held accountable; after all, they chose to work at the school:

> Here they are. Your students are going to be tested on them by the state at the end of the year. You've a responsibility to our students to get them ready for that. So that is a strength. It is making it very clear that we are accountable for teaching students (Bochere 2nd _Interview08/24/05, line 79-82).

On the other hand, Bochere noted that the system has many weaknesses. But she keeps on stressing the system is here to stay and teachers have no way of avoiding it as long as they are working in this school. Therefore, it is important that teachers try to utilize the system to improve their teaching.

> One huge weakness is that the test; I don't believe, accurately measuring what students know and don't know. Its saying seventh grade math 1st nine weeks there are 25 objectives. Well there are 25 questions. So one question for one objective? Hello? I mean, a kid could guess and get it right and we would think the kid knows how to — knows the material in that objective. Or they get it wrong and we assume they don't know it. So I think that is a pretty shallow way of getting at what students know and don't know. I think another weakness is that no matter how much they say, it is only about celebrating, it is not. When you post scores on the wall, our accountability system, and people are walking down the hall comparing teachers. And teachers who had 40% again get an e-mail from the Superintendent and teachers who had a 20% gain don't and that conveys a message that we are comparing. And I think people who teach students who have a lot of support at home and have some natural aptitude to begin with are going to see more gain than students who are struggling with poverty, with home life that is not necessarily supportive. And I think that 20% gain there may say more about the teacher than a 40% gain in another class. So I think none of those things show up in our pre-post test. It is a one-dimension look at a teacher's classroom (Bochere 2nd _Interview08/24/05, line 84-100).

Bochere noted she had shielded the teachers as much as she could from the politics when scores were posted. She tried to have conversations with them more about what the tests showed than about how students did on the tests. Bochere agreed she would feel the same if her students' scores were displayed in the hallway. She knew the system made teachers feel insecure, worried, and stressed out but all of them had to understand that the system was not going away. Therefore, it required that they find a way of getting the good out of it to make teaching better.

Asked to comment on the perceptions of the three teachers, Bochere noted she believed they were against the system:

> I think they know it is there, and it is not going away. They can't change it. I think they — I don't know, I hope they just say, well, I've got to do it so I might as well get something from it. I know that all three of them look at what their students, how they did on questions. I mean I know that they get there and they look and they say, oh, students

> do not know this one. I have to be the focus on that (Bochere 2nd _Interview08/24/05, line 124-129).

Bochere notes the irony of all this is that the teachers stop teaching three or four days before the post-test to get the students ready for the test. Teachers keep on guessing what might appear in the test and make students practice over and over again questions likely to appear in the test. As a result of this, valuable instruction time is lost.

Concerning whether the accountability system will have an impact on teachers when implementing CMP or GPS, Bochere noted it was going to have a great impact on teachers for the GPS in terms of tending to teach to the test, but the state so far has not supplied any test samples. As Bochere put it:

> the big issue is that the state hasn't decided what the end of the year test is going to look like. We do not have any sample questions. We don't know what that is going to look like. They haven't told us yet. They just say it won't be criterion reference. It will be performance based. We don't really know how we are going to do that in multiple choice questions. But the test will be multiple choice, and we will get back to you later on that. So we are, we are stuck. Maybe it is a good thing. We can't possibly teach to a test because we have no idea what the test is going to look like. I did the best I could when I made our pretest for this nine weeks to try to find questions that were more conceptual that seemed more task oriented or performance oriented but yet were multiple choice (Bochere 2nd _Interview08/24/05, line 153-164).

On the other hand, Bochere has realized teachers are getting worried about how the post test will look. She noted some sixth-grade teachers are feeling it is taking too long to cover something that could have been covered in one week. It takes them 3 weeks and therefore time is wasted. Bochere realizes that one of the teachers is focused on the 25 objectives to be covered in 45 days and feels that at the pace they were going, it was not going to be possible to cover all in 45 days. That really surprised Bochere, more so after doing rich CMP explorations. Bochere said to the teacher "the standards that you have given and the pretest you have given and you will see what we are covering now, we are more than half way through the material we are supposed to cover"

(Bochere 2nd _Interview08/24/05, line 177-179). Bochere noted that this teacher's students did very well on CRCT, "well you can see that a test to him is a good CRCT score. And I haven't heard that from the other three teachers. Not once in our meetings has that come up" (Bochere 2nd _Interview08/24/05, line 183-185). She said she has not experienced the same from the other three teachers who were participating in my study. This was an example of a test-oriented, drill oriented teacher that Bochere brought into my attention.

> The other three teaches — they talk about how much fun it is and how the students get it and they see it, and is so great; they do not talk about the test at the end. You know, I don't know if it's fake. It may be a combination of ...now it is in my hands and I'll do the best I can and they do not need to worry about it or they do not care, because the students are having so much fun (Bochere 2nd _Interview08/24/05, line 203-208).

Bochere does not know how the accountability system is going to affect the implementation process since the three teachers she is working with have not expressed concerns about the nature of the post-test so far. "But I understand they are worried about the list of standards that were handed out and told to teach all these and I am going to come in here and test you at the end to make sure you did" (Bochere 2nd _Interview08/24/05, line 216-218).

Asked specifically to identify how the accountability system has impacted the three teachers, Bochere commented that:

> I think it impacts me significantly. I am the one that has to figure out how to take three things and merge them together. Our pre-post test system, Georgia Performance Standard and the Connected Math. It's a significant part of my job. … It is to, one, show that Connected Math does in fact complement the Georgia Performance Standards. So if we go through Connected Math — and I just got our school system to spend $25,000 on it — and the end of the year our students bomb. Whatever it is the state decides to give them. Hello? Bochere, we trusted you on that decision you said it was going to work… So I look often at the Georgia Performance Standards and I look often at that list. Are we doing what they want us to do? But they are very vague. So I just looked at that list and say. We are talking about these things. You know our students are investigating these things. I think we are lining up really well. You know that there is a unit volume and surface area that we do in sixth grade that we don't have a book for in CMP books. So there's that. I am responsible for making sure that the curriculum that we use supports the Georgia Performance Standards that are mandated by the state. Then I have a

> responsibility to our school system to offer pre and post test that line up with our curriculum. That line up with the standards. (Bochere 2nd _Interview08/24/05, line 225-243).

Bochere said she is not sure how the accountability system will impact teachers, but they still have pre and post test like they had last year. Nothing has changed. She noted it is unlikely that the accountability may drive instruction because they have no idea what the state will throw at them and they have no idea how the end of year test will look. The State is not trying to hide that from teachers, but she believes the State has yet to figure out how the end year test will be. Therefore, the issue of teachers teaching towards the test may not arise since they do not know what the test will be. When specifically asked to say how the three teachers have been impacted by the three influences (CMP, GPS and Accountability system) in terms of resorting to teaching in ways that makes them more comfortable, Bochere had this to say:

> B. Sure, but I'm not sure that is because of assessment as it is. If you are not sure that you are doing a good job teaching something in a different way, then you are going to go back to a way that you felt like worked.
> R. Yeah.
> B. If you get uncomfortable or you get confused about the mathematics then you will match or jump back to what you have been doing.
> R. Do you foresee that happening?
> B. I'm sure that that has happened.
> R. Is that due to the accountability system or
> B. No.
> R. Okay?
> B. I think the accountability system if it does anything, it discourages that. I tried to write the pre-test in such a way that it doesn't say pick which number is prime. That it doesn't say find the greatest common factor. That students have to have an understanding of it and be able to apply it to a task. If our assessment is that way, then that encourages us to be teaching that way. So assessment can be a really positive thing to have. We're just worried, we are all worried what we are doing will not match what is going to happen at the end of the year. There is nothing we can do about it because we don't know what the state is going to give us.
> R. Okay. Okay.
> B. So all we can do is the best we can do (Bochere 2nd _Interview08/24/05, line 257-277).

Explaining what role the GPS has played in planning, classroom management, teaching style, assessment practices, and teacher collaboration, she noted that the only role GPS has played is in the selection of Connected Mathematics Project materials (CMP). "…from then forward all of that is driven by the fact that we are doing Connected Math" (Bochere 2nd _Interview08/24/05, line 286-287). That is so because the CMP is considered to be a middle school mathematics curriculum consistent with the GPS. Therefore, the interpretation of GPS along with the teachers' input led to the adoption of Connected Math. She also noted that GPS drives, to some extent, the order in which to put the Connected Math books:

> So a couple of things that they said at the workshop; like you should do the data of — data around us; whichever one that is first. We decided not to do that because we had already set up our nine weeks and we felt like we had said with all that we have to teach, here is the plan. We picked that before we picked Connected Math. We paced all the standards and figured out what we wanted to teach. When and what went well together and then we took our Connected Math books and matched them up to that (Bochere 2nd _Interview08/24/05, line 298-304).

Other than how she states the role of the GPS, Bochere's understanding and interpretation of the GPS was as a way of teaching mathematics more conceptually.

> Idealistically, I believe that GPS and Math for sixth grade truly is an attempt, and the best one I have seen as long as I have been to teaching, to teach math more conceptually. I believe that the standards are written in such a way that you can. That they have taken content — enough of it out that you can spend time really talking about concepts. And I think this past 4 weeks have shown that. I don't think you have to, I think there is nothing about the curriculum, just looking at it, just looking at Georgia Performance Standards that you can't teach procedurally. Because they are worded in such a way that, I think you could take them either way. When you read them, somebody who comes from a really conceptual approach to teaching math will say, oh, like me, Oh that is so great! That is so wonderful! I am so glad the state is finally not just saying this but actually holding us accountable for doing that. But somebody else can read the same thing; and I have heard it, and say; this isn't any different from what we have been doing. This is just all the QCC's written in a different format. (Bochere 2nd _Interview08/24/05, line 306-318).

Bochere notes she does not understand why people interpret the standards that way. She believes the new standards can be what drives a huge change in what goes on in classrooms. She noted that people who attend their workshops are excited about the mathematics. Not only are those people excited, but also institutions such as Pioneer RESA are doing something to help teachers.

> Our Pioneer RESA is starting a whole partnership around these standards. So math teachers — sixth grade mathematics teachers and seventh for next year — will have all of these opportunities to get together, sponsored by Pioneer RESA to talk about what we are doing. We finally have time, our curricula — to put some of these things in, to take time to have conversations with other teachers and the students. You see, I think, I think they can be the most wonderful thing. I think they encourage other people to choose Connected Math. That's huge. And I am hoping we do (Bochere 2nd _Interview08/24/05, line 334-340).

According to Bochere, not only institutions are striving for change but also individual people are really working with teachers to help out. People are using this as an opportunity to really foster some change and she thinks that teachers should take advantage of the situation.

The interpretation of GPS, as noted by Bochere (mathematics coach), led to selection of CMP materials. One role that the mathematics coach is to play in the implementation process is to run in-school professional development.

> My interpretation of GPS, along with the teachers, led to our adoption of Connected Math. As I was saying, my interpretation of GPS affected my decision to adopt Connected Math along with other teachers. And it is really what we are doing in Connected Math that drives what we do in the afternoon in our times of professional development. I know that the state says that they are going to do more performance-based tasks, and certainly the Georgia Performance Standards are written that way, and the tasks that they show us, samples, you know, to support each of the new standards are very performance-based which means we really do need students to be able to read and to write responses to questions (Bochere 2nd _Interview08/24/05, line 361-369).

One of the issues they are dealing with in their in-school professional development is the ability of students to read and write mathematically. The school has a high immigrant population of

Hispanic students, and the way CMP material are written, reading and writing can be a challenge.

> … the big issues that we are doing right now is students ' ability to — that reading level is pretty high from the Connected Math, and we knew it. We knew it even with Georgia Performance Standards that that would be an issue. So we have been talking about our ways to address this whole issue: how do you get students to learn to write about Mathematics? So I guess that comes out of both CMP and our standards. We know that that part of CMP is important to what we are doing in terms of supporting our new standards (Bochere 2nd _Interview08/24/05, line 371-377).

Concerning what goes on in the professional development meetings that Bochere runs, she states they are basically teacher driven. She does not plan ahead of time in terms of what kinds of conversation to have in these meetings. Teachers use these meetings to discuss issues that have come up in their own classrooms and then get feedback from the other teachers. Bochere also uses these meetings to get feedback on her teaching. As Bochere put it: "I have issues that I have come up with in my own teaching that I want to discuss and get feedback on. I don't look at GPS and say, Oh, we need to do this in our meetings together" (Bochere 2nd_Interview08/24/05, line 381-383). Bochere made it clear this does not mean her interpretation of GPS does not have any role in terms what she decides and the rest of the group members decide to do in these professional development meetings.

> ...whole decision to select Connected Math; the whole reason that we did that is because it supports GPS. We would never have chosen it — we wouldn't be doing this if it was not such a good fit. So I guess it is that GPS affected our choice to do Connected Math. Connected Math supports GPS and so Connected Math is what we are doing on a daily basis. So when we meet, we are talking more about how to implement Connected Math than we are about interpretation of specific standards (Bochere 2nd _Interview08/24/05, line 388-393).

That means the standards have played a great role, at least indirectly. Bochere frequently refers to the standards whenever she makes instructional decisions. She uses the standards to come up with test items when constructing pre and post tests.

> Now when I wrote the pre imposed test, I could look carefully at the standards. So I guess in this way, I think all the time about what is on the pre and post test because I wrote them. So when we are having conversations, and the teachers say, well, students are having a hard time doing this and I say or don't say that is what we are going to post on. And I have seen sample tasks in GPS and I don't — and that conversation doesn't turn into, well that is something that we don't really need to worry about it at this point. Because I know that is something we need to focus on directly (Bochere 2nd _Interview08/24/05, line 395-400).

It was GPS, which led to CMP, which really spurred the conversations about what is really cool or what they are being frustrated about that shaped the kinds of conversation during the in-school professional development run by Bochere.

Nyanchoka

Nyanchoka had issues that were similar and different from those of the mathematics coach as far as the district accountability system and the Georgia performance standards were concerned. When Nyanchoka was asked to describe the accountability system, she was reluctant doing it. But she did assess the system by giving the strong and weak points of it. One thing that she identified as a strong point in the accountability system is that it gives teachers a chance for self-evaluation. As Nyanchoka puts it, "I guess the strength in that would be if there were negative comments made, then I, as an educator, would try to find ways to improve on it" (Nyanchoka 2nd _Interview08/24/05, line 34-36).

Nyanchoka sees the issue of pre and post test advocated by the accountability system as a good thing. She believes that will definitely help " ...to improve on my teaching that I can help my students be better students, I guess that is the strength (Nyanchoka 2nd _Interview08/24/05, line 39-40). Nyanchoka hopes the accountability system will indirectly cause the test scores of her students to go up and that is what the system is there for. Nyanchoka said:

> I'm hoping test scores will improve. I am hoping to see test scores skyrocket is what I am hoping to see. I know I feel sure that is what the system wants to see; is that test scores will go up…that they will not go down, I think that they are going to hold us

> accountable for that — this program will boost test scores. (Nyanchoka 2nd _Interview08/24/05, line 58-63)

But on the other hand, she strongly voiced her opposition towards the accountability system by noting that she does not want to be put under a microscope. She hates being judged, being put on a camera, and she simply does not like being judged in this way. Although there are both positives and negatives of the accountability system, Nyanchoka strongly believes it is a good thing sees the system having more positives than negatives.

> … the feedback for the program has been very positive. A lot of parents are very excited about what the students are doing. A lot of students are excited about what they are doing. And we as teachers are excited about what we are doing. So I think as far as the system goes, it is very positive about giving us the support and giving us what we need to make this program be a success (Nyanchoka 2nd _Interview08/24/05, line 69-73).

She continued voicing her support of the program by saying that sometimes being put under a microscope is a good thing. By so doing, she believes bad teachers will be weeded out. According to her, bad teachers pose a big challenge not only when new reforms are initiated, but also setting a bad example for the incoming teachers. Hopefully, the best teachers, who actually love teaching, will remain and therefore be a great plus in the implementation process of CMP materials. As Nyanchoka puts it, "...and so you're going to have teachers in the program that love teaching what they are teaching and are going to love the program. Because I think the more you enjoy something the better you are at it" (Nyanchoka 2nd _Interview08/24/05, line 83-85). Again on the point of negative issues related to accountability system, she clearly stated that when she accepted a job to work at Tabaka Middle School, she knew what she was getting into. As she puts it: "You have a job to do, you are told what that job is so you accept the responsibility of that job and you do it to the very best of your ability and I think that is what we have been told here" (Nyanchoka 2nd _Interview08/24/05, line 99-101).

When asked to comment about the role GPS will play in planning, classroom management, teaching style, assessment practices, teacher collaboration, Nyanchoka discussed each in turn.

Planning: Nyanchoka noted the sixth-grade teachers and the mathematics coach meet every week to plan together for the things they want to do. This means the three teachers are doing exactly the same thing so that no one is ahead of the others. They communicate daily and share ideas of what worked and what did not work. According to her, that is how the GPS has played out in her planning.

Classroom management: She strongly feels that GPS has no role at all as far as her classroom management is concerned. She noted that classroom management is not an issue in her classroom " because I'm a strong disciplinarian" (Nyanchoka 2nd _Interview08/24/05, line 128). Nyanchoka on the other hand point out that:

> N…the problem I can see with this program is doing the group type things, is the students want to socialize more so than they want to work with each other and do as asked of them to do. They want to socialize.
> R. So what do you mean by that?
> N. They want to talk and share their personal information.
> R. Okay.
> N. More so than they want to share mathematical stuff.
> R. Is this because they are put in groups?
> N. Yeah. I think it is because they are put in groups.
> R. So you think it would happen better if they were working individually?
> N. No I think they need the group activity because they are learning from each other but we as educators are going to find a way to put them in groups and keep them so busy in the program that they don't have time to talk about their birthday parties or whatever (Nyanchoka 2nd _Interview08/24/05, line 112-124).

Teaching style: According to Nyanchoka, her teaching style has changed a lot because she is used to giving the student the information and not students giving it to her instead. She cites this as her greatest challenge but she will try to pull away from giving students the information and let them give to her instead. Asked if she feels it is a good idea to do that; Nyanchoka said that:

> I think it is a good thing because they should be allowed to express themselves more so we will know what they are thinking and how they are thinking, instead of just constantly testing all the time. So I think they should have the right to share the information. And some of the students have some really great ideas. I mean they are exceptionally bright children and some of the things they come up with you think, well, where did that come from? So they are amazing students (Nyanchoka 2nd _Interview08/24/05, line 136-141).

In the first interview, Nyanchoka was really concerned about the issue of her role as a source of knowledge being taken away. But in the second interview, Nyanchoka hand changed her opinion.

> I have changed that opinion, because I do see my role in it. It is just that I am not up at the board performing, but I am teaching and that is the difference. Before I was the performer, I am not that way now. I am still teaching I have to pull away from performing so much (Nyanchoka 2nd _Interview08/24/05, line 145-148).

*Assessmen*t: Her assessment has changed; it is no longer paper and pencil only. She assesses her students while they are working together as a group and therefore they need to get a long and be team players. She noted that,

> ..they are going to have to come up front and perform for me, so they are going to be accessed by their performance as to how they can take an assignment and teaching to the class. They are going to have to do stuff like that. So the assessment is definitely different (Nyanchoka 2nd _Interview08/24/05, line 152-156).

Teacher collaboration: Nyanchoka noted that, the Sixth-grade teachers do meet and talk daily about how to handle the CMP books. They are sharing ideas of what worked and what did not work in their classroom. So according to Nyanchoka, teachers are collaborating on daily basis.

Finally, when Nyanchoka was asked about her understanding of the GPS and how she interprets them, she had the following to say:

> I don't know my understanding other than the state has taken the 50 some objectives that we have to teach these students and combine them into maybe eight smaller objectives. So that we are teaching less objectives but they are applying more math (Nyanchoka 2nd _Interview08/24/05, line 162-164).

Moraa

Moraa was highly regarded by the other sixth-grade teachers and was in-charge of writing the lesson plan that the other three teachers used in their classrooms. Among the three teachers, she was singled out as the one who has used, and likes using, manipulative in her classroom. For Moraa, the district accountability system consist of:

> …the pretest and the post test. And it is posted in the school and on the web sites so parents can go up and look how their children are doing, they can look per teacher too so they can kind of get a feel for things (Moraa 2nd_Interview08/24/05, line 7-9).

The pretest is administered at the beginning of the nine weeks and followed by the post-tests. As noted by Moraa, the results are posited on the hallway for everybody to see. According to Moraa, the accountability system has issues that need some attention. The act of displaying the results both on the hallway and the Internet is not a bad idea for parents, teachers and students to see as long as it is not used a way of changing and comparing performances among teachers. As Moraa puts it, "It is good for the parents to know, it is good for the teachers to know, as long as they are not evaluating the teacher" (Moraa 2nd_Interview08/24/05, line 9-11).

Evaluating teachers has been seen as one of the major weaknesses of the accountability system. Demographically, Tabaka Middle School consists of the following: 21% White, 3% Asian, 49% Hispanic, 2% Multi-racial, and 25% African-American students. Most of the Hispanic students are migrants to the United States, which means English is their second language. This is the point that Moraa emphasized the accountability system does not take into account; that is, the demographic background of the students. Some students have limited access to English as a language, which definitely affects their test scores. When the accountability system was initiated, such issues were not considered. Moraa noted that:

> You have to look at the makeup of the students. I mean if you have a whole bunch of one class, second language learners, of course their test is going to be lower than the students who lived here and grew up here their whole life and speak English. You know, there is going to be a lot of big difference, but it does not show that on the test. As far as the records show when your parents are looking up the reports, they don't see that (Moraa 2nd_Interview08/24/05, line 11-13).

For that matter, Moraa gave an example of a class with 90% Hispanics who happen to be second language learners — there is a great chance their scores will be lower than other students for whom English is their first language. In such instances, Moraa observed that, parents will not see that there were 90% Hispanics in that class but rather "see the different teachers" (Moraa 2nd_Interview08/24/05, line 19-20). She asserted that most of her classes have fewer Hispanics and always her scores are higher, but that does not mean she is a better teacher but rather is a reflection of the kind of students she has. So those are some of the issues that the accountability does not take into account. Moraa stressed that that does not mean that Hispanics are non-performers but rather the issue of language is the factor that contribute towards their performance on the tests even though they were taught the same way.

On the other hand, Moraa observed that the act of posting scores in the hallway and Internet could affect the self-esteem of those with lower student test scores. This can lead to low motivation and even poorer grades. As Moraa puts it, "if I look out there and see somebody's score, and my test scores are a lot lower them, my self-esteem will go down as a teacher. But I don't mind people seeing my scores at all (Moraa 2nd_Interview08/24/05, line 48-50). Poor test scores according to Moraa may affect the way teachers are teaching. This can be a good or bad thing in that if teachers are trying new innovative ways and get poor results, the teacher may resort to the old ways that worked. On the other hand, according to Moraa, teachers may try to use more innovative ways to improve their teaching. Also, teachers with poor scores may want to seek advice from those teachers with high students scores, hence fostering teacher collaboration.

Concerning the role of the backgrounds of students in determining class performance, Moraa gave an example of what happened in the previous year:

> …like for instance last year we had a decimal, percent, and fraction quiz, we had to give last year. Our goal was to have all the students up to 90% by the end of the year. All of my classes were but my lowest. The highest they ever got was 70% which according to that class — that class was low compared to the other ones. But they didn't realize nobody could see that they started out at 4% and went to 70%, nobody could see that. All they could see is 70; oh they didn't meet their goal, they only went to 70, but from 4 to 70% was a big jump, nobody could see that (Moraa 2nd_Interview08/24/05, line 76-82).

To her, it is very discouraging because that increase from 4% to 70% may mean more that an increase from 70% to 90%.

Asked if she thought the accountability system would have an impact on teachers' implementing CMP and GPS, Moraa noted that it was still too early to know. It may take more than a year to assess the impact, if any. She also noted that it could have been easily assessed if there were two classes, one with the accountability system and the other without. Then comparisons could easily be made to assess the impact. On the other hand, Moraa observed, "I don't think it would too much because this is brand new, we do not know what we are doing yet (Moraa 2nd_Interview08/24/05, line 93-94). Concerning the impact of accountability system on CMP materials, Moraa observed that:

> I think the post-tests are going to be a lot higher with this material than it would be without it. Only because it goes so in depth in with taking a whole bunch of things and culminating them together into one and they are getting it, and with all the manipulative that we are going to be using, they are just getting it. You know that I don't know how else to say it, but they are getting it and the light bulbs are coming on. I think this is going to make the post-test be a lot bigger than if we were not using it (Moraa 2nd_Interview08/24/05, line 96-101).

That means the accountability system will not affect the implementation process but by virtue of using CMP materials, Moraa asserted the pre-test and post-test scores will go up. Concerning other teachers, Moraa noted she does not know what the other two teachers think about the

impact of the accountability system, since they never discuss it. Basically, their discussion has only centered on the CMP curriculum.

Moraa was also asked to respond to how she thinks GPS will affect daily planning, classroom management, teaching style and assessment practice. To respond to that, she noted the following:

Planning: Moraa noted that the CMP materials have greatly helped in planning because the GPS and CMP are a good fit. The CMP is judged to be a middle school mathematics curriculum consistent with the GPS. Therefore, " ...we don't have to do a lot of planning for the GPS because it is already here. We have already looked into it and checked it and it is already here. It is already there" (Moraa 2nd_Interview08/24/05, line 127-128).

Classroom management: She noted that classroom management has been enhanced with the use of CMP materials and having students in groups has greatly helped with classroom management. The students are being engaged and doing what they are supposed to do.

Teaching style: Concerning teaching style, Moraa had the following to say:

> M. The teaching style is totally different. With this following the GPS, the teaching style is more hands off and that is harder than you think. I want to tell the students some of the answers but I am holding myself back making them find the answers, which is wonderful to do, but it is harder than it sounds.
> R. Uh Huh.
> M. It is a lot easier said than done.
> R. Can you say more about that?
> M. Well, like, I'm finding myself questioning more instead of saying more as far as lecturing or telling them this formula is this, this, this.
> R. Uh Huh.
> M. Letting them figure it out themselves. Like today in one of my classes we talked about — we started talking about square numbers. And I asked them do you know why a square number is a square number?
> R. Uh Huh.
> M. And they said no so I did 3 here to 3 there. Oh if you fill them in it makes a square! That's why. So I had to stop myself from just showing it to them and they started coming up with it themselves (Moraa 2nd_Interview08/24/05, line 133-149).

According to Moraa, her teaching style has definitely changed. The GPS through the use of CMP materials have had a big impact on her teaching style.

Assessment: The assessment definitely has changed, Moraa noted. They are doing things that are new as a result of using CMP materials that are a good fit for GPS. They are using students' notebook quizes. Students' notebooks consist of the following sections:

- 12" X 14" zippered, nylon covered 3-ring binder (The Mead 5-star, lst Gear Zipper binder is recommended) Nylon zippered, 3-hole pencil pouch for binder. This is were students keep their pencils, erasers, scissors, compass, protractor, etc.
- Student textbook, for instance, prime time. CMP publishes student textbooks with three holes that can easily be fitted into the student notebook.
- Papers: This section is filled with notebook papers so students can easily find it.
- Investigation and ACE section: This section consists of Investigation (labsheets), Applications-Connections-Extensions (ACE) problems and Homework section.
- Reflection /Journal section: This is the section were students keep their reflections and journals.
- Notes: This section is where students write anything written on the board.
- Glossary: In this section, students write the vocabulary words with definitions and examples.
- Assessment: This is where students keep their tests and quizzes.

As Moraa puts it:

> Yes, assessments have changed. Instead of taking up the notebooks and grading them like I did last year, Huh, it was a lot of work. One of the things that one of the presenters at the summer institute told us we could try is via notebook quiz. Their notebooks are supposed to be sectioned and it is supposed to be organized. Ask them what to write down like, give me an example of a prime number, copy down the definition of composite number. Just different stuff like that, so they could go back in the notebook, find the answer, write it down

> real fast and the test be timed. Because if it is not timed they'll have all day long to sit there and go through their notebook and find what they need. So as far as a notebook quizzes and tests, they are going to be different, so that assessment is different. On the assessment, like a regular test and, of course, all the objectives are there from GPS because it is already in here. Our assessments, a lot of them are why, explain, not just ABCD, which one is the right answer. You are asking the students why and if they can tell you why and explain the reasoning, they've got it (Moraa 2nd_Interview08/24/05, line 153-155).

Teacher collaboration: Moraa noted that the teachers do talk more about what they are doing and how far the students got. They also take time to compare their students to judge who needs more attention, who needs to go a little deeper into what they are doing and who will not. She noted that the other two teachers are wonderful people to work with and they all love it.

Finally, Moraa was asked about her understanding of the GPS, and how she interprets that. She said GPS would have fewer objectives than what is contained in the QCC, which according to her observation, it seems not the case. Moraa noted that in May 3, 2005 the three teachers and their mathematics coach met to unpack the Georgia Performance Standards. They learned about unpacking the standards and elements, writing essential questions, new terminology and the importance of vocabulary, performance assessments and rubrics, and the components of a standards-based mathematics unit**.**

According to Moraa:

> Originally, I was told that they were going to take all of the objectives from the Quality Core Curriculum and they were going to have less to teach per year. But that is not so. It is still about the same amount but we have just put them together in different — instead of doing one objective at a time, we are doing like 5 or 6 at a time, It is easier. They are woven together. They are accommodated together into one thing; so like with the factor game we talked about factors, we talked about multiples, we talked about products, we talked about multiplying, dividing, adding, subtracting so all of that into one little game. Instead of having today on multiplying, one day on factoring; that is boring. So it is all come together, and so instead of doing one at a time we are doing a bunch at one time. So I think the people who write this stuff are wonderful (Moraa 2nd_Interview08/24/05, line 178-187).

Since the CMP materials are believed to be a best fit for GPS, Moraa noted that the activities are nicely connected and more than one objective is covered in one lesson. But again, she did make some recommendations about ways to improve them:

> M. The things; I love these books, but the only thing that I would change if I could do it, like in this; we play two games. We play the factor game and we play the product game. In the back you have the applications, the connections and the extensions. Like the 1st half of the application is for the factor game. The second half is for the product game. The connection the 1st half is for the factor game, the second half product. The extensions, the same way, 1st half factor, second half product. We were giving the students their assignments, we were skipping around. So far the factor we could do like the first half of this, first half of this first half of this and they are getting confused, because we're skipping around the numbers.
> R. So you feel like. How could you do it?
> M. Anything related to the factor game should be with a factor.
> R. Ok.
> M. And then the product game and then you can come back at the end and talk about both of them.
> R. So first of all you feel like you need to finalize everything? Like in the product game you completely exhaust everything, and then you go through the factor game and you completely exhaust everything.
> M. Yeah
> R. At the end of it you bring it all together.
> M. Yes. Yes. Because you are jumping back and forth, these sixth graders, they are still babies and they are still having a hard time opening their lockers. They are still struggling sometimes to find their classrooms. So if you give them, okay we are doing 1-8 here, then the next day we are going to come over here to do 28-32 and then 39-44, wait a minute, what happened to all of this other stuff? That is what they are doing. Like application connection and extension, if they would have those just for the factor game and then just for the product game and then you have some more at the end where they bring them both together. In the teacher's guide, the teacher's guide does not show you anything what is in the student's book, nothing, so you would have to make sure you have a student book with you to look at what you are doing. So nowhere in here does it show what they are doing. It is a bunch of — I mean, I like the teacher's guide but you have two book sitting in front of you going back and forth and that kind of sometimes gets to be a nuisance.
> R. I see. I see. I see. Okay.
> M. That is the only complaint I have about it. But I love what we are doing. I really do (Moraa 2nd_Interview08/24/05, line 195-226).

Kemuma

Kemuma is the longest serving teacher at Tabaka Middle School. She has been at the school for the last 8 years. During that time, she has witnessed a number of changes in both the school and the school district. She has witnessed the implementation of accountability systems and also school changing from a tracking system to a program of choice. Kemuma has lived with all this changes and when asked to describe the accountability system, she noted:

> We have a pretest and a post test and we give the pretest on the objectives that we will be covering for the nine weeks, before they are taught at the beginning to see what the students know and then at end of the nine weeks they are give a very similar test over the same objectives to see how far they have grown (Kemuma 2nd_Interview08/24/05, line 3-5).

Kemuma noted that when the results of the pre-test and post-test are out, the administration posts them in the hallway with the name of the teacher under them, posts them on the Internet and also has them at the school district education board meetings. Kemuma noted her scores have always gone up but she has seen scores of others teachers go up and others go down, " I'm not saying it's their fault it is going down, but it is perceived as their fault when it is put out in the public" (Kemuma 2nd_Interview08/24/05, line 18-19). According to her, the results of pre and post tests have positives and negative implications. The main weaknesses according to her are in a case when test scores of a teacher go down. In such a situation, it might be perceived that it is basically the fault of the teacher, which might not be the case. There are a number of factors that are always overlooked. As Kemuma puts it:

> And you know they are thinking that is a bad teacher, and that may not be a bad teacher at all, it may be the students. It does not tell what level the student is on. It does not tell if they can't read or speak English. I personally don't like them being posted everywhere with your name on them (Kemuma 2nd_Interview08/24/05, line 22-24).

The issue of language at Tabaka Middle School is of great concern. Half students in the school are children of immigrants are Hispanic. The issue has been complicated with the

implementation of CMP materials. CMP materials are written in such a way that students are exposed to more word problems, which is a great challenge to second language learners. So, according to Kemuma, such issues are never taken into consideration when posting the result of the pre and post tests.

According to Kemuma, the administration made it clear that the test scores have nothing to do with their jobs, and, therefore, they should not worry about it. But there are instances in the school that suggest otherwise. As Kemuma put it:

> And they tell us that your scores have nothing to do with your job or anything. However, I know of two teachers personally who have called and asked why their scores did not go up. But they say it has nothing to do with the scores, do not worry about this, do not worry about that, but they have called them in and said what's going on here? Are you not teaching them? Why are they not learning this? Like I said, the administrator is not in the classroom. They don't know what kind of class they have, they don't know if the students can't behave. You know they do not know anything about it but they just put all of this into one big nutshell and say; then you must not be doing your job (Kemuma 2nd_Interview08/24/05, line 26-33).

According to Kemuma, one issue of great concern about the accountability system is that it is not put in place as a way to inform parents about how children are doing in school but rather a show me thing. This is because a good number of parents, who happen to be Mexican do not know how to read, never come to school to see their children, and maybe have no access to the Internet. And she said:

> Honestly the program that I am in, we mostly have Hispanic children. We have the whole time the program is started. And the Hispanic parents very rarely come in. Because they have to work and they work 12-hour shifts. And if they have to get off they are only allowed so much time off and any other time they will get fired and they can't afford to loose their job so very rarely, I can't think maybe one time in eight years. And maybe one time that a parent has come in to check on their child rather than us having to call the parent to come in. So they don't just come in and see this stuff posted, they don't understand it, they don't know. No one has explained it to them. So personally as far as that goes with my group of parents I don't think it has any impact on them at all (Kemuma 2nd_Interview08/24/05, line 35-43).

Therefore the accountability system has not served parents well according to her, other than being used as a show me thing or a show-off thing, for that matter. As Kemuma put is: “Look at this teacher, look at those other teachers. Go ask this teacher what they are doing and you know.” (Kemuma 2nd_Interview08/24/05, line 45-46). Basically, according to her, the accountability system is at Tabaka Middle School is mainly not geared towards parents' consumption.

As noted by Kemuma, the public display of children’s tests scores with the teachers' name' is the main weakness of the accountability system. In that display, no information is given to the public to educate them about the context of respective classes. Information concerning the kinds of students these teachers have is concealed from the public. Some classes have a co-teacher, whereas others do not, and such information is not revealed. The number of students in the respective classes is not revealed in that display, “like last year I had like I had like 30 students whereas other teachers will have like 15. You know there is a big difference going from 15 to 30 and the perception of it on the wall will be; this is a good teacher, this is a bad teacher” (Kemuma 2nd_Interview08/24/05, line 57-60). On the other hand, Kemuma said, “also the students may not test well they may have test anxiety — also it is multiple choice and they can guess. Nothing else, they have 25% of getting it right. That is a weakness to me. Just guess and get it right” (Kemuma 2nd_Interview08/24/05, line 60-62). These are some of the issues that Kemuma thinks that the accountability system fails to educate the public about.

On the other hand, she said there are some strengths of the accountability system. She has found the accountability system helpful in that it helps teachers with their instructional planning. Teachers can use pre-tests to know which areas students are weak in and which ones they can ignore. Kemuma observed that:

> I do like seeing wide objectives that are going to be taught exposing them with the pretest. Then we can spend more time on the ones that they don't know. They know something — if 98% of them get something right, we do not have to spend a lot of time on it. We can just touch on it and go onto what they are really having trouble with. I do like that (Kemuma 2nd_Interview08/24/05, line 64-68).

Another area in which Kemuma finds the accountability helpful is concerning programs that exist in the school — the low performing perceived program is doing better and therefore conveying the message to the rest of the students that all students can achieve academically, no matter which program they are in. After the school did away with tracking four years ago, the school introduced three program of choice: Classical studies, Earthquest and Humanities. Students join these programs voluntarily but expectations of the three programs are presumed to vary. As Kemuma puts it:

> I do like and this is a little contradictory to what I was saying before. They have put them up by programs and we have three programs of choices of classes: Earthquest, Classical, and Humanities. And I am in Earthquest and our students from day one when they have graded these programs — the Earthquest program is seen as the dumb program. For all the dumb students, that is the students ' perception of it when they get here, but what I'd love to do is, this sounds bad, but I would like to show them Earthquest scores compared to classical compared to humanities. Because we have always come out on top, so that gives them ego boost (Kemuma 2nd_Interview08/24/05, line 68-75).

It is perceived that Classical is the top group, the group that everybody wants to be in. From what Kemuma has been told about what happens in elementary school is that students are told if they want to go to college, they need to be in Classical. On the other hand, they are told that if they do not want to go to college, then Earthquest is best for them. They will not be pushed hard to the standards of the Classical program. But according to Kemuma, she does not lower the standards for them; the expectation is the same across the spectrum regardless of the program they are in. Kemuma summarized the strength of the accountability system by noting that:

> Like I said, I like to let them see that, you know, that they make it into a competitive thing and they see the Earthquest gets higher scores than another program and that makes them feel real good. And you the whole time say to them; see I have been telling you. But then

> again, that is sort of putting a weakness as far as competitiveness against groups; Earth Quest, Classical, and Humanities and that is not what they are for. I also like to see how much each class has grown. You know, like one class if they start out in at 20 and by the time they get through they are at eighty-five. So the pre and post test has gone up that much. Which is you know a big strength. Because like I said it makes them feel good that they know (Kemuma 2nd_Interview08/24/05, line 102-110).

Given the strength and weakness of the accountability system, then what impact might it have in the implementation process of GPS and CMP? According to Kemuma, she does not see how the accountability is going to affect the implementation process, "because we are already doing GPS, and CMP is still going to cover these standards that we must cover" (Kemuma 2nd_Interview08/24/05, line 114-115). According to her, the CMP materials are a best fit for the GPS, which was the reason why CMP was selected. The CMP and GPS match up:

> ..we got to where all the performance standards we put with CMP to see what matched up with what book and that is how we know which performance standard to teach that nine weeks. So I will still be doing the same thing I am doing. Like I said, it gives you a set guide of what to teach and that is what I like about the pre and post test. You have that objective, you usually have 25 of them, you know well this one is covered you check it off and go to the next one instead of saying what do I need to cover. You know exactly what to cover (Kemuma 2nd_Interview08/24/05, line 121-127).

She is sure that the administration is going to watch them carefully since they are doing it for the first time. She said that they have heard good things about CMP "even students that are not good in math are doing well and so I think that will have an impact" (Kemuma 2nd_Interview08/24/05, line 130-131). She noted that although there is a lot to do with accountability system, she does not think it will affect the implementation process in anyway.

Asked to explain the role GPS has played in her planning, classroom management, teaching style, assessment practice and teacher collaboration, Kemuma had the following to say: *Planning*: Since GPS are statements (objectives) of what is expected at each grade level, it has been a great help to teachers as far as planning is concern. Teachers do not have to struggle to

come up with objectives, it is well spelled out for them. And since they are using CMP, planning has been a big relief to them.

> I know what my objectives are going to be that day and so I can plan for that objective, I can teach that objective and make sure that it is covered and so I don't have to jump around the book and say what comes next? What do I need to do? It is pretty much laid out in the GPS (Kemuma 2nd_Interview08/24/05, line 142-145)

Classroom management: She observed that classroom management will be pretty the same with GPS but a bit different for the CMP[3], "but GPS I'm thinking is a lot like the QCC's" (Kemuma 2nd_Interview08/24/05, line 148). Kemuma interprets GPS as not any different from the QCC, they are the same objectives but worded differently. Kemuma asserts that since GPS and QCC are not different, then classroom management will remain the same.

Teaching style: Kemuma noted that the teaching style would definitely change. As Kemuma puts it:

> K. GPS uhm the only way I can see it changing with GPS is because of CMP.
> R. Okay, okay, okay. Are you suggesting that they match very well?
> K. Uhm. Like I said, when we sat down, as a group of math teachers and you know, we said okay; these are the GPS, this is what CMP has to offer. We could match them up very good (Kemuma 2nd_Interview08/24/05, line 157-163).

She observes that CMP has a role to do with the change in the teaching style but not GPS. This is so because GPS are not much different from what QCC did offer in the past.

Assessment: Kemuma noted that assessment will definitely change but that is because of CMP and not GPS.

> …once again that would change again because of CMP and not because of GPS. Because I've never used rubrics to grade before, but I will with the CMP, but that is a good thing for me because I guess I have always been scared to try it. And how I will be doing notebook

[3] Kemuma sees CMP and GPS as two different implementation processes, distinct from each other. In other instances, she makes the connections very well. Check the way she interprets GPS.

> quizzes and things like that. Like I said that is because of CMP not the GPS… like now they have to keep a notebook. We have a notebook quiz. We have vocabulary now. Before we did not have vocabulary. So that is something good that we have done (Kemuma 2nd_Interview08/24/05, line 165-168).

Teacher collaboration: Teacher collaboration has been enhanced as a result of the GPS. Kemuma notes that, they are meeting more now, which was not the case in the past. They used to meet but not on regular basis like now.

> We are definitely working together a lot, we try to keep up and do the same things in the same day. That way if any of us have a question or a problem we can go to the other one and we all seem to be willing to help each other out (Kemuma 2nd_Interview08/24/05, line 174-176).

Teachers are now working together, planning together and giving each other feedback on their instruction. They are sharing activities that worked and which did not work in their classrooms and giving each other feedback.

Finally, Kemuma was asked about her understanding of GPS and how she interprets the new standards. In responding to this, Kemuma offered the following explanation:

> From what I understand as far as I am seeing it, it is the same, pretty much the same. There is a little bit of a difference as far as where one is located and like I said they are pretty much to me the same. There is a little bit of a difference as far as where one is located and like I said, they are pretty much to me the same (Kemuma 2nd_Interview08/24/05, line 187-190).

Kemuma continued to make the comparison between GPS and QCC by noting that there is a slight difference between GPS and QCC in terms of general organization. "The GPS has tasks, I believe that go along with them, whereas the QCC just made a statement" (Kemuma 2nd_Interview08/24/05, line 194-195). Concerning the way the content will be covered, Kemuma asserted there will be no difference from what the QCC was doing but "if it is covered differently, once again it would go back to CMP" (Kemuma 2nd_Interview08/24/05, line 201).

In this sense, Kemuma believes all changes are coming as a result of the CMP material that they are using but not the GPS.

Implementation Process

After some weeks into the implementation process, and towards the end of my data collection, I interviewed the three teachers and the mathematics coach about their experiences going through the process.

Bochere

Before the adoption of the CMP textbook, Bochere did some fact finding about what kind of textbooks were available and which one would be the best fit for the Georgia Performance Standards. She and the other sixth-grade teachers choose CMP for two reasons, "one is just its reputation and the little bit that I had looked at it when I was at Georgia," and secondly "the relationship between the GPS sixth-grade standards and Connected Math" (Bochere 3rd_interview 11/03/05, line 4 – 5).

> So that was why it became one of our choices. And then when I looked through it in semi-detail it seemed like such a good fit for our curriculum and so same thing with the sixth grade teachers when they chose it. So we were really excited about it; nervous because we new it was really different from what we had been doing (Bochere 3rd_interview 11/03/05, line 9-12).

The decision of choosing CMP was done collectively by the sixth-grade teachers with the guidance of the instructional coach. They were given the opportunity of scanning through the four standards based sixth-grade curricula books, which greatly helped them make a decision.

> You could look at all of them compared to our Prentice Hall Book 1[4] (Chapin, 2001) and know this is going to be different. We also have been unpacking standards all year. So we knew from looking at the GPS standards before we ever looked at curriculum that this was a big shift in the way that we were thinking about and teaching mathematics. So it

[4] The book they used previous year

> was no surprise that this year the classrooms would be different, or teaching would be different (Bochere 3rd_interview 11/03/05, line 19-23).

But on the other hand, Bochere has acknowledged the challenges they face in using the materials. One, it is hard to use and really slow, and it takes longer to cover topics. One researcher from a research institution in the state of Georgia told her, "it was going to take us at least six weeks to do prime time and we just laughed because we were like because that's GCF, LCM, Prime composites, even, odd, squares a little bit of exponents and for that to take six weeks was really a foreign idea to us" (Bochere 3rd_interview 11/03/05, line 19-23). It turned out to be true that what they had planned for nine weeks, was not finished. It actually took too long, and they really got frustrated "in a sense that we have to cover a certain amount of curriculum"

> So we are feeling really stuck right now. Because in order to get done what we said we were going to get done topic-wise right — the temptation is to chuck it, just bring in our old books to catch us back up with where we need to be quickly and then go back to CMP. So part of it, too, when we talk about it; part of our issues at the beginning had nothing to do with the investigations themselves. They had to do with our lack of materials. We just got practice workbook things to run copies off today from CMP. We had nothing. We had to go finally after, what, five weeks, we were told; oh, you can get some of that on line and that helped, but we were trying to use the curriculum and we didn't have all of the pieces of it (Bochere 3rd_interview 11/03/05, line 67-74)

In order to support them in the implementation process, the publisher was supposed to send them supporting materials—Assessment resources, blackline masters and additional practice, transparencies, lesson planner and testworks™CD-ROM Software, — which they did not send. Bochere noted that for next year, she expects a better job in keeping themselves on pace with the topics they are expected to cover because "we have a better understanding of how to start the classroom management part of it; notebooks and all of that" (Bochere 3rd_interview 11/03/05, line 85-86). She really likes the CMP activities, which help students understand mathematics conceptually but:

> I don't know. I just think it is really hard. I really wrestle with this because although the CMP activities are great and they are well thought out, that does not mean that they are the best. You are kind of stuck. If you decide to use CMP, I think you are committing to this as the way you are going to do it. And maybe that is not the best way. So maybe we will say we are not doing bits and pieces of book two and three (Bochere 3rd_interview 11/03/05, line 124-128).

Bochere worries that because of the challenges they have encountered with the implementation, the teachers may develop a dislike of the CMP. She said that teachers are getting frustrated with the pacing at which they are covering topics within the 9 weeks period. Bochere noted that the frustration is mainly coming from Moraa, who is kind of a leader in lesson plan preparation, and who was

> looking over what we decided on our pacing it and our workdays at the beginning of these nine weeks, and she said we are not going to get there; we are not going to get these three books done. So that frustrates her. Nyanchoka has about had it. I mean it took everything I had to convince her to keep doing CMP and she basically quit it her first three classes[5]. I think she has pretty much quit. The plan was that she would do investigations in the CMP Book in class and labs for them to investigate, and she gave them these workbooks that were the course one Prentice Hall workbooks that every kid can have, and she gave them that workbook, and it is just drill, drill, drill. That's what she sends them home with at night. Then I think we just made this decision like a week and half ago and I think the days have progressed, she is focusing more and more on that material; that little blue book, it's just skills. If you look at the blue workbook and then you look at the workbook that just came in today from CMP, it is the same stuff. I mean it is just practice drill sheets (Bochere 3rd_interview 11/03/05, line 143-153).

Bochere thinks one of the contributing factors leading to Nyanchoka's decision is that she had used the Prentice hall book for eight years and feels very comfortable with it. The three classes are what she calls her low level, and they are low readers. She felt the reading was hard and the students were not getting anything from the homework from the CMP books simply because they "couldn't read or understand what the questions were even asking so they would just quit and

[5] What she calls her low level students.

shut down and not do their homework" (Bochere 3rd_interview 11/03/05, line 143-153). When Bochere was asked if she agreed with Nyanchoka, she said:

> Absolutely. I went and sat in her class with her students for a week, with those students, and the day that she handed them the blue book, that workbook, and said go home and do page 23, these 20 problems. The next day every single kid in that class had done their homework—every one of them. Whereas that day in class when I had checked their homework from four out of CMP books five of them had done it out of twenty (Bochere 3rd_interview 11/03/05, line 165-169)

Bochere thinks is happening because the blue books do not need any reading skills. They have computational exercises, which do not need any reading skills. This is evidenced in Nyanchoka's other two higher-level classes where she has continued to use CMP and the students love it:

> She is not doing any blue workbook stuff with them. They are just doing CMP, and she feels good with them. Because they are engaged and they are answering and they are doing homework. And Moraa got three classes like that and two that are struggling and it is very difficult for them (Bochere 3rd_interview 11/03/05, line 181-184)

Bochere noted that the current sixth-grade students have come out of a very skill-and-drill environment. The students find CMP very new to them — so is middle school, so is changing classes; all of these things have hit them. They need some adjustment but a good number of them are faced with the additional problem of having poor reading skills and are, therefore, unable to approach word problems provided by CMP.

> So we got our reading specialist to come and meet with us. And she spent, I guess, a whole afternoon with our sixth grade teachers. With bits and pieces one talking by going through and talking about how to get students to pre-read or things that we can do to identify words that are going to be hard in advance and she gave a lot of strategies which takes a lot of work to go to do all the things in advance to use good strategies. Everyone is trying them. I feel like that the three of them are working so hard to make this work, because they believe in it. I think if they didn't believe that this is good for students they would have quit a long time ago. They really believe and they will all say this is good stuff and this is good for students. But if our students can't access then it can't be good for them. Does that make sense? If they can't read it and they can't engage in it — then how can that be good for them mathematically? (Bochere 3rd_interview 11/03/05, line 187-197)

The issue of reading has come up a lot among the three sixth-grade teachers. The mathematics coach has initiated a number of in-school professional development plans to support the implementation process. In the first nine weeks, they used Connected Mathematics 2: Prime Time (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2005). There were a number of in-school professional/planning sessions that took place in the school, and I attended five of the major ones. The participants of these meetings were the mathematics coach and the three sixth-grade teachers. Occasionally, two other sixth-grade teachers showed up at these meetings.

In one of the in-school professional development/planning sessions, Moraa said some of her classes would have it easy with the homework whereas others would not. Nyanchoka said that some of her classes are Hispanic and are poor academically. Moraa reacted to that, saying some of her classes are Hispanic but are very good academically. Kemuma injected they are good in mathematics but have problems reading, and she would ask Bochere if it is okay to read to them when they are taking tests. At times when she reads to her students, they get it and do well in assigned tasks. Nyanchoka was planning to take time to find out what their problems are, really; "are they getting the problem wrong because they did not study or simply because they cannot understand the question?" Kemuma reported some students had told her they did not understand what the question was saying and "I believe they were telling the truth". Nyanchoka was willing to do a number of things to understand the students, but her challenge was, "how much are they allowed to do that and have alternative assessment?" It could help if Spanish version books were also available to students who need them; she said. Moraa responded and said, "there are Spanish books only that they have not arrived yet." "How long are we going to wait to receive them?" Kemuma asked. Moraa noted that "don't even start asking yet — we don't even have enough English version; my sixth period, they don't have enough copies."

Bochere then joined the group towards the end of the meeting and asked them what they thought about the investigation quiz 1 and vocabulary quiz 1? She asked them, "are they too hard, too long or…" In response Kemuma noted that: "I and Nyanchoka have talked concerning our students. When I read the problem to them they understand". Kemuma asked Bochere, "are we supposed to read to them or assess them differently or…" Bochere responded that, "you know your students and just do what is good for your students." Kemuma continue to note that "it will make a huge difference if we read to them." Bochere again noted, "we have to adopt per class on what we are doing. Even ACE questions, you don't have to assign the same to every class, we have to make some adjustment that now we know our students."

Bochere added:

> We knew when we ordered the CMP the reading level is grade 6. We have students reading at Grade Level 1 and 2. Nyanchoka's 3rd period class is made up of students who are reading at Grade Levels 1, 2, 3 and so they are trying to read materials at a sixth grade level which reading research says that should read up but not more than two levels. So we are asking students to jump ahead, in some cases, five levels of reading a head. Those things like reading the homework problems to your students before they go home…picking up those key words before you start, drawing pictures of things like what is a thermometer? Getting students in the context by switching the context to something that they are more familiar with, and we are trying. We are doing the best we can and we keep asking for help in reading area, and we know it is an issue and I think this is the reason Nyanchoka has decided that what they do in class when she can read to them and help them set the context and help them understand what a problem is asking. She does that in class and what she sends home doesn't require reading (Bochere 3rd_interview 11/03/05, line 204-212).

Yes, reading is the problem with some of the students; but are teachers comfortable with the materials? In response to that, Bochere said they have tried several ways to support teachers through in-school professional development to help them reflect back on their experience in Michigan whenever they get frustrated. She added that the three teachers are supporting each

other and that has really helped them. She said the three teachers really value the CMP materials for what they can give in terms of understanding mathematics.

> And every time we talk about that, that is what they don't want to give up. That this is the time that their students are getting things conceptually and they are seeing it. And they are starting to see some of what they did in the old prime time for eight weeks show up now in bits and pieces and that they are understanding that it is really helping. There isn't any one of the three teachers that would say that there is some other way of teaching that is better than that. I mean they get it that this is good. Now are they comfortable with it? No. I'm not (Bochere 3rd_interview 11/03/05, line 234-240).

The question about being comfortable was clarified: it does not mean comfortable when one thinks about the kind of students they teach, but rather being able to grab the material and use it elsewhere. Being comfortable in having a deeper understanding of the material. In response to that, Bochere noted that:

> I think that we can answer that question with a more resounding yes next year. I think part of this is going through the whole year of it and really seeing how all of this weaves together from book to book and I don't think that you can get that just by reading through the investigations. I just think there is just so much there that you can't get unless you have done the mathematics and done all the labs. You can read them and you can read the mathematical descriptions, but I would never say right now that I am comfortable with this material. I think there are some of us that are more comfortable with the mathematics behind it than others. So it easier for us to make sense mathematically of what these tasks are trying to get students to do (Bochere 3rd_interview 11/03/05, line 250-258).

Bochere feels that it will take a while before she and the rest of the teachers become comfortable with the materials because this is their first year of the implementation process and none has ever used this material before. She believes that next year, teachers will be more comfortable with the material and will look at their planning over the long term. In doing the CMP program, Bochere noted that the benefits are that they are taking time, a lot of time, to let students wrestle with these activities "you know they are inventing stuff right now are all

scrambling and sharing projects". It also gives them a reason and time to talk to each other. That is the greatest part for her.

Bochere was asked to give an account of what the in-school professional development that she ran had produced. In response, she said:

> I think what was really sad about that is that I think we all started out thinking that there time would be a time to talk about teaching strategies and looking at students ' work and sharing what students are doing, you know, reading things that other people who have implemented CMP and what we — I think we may have started it like that. All it has become now is planning. All it has become is, "oh, my God, how are we going to get this done". And looking through investigations and trying to place value on them with respect to time. And that is what it has become; now you've been there for most of them I guess. Probably the first 15 or 20 minutes kind of just share what you know — "How would your students react to this or how did they do on this quiz? Or what units they liked, did they like this investigation?" And then it turns into "We've got to figure out where we are going from here." And that is another thing that I can think of that will change next year. (Bochere 3rd_interview 11/03/05, lines 280-288)

Bochere noted that in spite of what has happened, the in-school professional development had produced a number of good things among the three teachers. It gave:

> a sense of I'm not alone in this process. Other people who are teaching this course are validating my likes and dislikes. Uhm, it has provided an opportunity to look ahead as a group. Michigan seemed a long way back, and we keep trying to think, all right, what was so great about this activity? So we are trying to reflect back on some good mathematical experiences, but I think we depend on being together. And if you tried to take that away from us, we would be very unhappy and panicked. We really need each other. So I don't know. I guess it is like the first time you try anything you know it is just nice to have someone trying with you (Bochere 3rd_interview 11/03/05, line 208-314).

In the first meeting of in-school professional development held on August 11, 2005, Bochere asked one of the other two teachers who did not participate in my research to share what he has been doing in his classroom and how far they have gotten. He started by telling the rest of the group how things were going. He said that students had set up their notebooks and necessary items that go with it. He noted that some students did not have necessary supplies and that he

helped them do that. He started that day's class with Unit Project: My special number in the Connected Mathematics 2: Prime Time unit as follows:

> Many people have a number that they think is interesting. Choose a whole number between 10 and 100 that you especially like. In your notebook:
> - Record your number
> - Explain why you chose that number
> - List three or four mathematical facts about your number
> - List three or four connection you can make between your number and your world (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2005, p. 5).

The students found it interesting to choose a number between 10 and 100. He noted that after they chose the numbers, the students started milking him for ideas and he that had offered an idea, which ended up as everyone's idea. So he tried not to offer any ideas, which was hard to do, but he tried to back off and let them think. He suggested that a teacher could give a number of examples and ask students to do three more, which were different ones, on their own. In response to the unit project activity, Nyanchoka noted that she did not allow her students to use the same examples that she used. Nyanchoka chose 15, and they could not use anything that had to do with the number 15. She continued to say: "If the number was a combination of 15, they could not use it because 15 was my number." Nyanchoka noted that the students did not have problems answering the first three questions in the project, "but answering the fourth one that wanted them to relate the number to something in the world, they did not understand that." Bochere then asked Kemuma how her students had responded to the fourth question. In response, Kemuma noted that she had told her students to think where they had seen that number, any time they had used it, not necessarily in the classroom but where they had used it or seen it before. She noted that one student gave an example that when he came to school that morning, there were 22 cars in the parking lot, and another said he had 16 dollars in the bank. Kemuma was very impressed with the examples the students came up with. Moraa, used 82. The reason she

choose 82 was because her son's football jersey number was 82. She noted that mathematically, 82 is an even number because it is divisible by 2; it is a composite number; was and if you add 80 and 2, you get 82. For connections to the real world, she said her grandmother is 82 years old and she had 82 different flowers in her backyard.

The meeting was a nice place for teachers to share and reflect what they had been doing and give each other feedback and support. In the second meeting, which was held on August 16, 2005, the teachers started updating each other as to how things had gone so far. One activity that they discussed in the meeting was the Factor Game. To play the game, one needs the following: Factor Game Board, colored pens, pencils or markers, and Factor Game rules.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

Figure 4: Factor game board (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2005)

Factor Game Rules

1. Player A chooses a number on the game board and circles it.
2. Using a different color, player B circles all the proper factors of player A's number. The proper factors of a number are all the factors of that number, except the number itself. For example, the proper factors of 12 are 1, 2, 3, 4, and 6. Although 12 is a factor of itself, it is not a proper factor.
3. Player B circles a new number, and player A circles all the factors of the number that are not already circled.
4. The player take turns choosing numbers and circling factors.

5. If player circles a number that has no factors left that have not been circled, then the player does not get the points for the number circled and loses the next turn.
6. The game ends when there are no numbers left with uncircled factors.
7. Each player adds the numbers that are circled with his or her color. The player with the greater total is the winner (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2005, p. 7).

Nyanchoka's, students had not done the whole of Labsheet 1.2 because she had spent most of the time issuing books and the students kept asking questions. Therefore, they were limited to the first few rows of Lab sheet 1.2 and planned to finish the remainder of the sheet together the next day. Moraa's, students found it very easy to go through labsheet 1.2. Her students quickly noticed, "my score is the first move and my opponent's score is adding the proper factors together." Even her slower students caught on very quickly.

Table 1 (Table for Recording First Moves (labsheet 1.2))

POSSIBLE FIRST MOVE	PROPER FACTORS	MY SCORE	OPPONENT SCORE
1			
2			
3			
.			
.			
30			

Bochere inquired if anyone had made an attempt to do problem 1.2, prime and composite numbers? Problem 1.2, which is, based on labsheet 1.2 which states as follows:

1. Make a table of all the possible first moves (numbers from 1 to 30) in the factor game.
2. For each move, list the proper factors of the number, and record the scores you and your opponent would receive.
3. Describe an interesting pattern you see in your table (G. Lappan, J. Fey, B. Fitzgerald, S. Friel, & B. Phillips, 2005, p. 10).

Bochere noted that "those are very good exercises for students to do because it brings together all they have learned—prime, composite etc." Kemuma noted that the way she will go over labsheet 1.2 is to ask students what they got so as to make sure they all have correct answers; Nyanchoka

concurred with that, and said she would do likewise. For Moraa, she said that her class went through labsheet 1.2 “from 1 through 15 yesterday, and they went through 16 to 30 today” then the students and the teacher had gone through the sheet together as a class. She noted that, “actually the students gave answers as reflected in their labsheet.” After finishing with labsheet 1.2, they went through with the class problem 1.2—prime and composite numbers. Then Moraa reaffirmed that “students are getting it. I’m surprised how much faster they are getting it.” She also noted that:

> one parent has indicated that she has seen a great improvement in his son. He is doing very well, he used not to like math but now, he likes it a lot. Parents are getting involved more than before, they are playing the factor game with their students — that has generated a great learning experience for their students.

The teachers also discussed that it is important to notify parents of the new curriculum because some of them expect to see Algebra on their child's report card. But some parents do not care what their children do, said Nyanchoka. Moraa noted that not only parents are excited, but also some teachers in other grade levels at the school are commenting on the good stuff the sixth-graders are doing — for example, the factor game. She also noted that “students are saying that they love the stuff, this is my favorite class this semester, they also like working in groups." To make sure things would continue to go well Bochere noted that:

> let us make the list of things we need to do and let each of you pace it to get there:
> - Get the chart done — lab sheet 1.2
> - Do something like problem 1.2, prime and composite numbers? ((G. Lappan, J. Fey, B. Fitzgerald, S. Friel, & B. Phillips, 2005, p. 10). Get the words prime and composite out of that and then into the glossary. That very much wraps up investigation 1.2 which is the factor game and sometime in there go over the homework if you have not.
> - And then play the product game which is an investigation

Moraa suggested that since she is ahead of the rest, she can go more in-depth with some of the problems given and wait for the other two to catch-up with her. To that aspect, Kemuma noted that she thought she could catch up the next day.

How to grade homework was brought up by Nyanchoka. She asked, “do we let them keep them?” Bochere asked her what she has been doing in the past, and she responded that, “since this is new, I don’t know what to do.” Moraa responded that what she does is go around the class and give ticks for those who have done it and let them keep the homework. That ended conversation but they seemed to buy into the idea of going around and giving ticks and letting the students keep their homework.

Bochere again revisited the plan for the week and said; “for tomorrow there are two vocabulary words that need to go to glossary—prime and composite.” For the next day, she would make the copies of the product game that they will need for instruction. She told them that to play the product game, they will “need two paper clips, and that will basically end investigation 1.”

One thing that Bochere has noted to be very significant is that the in-school professional development has promoted the spirit of sharing the mathematics and correcting misconceptions and clarifying interpretations. This was evidenced in the third meeting held on August 29, 2005, as the teachers took time to reflect on the students' performance on the quiz previously given. Moraa asked, “how did your students do in the vocabulary quiz?” Kemuma and Nyanchoka noted that they did poorly. Moraa shared tricks that she using in her classroom to make her students do well on the vocabulary quiz. She is making her students use index cards to write the vocabulary in addition to writing them in their notebook glossary. The students are using them like flash cards to quiz each other in the form of a game. Nyanchoka liked the idea of index cards

and said she will start using them, but she had one concern about where to keep them to avoid their being lost. To avoid that, Moraa told the students to punch two holes in them and put them next to the pencil pouch in the notebook. They all agreed to start writing vocabulary words on index cards as part of their startups activity. Moraa then spent time explaining how she has used index cards. What she does is that asks her student to write the vocabulary on one side and the definition on the other side. In that way, one student can show the word to his/her partner and ask for a definition and an example.

Tuesday, September 6, 2005, they will continue with investigation 2.3, in which the vocabulary word is the Venn diagram, and the problems 2.3(A)—Classifying Numbers as part of class work. Then have parts C and D for class work on Wednesday. Moraa suggested that it is a good idea not to have them in groups but rather go through problem 2.3(A-D) as a class discussion. Homework for Tuesday and Wednesday will come from the Application Connection and Extensions (ACE) section on p. 30. For homework for Tuesday, they can have number 17 and 18 and go through those on Wednesday, Moraa suggested. On Wednesday, the homework will be 19-21. That would bring them to the end of investigation 2.

The group then turned their attention to the quiz on investigation 2 to be done Friday September 9, 2005. They asked each other if they handed out the investigation 1 quiz. Kemuma noted that she gave hers back and decided to give them a make-up quiz because it was poorly done. She asked the rest if she should average the two quizzes "or… any suggestions?" What Nyanchoka does is that she records the original score and then gives them a chance to do the test at home and get partial credit; i.e., for every five questions corrected, she adds two points to their original score. She suggested Kemuma might try the partial credit strategy.

Kemuma brought to the attention of others what she noticed when grading investigation 1 quiz number 12 (see APPENDIX A) which states that:

If you were playing the factor game, which of the numbers in question number 11 (20, 30, 15, 21 and 23) would be the worst first move? Why?

From the numbers 20, 30, 15, 21 and 23, he choose 30 as the number that would be the worst first move. Nyanchoka and Moraa also choose 30 because you would only have 30 points where as your opponent would get 42 (1+2+3+5+6+10+15 = 42) and the difference 42-30 =12. But when Kemuma saw the answer 23 by one of the students, she gave it a second thought! Kemuma noted that for 23 you get 22 points more point than the opponent; for 30 you only get 12 points more. They all laughed in agreement. Kemuma changed her grading key and notified the students why 23 was the right answer rather than 30. Nyanchoka noted that 23 is a prime number and therefore the opponent gets 1. Kemuma responded that, "that is 23 more points, the other one is 30 and 42, which is 12 more points". Moraa injected to clarify: That is true if I chose a number I will have the points— I will get the 23 points. Kemuma noted that she checked both sides, and noticed that "one time you will have more points, another time they will have more points; something not right here!" Nyanchoka said, she chose 30. Nyanchoka noted that she read it like: What will be the worst; your worst move (that is how Nyanchoka read it also). If I choose 23 it will be good because they will only get 1, Moraa said. Kemuma noted that; she thinks the problem read: what will be the worst first move? Not your worst first move. So Kemuma continued to say that it depends on how the student reads the problem, "I read it like your worst first move and I said it is 30 because they get 42 and you get 30, but I guess she probably took it from the book then and I can see why she got 23. So I can see either one, you know." Nyanchoka noted that she graded them with 30, which Kemuma also did. They all agreet that 30 was the

right answer but it gave them a chance to reflect on how students may interpret a problem incorrectly.

Bochere had intended for the in-school professional development to be a place where teachers share teaching strategies, and it was evidenced on a number of occasions during the teachers' meeting. Bochere reminded the teachers that when they were at the summer institute, the class played with the instructor and earned points against the instructor. Maybe that is something they can try, she suggested. To make sure everybody was on the same pace, Bochere walked them through the first five moves of a sample game (G. Lappan, J. Fey, B. Fitzgerald, S. Friel, & B. Phillips, 2005, p. 8). They then started playing among themselves to make themselves comfortable. Kemuma asked: is there a winning strategy here? No but prime numbers are the best bet—Bochere responded. Bochere then outlined how the lesson plan might look:

- Do vocabulary
- Teacher to play the game against the class
- Students to play the game with each other.
- students to start sharing winning strategies

Bochere suggested to the teachers that they should give the students an opportunity to play the game (labsheet 1.1) and be comfortable with it before introducing labsheet 1.2 (see Appendix A).

> after students play the game, hopefully, they will start to see the difference between prime and composite. That is, some numbers have only one proper factor and the others have lots of them. So what they want to be able to say to you is the best first move is the highest prime number.

Bochere then suggested to them that they do labsheet 1.1, and then the next period they ccould focus on labsheet 1.2. In the meeting, they discussed what would be appropriate assignments to

give to the students and how long investigation 1 may take. Bochere suggested the factor game will take 3 days — playing it, doing labsheet 1.2, and making conclusions. She also suggested to them that they need to focus the third day on the application connection and extension (ACE) section "because that is where the mathematics is."

> Bochere pointed out that at the end of ACE section, there are questions about: What is abundant number, what is deficient, and what is perfect. All have to do with how many factors they have. The reason I'm bringing this up is maybe if you have a class that gets the whole chart done on Monday and you kind of rub it up on Tuesday, that is something you can say: what is abundant number, deficient and perfect? That will be fun if they finish 1.2.

Kemuma asked Bochere if the Spanish version books would be available for use, because some students would benefit from them. Bochere responded that, according to the publisher, it would take time to get them. They ended the meeting and agreed to meet within a week to see how far they had gone.

The three teachers indicated they have had the support they need and guidance from their mathematics coach, but the mathematics coach feels that she has not done a good job. She was asked why she feels that way; Bochere noted that:

> It is because I want everyone to be happy. I want everyone to feel that their students are getting the best possible mathematical experiences that they could have. I just, I take that on. I feel a sense of responsibility to these three teachers to do everything I can to make sure that this year is— I guess it is not going to be smooth. I just have to give up on that idea but that we are learning as we go. That is what I am trying and I am just trying to be there, trying, not letting them compare. You know, get on this thing — I am not as far ahead as Moraa, or Moraa wrote this quiz and it doesn't match with my students and how come Kemuma's scores on the post are higher. They will get in this — not, it is not a competition with each other because they really love each other but — Yes I would say, the thing I have done is try to help them understand that they can individualize this curriculum in their classes. That it doesn't have to look the same in everybody's room. We started out like that because we just wanted to. I think that has been this past probably 4 weeks. It has just been you know it is okay. It is okay if your first period class takes a different kind of quiz or partner quiz than your sixth period class. It's okay. I mean we need to access students where they are and try to focus on that (Bochere 3rd_interview 11/03/05, line 344-357**).**

How much did what they did in professional development meetings that Bochere was running trickle into the teachers' classrooms? In response to this question, Bochere noted that:

> I think a lot of the strategies that people have come up with to deal with unmotivated students and non-readers; I think they really came from teachers. If I saw somebody doing something, I thought that is a really good strategy. In the meeting I would say, I saw Kemuma doing this. You know, it worked, and Kemuma would tell about it, and people would try. I think we all influence each other. I just try to make that happen. Make them be confident and share what they are doing. I think the things that we talk about in there definitely trickle into the classroom (Bochere 3rd_interview 11/03/05, line 390-396).

Nyanchoka

The adoption of the CMP textbook process involved all teachers to some degree. Nyanchoka was one of the three teachers who participated in the selection process. From day one, Nyanchoka had reservations about the CMP Material. She felt like they were not the best fit for the kid of students they have. She observed that:

> My initial reaction was that I wasn't going to be crazy about the textbook. Right from the beginning, I didn't like it simply because I felt like the students that we teach would have a language problem with this book. And I felt like we have students who don't like to read, so therefore they would not read the pages. I felt like the reading of this textbook will turn off these students. So that was my fear and that was my reservation about it. I wasn't sure it was appropriate for our students. (Nyanchoka 3rd_interview 11/03/05, line 5-10)

Their mathematics coach gave the teachers three standard-based curricula to choose from in the process of implementation of GPS. Nyanchoka raised reservations about all the textbooks that were presented but ended up choosing CMP:

> because all of them were a lot of reading. I think we like this one because it was smaller. It was not giving them the entire textbook. They were given pieces of the textbook. I think that is the reason we like this one. We felt like it was going to make it lighter on the children. It wasn't carrying a thick book. We also felt like the children could keep up with it better because it had holes in it and they could put it in their notebook. So we felt like our students would like it better. That's what we thought (Nyanchoka 3rd_interview 11/03/05, line 22-27).

Asked if the GPS played any role in the selection process, Nyanchoka said, “I feel like they did because Bochere went to all those meetings and picked three textbooks that she thought would go with the new math program that we were having to adopt, and this textbook went with that program the best” (Nyanchoka 3rd_interview 11/03/05, line 29-31). Nyanchoka has been using the book for almost one semester and she still has reservation about it. Her overall opinion will emerge after going through the CMP series to come up with the correct assessment about them, so she will need time. But for the moment, Nyanchoka noted, “I guess it is okay. I mean you know, I have not truly formed an opinion of this textbook yet. I still have my reservations about this textbook, and I think until I get through all the series I can’t make a true opinion on this book." (Nyanchoka 3rd_interview 11/03/05, line 32-35).

Nyanchoka continues to have reservations about the CMP materials because she is strongly convinced that the materials are not geared towards nonreaders or not geared toward students who speak a different language. “Those were my reservations when we adopted this book, and they are still there, they have not changed” (Nyanchoka 3rd_interview 11/03/05, line 42-43). Supporting the implementation process of GPS is the number one priority at Tabaka middle school. To support teachers, Nyanchoka and her colleagues were sent to Michigan for the summer institute to learn about the CMP curriculum, which is judged to be a middle school mathematics curriculum consistent with the GPS. To sustain what they learned and support the school, the mathematics coach initiated in-school professional development. These were, in most cases, weekly meetings of the sixth-grade teachers with their mathematics coach.

Asked to comment about what goes on in the in-school professional development, Nyanchoka noted, “We all sit and voice our opinions on what we think is good for our children as to making out lesson plans and stuff like that. We all do that. We all make an opinion. We

all contribute something. Not one particular person contributes one thing more than the other" (Nyanchoka 3rd_interview 11/03/05, line 62-64). She strongly believes the in-school professional development meetings have helped them greatly. "I don't think we could teach this book if we didn't sit and do that. Because I think we would all question whether or not we are doing it right (Nyanchoka 3rd_interview 11/03/05, line 75-76). She pointed out she learned more about the CMP material in the meetings with her colleagues than she learned in Michigan during the summer institute. As a matter of fact, she believes she did not learn much in Michigan during the summer, but that gap was filled by what she learns in the weekly meetings. The kind of support and collaboration she gets from her colleagues has been phenomenon and that is what matters to her most.

When asked to state the benefits and drawbacks of the CMP materials, Nyanchoka observed:

> I guess if there were any benefits the book is smaller. I like the way they lay out the lesson plans. The drawbacks would be there is not enough skill drill practice for these students. I wish it moved a little faster than it does. Because I could teach several skills together where this book makes it into 2 or 3 skills. Like right now we are teaching comparing fractions. Instead of doing the way this book would do it, I would just simply show my students the two methods for comparing fractions and move on. This book relates it to real life situations. And to me I don't have that kind of time (Nyanchoka 3rd_interview 11/03/05, line 100-109).

Nyanchoka feels it is taking too long to finish a topic and fears they may not finish the syllabus to get the students ready for CRCT. As noted, she believes the books do not offer enough drill and practice problems. She tried to drill and practice the student by giving similar problems and going through the same procedure over and over again. Her main goal is to make sure students understand the process so that they can understand how to handle the homework and test problems. This was evidenced in her classroom instruction as shown in the following classroom

episode. The lesson was about the factor game (G. Lappan, J. Fey, B. Fitzgerald, S. Friel, & B. Phillips, 2005, p. 7). Using labsheet 1.2 (see below), she asked students to write down the answers and figure out how to do it when they got home. “If you circle 1 you must write NONE in the proper factors. You must write the word NONE, you cannot write zero. If you circle 1 and there were no factors for that number, what happens with your score?” A student said, “you loose the turn, which means you don’t get a score.” She then asked the students, “What is your opponent's score?” They said in a chorus: zero.

Table 2 (Table for Recording First Moves)

POSSIBLE FIRST MOVE	PROPER FACTORS	MY SCORE	OPPONENT SCORE
1	NONE	Lose a turn	0
2	1	2	1
3	1	3	1
4			
. . 30			

She continued and said, “this time you are going to circle 2. What are the proper factors of 2?” The students said 1. What is your score? The students sounded 1, Nyanchoka said “No; what did you circle?” The students said 2, and she wrote 2 in my score column. What is your opponent's score? The students said 1. Nyanchoka said: “Let us try the next one; you are going to circle 3. What are proper factors of 3, the students said 1, what is your score? They said 3. What is your opponent's score? One student said 1 and the other said 3. One student wanted to know how values of my score and opponent score column were obtained. Nyanchoka said, “you need to note the pattern.” The students seems to notice the pattern but were not sure if they understood what was going on. She noted that I’m not giving a clue, you need to see the pattern… “let us go to 9. What are the factors, students said 1 & 3, what is your score? They said 9 and what is your opponent score? The students did not have answers. She told them, “your score is what you

circled." This process went over and over again until labsheet 1.2 was filled from 1to 17, and she told the students to do the rest for homework. Discussing with one of the students who needed help understanding the process, Nyanchoka said to her that "what you circle goes here, the sum goes there" and the kid walked away and did what she was told and got her answers correct in the activity. Nyanchoka wanted to give her student an opportunity to practice doing as many problems as possible.

In the section on prime factorization, she pulled worksheets from the book they used the previous year (Chapin, 2001) to teach prime factorization by using the ladder and factor tree methods. In the two methods, she skillfully outlined the method to use and gave several examples on how to do them. At the end of the lessons, she said, "I expect you to go home and do the same with different numbers." She gave homework and ended the class. She noted the worksheet gave students the opportunity to practice and did not require reading.

Reading has been a big issue in the implementation of CMP materials, and Nyanchoka said this was a drawback of the program:

> Because I don't feel like my non-readers and my students who speak a different language are getting it. I think they need to be taught the skills because they don't read. So, yeah, it has been frustrating to me to say the least. Because there are certain problems in this book the non-readers will turn off and won't attempt to do because they can't read it. And then when they look at the page they feel like it is a lot because of all the words when it may be a simple word problem. These students just don't do word problems and this book is word problems (Nyanchoka 3rd_interview 11/03/05, line 117-122).

In one of the in-school professional development sessions, Nyanchoka noted, "the main challenge with the sixth-graders is the reading we are giving them and having to write in their own words. They want to be told exactly what you want." She said that students are always afraid to tell her something which may turn out to be wrong. Bochere suggested to them:

> what if we gave them prompts instead of just saying write in your journal what is the difference between square numbers and composite numbers. Instead we gave then like almost like a paragraph where they fill in the blanks. This will help them see how to write mathematically.

She said there is a need to ease the students into writing mathematically and then back off as they get comfortable. The three teachers also resolved they need to start reading the word problems to their students to help them understand so the students can do their homework. The strategy that Nyanchoka used, as discussed in the in-school professional development meeting, was reading to her students the homework that required reading. She did spend time reading to them and explaining areas that were not clear.

Nyanchoka claimed that the problem of reading was an issue for only the low-achieving students. "My higher achieving students get it, they are enjoying it; they have no problems with it. They can read the word problems and decipher what it is asking them to do. They give me what I am looking for, but my nonreaders don't (Nyanchoka 3rd_interview 11/03/05, line 124-126). She believed the problems the students had had nothing to do with the materials but rather something to do with the students. She pointed out that: "If these students have not been taught to read from day one, you can't make them learn to read in sixth grade" (Nyanchoka 3rd_interview 11/03/05, line 128-129). She said that the CMP materials are designed for specific kinds of students —the average kid. Nyanchoka had supplemented materials in her teaching

> R. Have you supplemented the material in the book at all?
> N. We brought in other materials to use. Yes, from previous books that we used.
> R. Why did you do that?
> N. Because we felt that some of these students needed more practice. More skilled base type problems to solve and that is the reason we pulled the extra material. Our non-readers weren't getting it and they needed to build on a skill more so than build on a reading.
> R. Okay, so what kinds of things have you supplemented?
> N. We only started supplementing this quarter mainly with fractions because fractions seem to be hard for our students. And we are bringing in work sheets and trying to do

example problems and bring in models and try to get these students to understand what fractions look like and how you compare them.
R. Okay. So those materials that you supplement— you feel like they can reach these other students that are struggling?
N. Right those other students that are struggling.
R. Are you supplementing the same for your higher students?
N. No, no, no. The higher levels are getting the book. So the supplemental material is not for higher level. It is mainly for our non-readers.
R. So basically I can say that you have not supplemented anything with the higher achieving students.
N. Right we are doing it strictly with the book (CMP) for the higher levels, because they get it. They understand the book.
R. Do you think it is working well with them?
N. Yeah with the higher level. I don't see a problem with the higher level.
R. Okay.
N. Because they read. These are students that read.
R. Okay.
N. These are students that you don't have to make read, they enjoy reading.
R. Okay, okay.
N. And these are students that know how to express themselves and they enjoy doing that. So you don't have that problem with this book (Nyanchoka 3rd_interview 11/03/05, line 236-264).

The issue of supplementing materials was raised a number of times in the in-school professional development sessions. Nyanchoka did use all the supplemented material both for instruction and homework. The materials were obtained form the book they used the previous year. Some of the supplementary material had minimal or no reading at all (see worksheets: Ladder methods, Factor tree method, Reteaching LCM, Multiple, factor tower and comparing fractions). It was Nyanchoka who provided resources for the other teachers to use. These are resources she had used before and felt they had worked very well with her students in the past. Nyanchoka used the external materials in her classroom, and students were enjoying them because the materials do not require any reading. Nyanchoka noted.the homework was being done in time and done well.

One of the many things that Nyanchoka learned by attending the summer institute, the in-school professional development, and the courses she took over the summer was how to use

manipulatives in her instruction. In her class, Nyanchoka has used manipulatives in a number of instances. In one of the days that I visited her class; she started her class with:

Start-up — *Write 5 examples of factor pairs*

She asked students to give examples. The students gave the following: 5x5, 5x1, 5x10, 5x6, and 5x8.

They also gave the number that the factors go with; e.g., 5x5 goes with 25. She then asked them to take out the previous night's homework and talk about it. The previous night's homework was: *For exercise 1-6, give the dimensions for each rectangle that can be made from the given number of tiles. Then use the dimensions of the rectangles to list all the factor pairs for each number.*

(1) 24 (2) 32 (3) 48 (4) 45 (5) 60 (6) 72

She said:

> What I had hoped you would have done is this: I have seen some awesome work! I'm not going to be as creative as some of you were, but I will take a short cut. I will go straight to dimension, that is what I'm going to write. So number one, I'm going to write the word dimension so that you know what I'm doing. What I want you to know is the dimension of the number 24 that is what I want you to know. I want you to tell me what the dimension of the number 24 is.

She pointed to one student who responded: 6x4. She asked the students to give more examples of dimensions of 24. One student responded — 2 and 12, Nyanchoka responded, "not 2 and 12" the student replied; 12 and 2, Nyanchoka responded to the students; "not 12 and 2, give me dimension." The student asked Nyanchoka "what do you mean?" Nyanchoka explained— dimension has a x sign in there. The student happily responded, 2x12 and 12x2. She told students to make corrections if they did not represent dimensions of numbers in their homework properly. She reminded students that when talking about dimension, "we are talking about a rectangle, and it can be done differently". You have to remember; 2x12 rectangle is different

from 12x2 rectangle. She said, “When you give me 12x2 rectangle, it means you have 12 going horizontally and 2 vertical. She illustrated that with cubes with different colors as shown below.

Figure 5: 12x2

For a 2x12 rectangle it goes this way:

Figure 6: 2X12

“So when I ask you for rectangle dimension, remember it has to have the x sign in between and that you can flip the rectangle, keep that in mind, they are all different.” She then asked students to give the dimension of 24, and they responded with the following answers in the figure below.

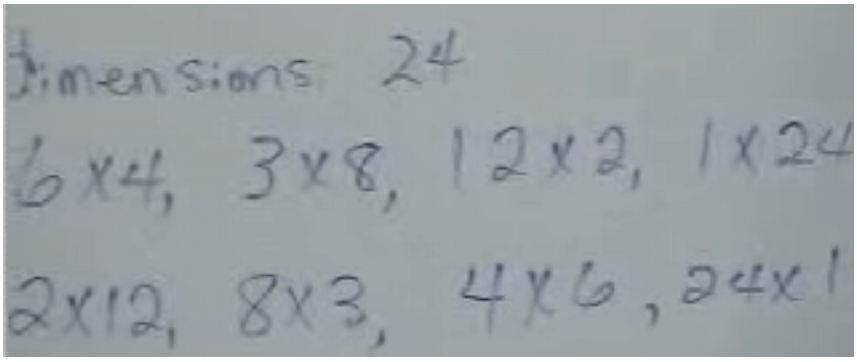


Figure 7: Dimensions of 24

Nyanchoka has been trying to involve her students in class discussions as much as possible. That is what the three teachers and their mathematics coach were encouraged to do when they attended the summer institute. Also in the in-school professional development, the three teachers encouraged each other to have activities that involve students' participation.

One activity that they learned at the summer institute and talked about it at the in-school professional development is the product game:

> In the product game, you start with factors and find their product. The product game board consists of a list of factors and a grid of products. The object is to mark four products in a row—up and down, across, or diagonally—before your opponent does.

1	2	3	4	5	6
7	8	9	10	12	14
15	16	18	20	21	24
25	27	28	30	32	35
36	40	42	45	48	49
54	56	63	64	72	81

Factors:
1 2 3 4 5 6 7 8 9

Figure 8: Product game board (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2005)

> To play the game, you need a Product Game Board, two paper clips, and colored markers or chips—one color for each player
>
> Product Game Rules
>
> 1. Player A puts a paper clip on a number in the factor list. Player A does not mark a square on the product grid because only one factor has been marked. It takes two factors to make a product.
> 2. Player B puts the other paper clip on any number in the factor list (including the same number marked by player A). Player B then shades or covers the product of the two factors on the product grid.
> 3. Player A moves either paper clips to another number, leaving one in its original place, and then shades or covers the new product.
> 4. Each player, in turn, moves a paper clip and marks a product. If a product is already marked, the player does not get a mark for that turn. The winner is the first player to mark four squares in a row—up and down, across, or diagonally (G. Lappan, J. Fey, B. Fitzgerald, S. Friel, & B. Phillips, 2005, p. 12).

In the in-school professional development, Bochere (math coach) pointed out that when they were in Michigan for the summer institute, they played the product game. The instructor played with the whole class. They discussed the winning strategy as they played the game against their instructor at the institute. When I visited Nyanchoka's class at the time she was teaching the product game lesson, she stated the class by calling roll. She walked around in the class, trying to keep students engaged. She was telling them "I'm not going to do it for you. You need to think. I cannot think for you." She noted that when the students play the product game with her;

> ...there are question you must answer. Let me read the question to keep in mind that you have to answer when you play with me. We are going to play one game against the class that means all of you are going to play to outsmart me. Okay. We are going to play the product game that you played with each other last period — you were supposed to play the game with a family member, now you are going to play with me. In the process of playing I will like you to look for pattern and strategies that might help you win. Write down those strategies that might help you win. There are four more questions you have to answer. One you have to play the game and watch how I play and how you play and see the best strategy to help you win.

She asked the students: "out of red, blue, or green marker, which one do you want to use?" the students chose RED. "The class is red, I'm blue." She supplied the paper clips and asked who was to go first; the class said, "you". So she went first. The class was more attentive than I had ever witnessed. They were all eager to win against their teacher. She said; "then I'm going to put the paper clip down first. Do you all see that? I'm going to put my paper clip on 6, where do you want to put yours?" They sounded: 3, 3, 4, 4, 6, 6, She said, we will go by majority, the majority I hear is 4. So she placed the paper clip at 4. She then moves the paper clip from 4 to 5 to give her 30. The students' turn came, and they started shouting out 7, 8; it became very noisy, 7,7,7,7,8,8,8. She said, " I heard seven, move 6 to seven to get 35. For her turn, she moves 7 to 4, which gave her 20. Some students were really giving good suggestions to each other. They finished the game with the students winning as illustrated in the game board below.

Figure 9: Product game

She asked the students, "Did you understand the strategy you used?" Some said NO. "Why was it important that I go first?" She asked. One student responded: "Because if you go first, you loose." The rest of the class laughed in that they did not agree with his answer. One student said, "try to start in the middle," and another students suggested that they tried to block the opponent. She gave them class work question a-e (G. Lappan, J. Fey, B. Fitzgerald, S. Friel, & B. Phillips, 2005, p. 12) and took time to read for them the questions and tried to explain to them what the questions were asking. In question (a), she explained the pattern and strategy the class used to win. She read (b) to another student and told her that "I'm not going to tell you, you figure it out[6]." Another student asked for help, she said, "The only thing I will do for you is just to read the problem for you. Came on, you can do this, I'm not going to do it for you." She walked around to make sure students were engaged in the task. One student was talking, and he was lectured that he will get detention right away. "You misbehave most of the time in this classroom. All of you can do it." She walked around to check their work—reading for them but

[6] She will not give answers but wants students to give her the answers.

telling them to figure it out. She said if you did not get a through e today, you have to do that as homework. She gave them homework for the day. Whenever she gave homework, the following day she took time to check their work and record the names of those who did not do the assignment and get detentions. This strategy was discussed in the teacher's in-school professional development and suggested as the best strategy for handling homework. She finally reminded the students that they would have a notebook quiz and a vocabulary quiz at the end of the week.

In response to what the students were doing in her classroom, Nyanchoka was asked how have her students reacted to the new ways they are doing mathematics?

> I think they like it. They seem to really enjoy it. I know when we do the group activities they really do enjoy it. They love sharing there ideas with their classmates; they love helping their classmates. So I think they enjoy it. I think they are having a good time with it. I watched them interact with their peers and I think they enjoy being the teacher. They enjoy teaching their peers how to solve a particular problem. And that way it is not me constantly doing all the teaching. They enjoy doing the teaching themselves. (Nyanchoka 3rd_interview 11/03/05, line 141-146).

She also noted that her students, even the low achieving students, like the book they are using. She said:

> I think the lower achieving students like it, too. Especially when there are problems that they can get. If I do the reading for them and try to explain what the word problem is asking; then they have no problem with it. And they understand it and they are okay with it. But they want precise answers. They want to know if it is yes or no, or they want an exact answer. And this book doesn't do that. My high level achieving students are doing fantastic with it. They have no problems. My lower levels — they are having a hard time adjusting to it. They find it hard. When they actually do get it, they really enjoy it (Nyanchoka 3rd_interview 11/03/05, line 153-159).

There are several issues Nyanchoka has raised about the CMP material. I asked her a questions related to that:

R. Is this the same problem you experienced in the other materials you used in the previous year?"
N. Not as much. Not as much. Because the other materials we used to use are skill-based. We taught the skills, and the students could do it. I mean there was no problem; you know they look on the page there were ten math problems and they could do those 10 math problems and go on about their business. It isn't so much that way in this book. It is a lot of reading.
R. Ok. Do you think all of your students can be successful using this textbook series? Why or why not?
N. I hope that they can. I really do hope that they can because I know this is where they are going to have to go — this is where the CRCT is going. So I hope that all of my students can at some point in time be successful.
R. But what do you think by now. Do you think by now they will?
N. I just don't know.
R. What are some of the barriers you have faced with this series?
N. Like I said it is the reading.
R. The reading.
N. The reading.
R. For the students.
N. Uh Huh.
R. Okay.
N. Not a problem for my top level students. But non-readers — there are problems for them (Nyanchoka 3rd_interview 11/03/05, line 162-182).

Since reading is a big issue in the school, Nyanchoka noted there have been a number of initiatives to solve the problem. For instance, in the in-school professional development, the issue of reading has been raised a number of times and suggestions have been offered. One thing the teachers have done is to invite a school reading specialist to their meetings. As Nyanchoka puts it: "We have asked the reading teacher to give us some idea of how to take what is on the page and chop it up into smaller pieces so that the students can understand what the reading is asking. So that's working" (Nyanchoka 3rd_interview 11/03/05, line 185-187). Asked how that has helped her in her classroom practice, Nyanchoka said: "I keep working with them. That is all I know to do. I just keep working with them and trying to pull out of them what I want. I try to keep leading them toward the kind of answers that I want" (Nyanchoka 3rd_interview 11/03/05, line 190-192). In that respect, she said "we are doing the journal writing and the

reflections. We didn't used to do those. Our students are writing more than what they used to write. They didn't have to write as much as they write now" (Nyanchoka 3rd_interview 11/03/05, line 195-197).

The idea of journal writing and reflection has come as a result of the notebook. All students are required to have a notebook. One of the sections in the notebook is a reflection and journal section. She learned the idea of notebook and its organization in the summer institute at Michigan, and they have spent some time in the in-school professional development sessions to talk more about notebooks. She thinks the notebook is an awesome way to teach the students organizational skills, which they need most. "The students are putting something in every section everyday." To make sure students are doing what is expected in the notebooks, the sixth-grade teachers give notebook quizzes that count in their grade. As Nyanchoka put it:

> So that we know because it is kind of hard to go back and check 125 notebooks and make sure that every kid has got everything that you want them to have. So we give them a notebook quiz to give us an overview that they have what we are looking for in the notebook. They are very well organized. The notebook questions are no more than 10; they can answer and make an easy 100 on. But they would have to use their notebooks to answer those questions (Nyanchoka 3rd_interview 11/03/05, line 218-222).

One challenge the three teachers are facing is to help students learn vocabulary, which goes into the glossary section of the notebook. In one of the in-school professional development meetings, the three teachers suggested the use of flash cards as a way of learning vocabulary. students can use flash cards as a game for learning the math vocabulary. Nyanchoka has tried using the flash cards as a way of helping her students learn the vocabulary.

Moraa

The adoption of CMP material was good news to Moraa because there are a number of issues she had with the materials they have been using. She was not involved in the selection of

the CMP material as she came on board after her colleagues had already made the selection, but she liked the textbook:

> Well, when I saw the textbook, I liked it better than what we used in the past because it had more manipulatives — it was more hands on and not just a whole bunch of worksheets. Not just look in the book and do this, it was more of the students talking and helping each other. Because to me they can learn just as much from each other as they can from me (Moraa 3rd_interview 11/03/05, line 5-7).

Moraa has been using the CMP material which she likes very much. Although there are issues that were not resolved earlier, she still believes it is a good curriculum:

> I like it. I mean I like it a lot better than in the past but it would have been a lot better if we would have had some Spanish versions of the book at the same time as we got the books. But we were told that the Spanish versions won't come out until next year. We need the versions because we had a lot of problems with some readings. Especially with our ESOL students, the English as 2nd Language learners; if they can read in their own language hardly, how are they expected to read in English? And that was — the biggest drawback was not having that extra stuff for the Spanish speakers to learn from or to give it to the Special Education teacher so that she could work on it with the children in resource. Now they could do the English version in class and if they didn't understand it they could use the Spanish version in the resource class. But we don't have those resources (Moraa 3rd_interview 11/03/05, line 17-27).

The issue of reading at Tabaka Middle School is a challenge to the implementation process of CMP. Half of the students at this school are immigrants are Hispanic. The children have not only the challenge of reading but also writing. CMP materials are written in such a way that they have more words than numbers. The students are not used to having mathematics books with more words than numbers, and that has been a challenge for them. The students are not used to writing so much in mathematics. Moraa loves for them to write:

> Instead of just what is 4 x 4 we have to explain why? And they don't understand — why do I have to write this? Why can't I just say it? So that was the biggest difficulty that the students had with it. But I think by now they are getting used to it. Now after the first book; the first book kind of gets them into it. Now with the second book, I think they are used to writing out all of the stuff that they are saying instead of just saying it. Because they have to say why and explain themselves, which they have never been asked before (Moraa 3rd_interview 11/03/05, line 37-41).

Moraa has two lower classes, and a lot of the difficulty is language. The students know enough English that they do not have to go into an ESOL class per se, but they do have to be in an inclusion class. This is so because the school does not keep them in one of those sheltered programs for very long. "The next thing you know, you have a student sitting in your classroom. He can barely speak a word of English. He can barely even say the numbers in English, much less read the words" (Moraa 3rd_interview 11/03/05, line 51-53).

The issue of reading has come up in a number of in-school professional meetings that Moraa has attended. Suggestions were made in those meeting about how to help students with their reading — for example, reading to them before issuing the homework. Although that was a good strategy, Moraa believes "their reading skills will not improve if we keep on reading to them; we have to force them to read." This was apparent in her classroom a number of times. She would encourage students to read on their own. The only time I witnessed her reading for her students was in the class that did not have copies of the textbook. There were a number of instances in which she asked students to refer to their textbooks and the students reminded her that she has not issued to them the books. Sometimes she would say; "since you don't have your books yet, I'm going to read something to you and do this as a class. I know you don't have your books". In this class, basically, Moraa read to the students simply because they did not have their books — not to help them with their reading.

In spite of the challenges of the implementation process, Moraa cited why she liked the materials:

> It is more hands-on using the manipulatives, so that the children are not just seeing the numbers on paper, they are actually seeing it and playing with the models, like, we've got the pattern block they are going to be using probably next week. Not just one whole of a whole is 2 wholes or half of a half is a whole, they will be able to see it and not just see it on the board or on the paper in a book. They have things that they can see it — a

> manipulative that they can use with their hands (Moraa 3rd_interview 11/03/05, line 55-60).

The use of manipulatives has been Moraa's most favorite method of teaching. She has been using manipulatives to some extend in the past, but attending the summer institute reinforced her desire to incorporate the use of manipulatives in instruction and has been evidenced in her instruction. In one class episode, she began with a start-up activity. In her start-up she had this question: how many ways could we make a product of 30? The student gave the following:

1x30, 2x15, 3x10, 5x6

And Moraa said, "Look at this:"

1x30, 2x15, 3x10, 5x6

30x1, 15x2, 10x3, 6x5

She asked them, "What did I do?"

One student said, "Switched them around."

Moraa said, "If I switch numbers around when I'm finding the product, does that make a difference?"

The students said, "No."

"Does it make a difference in my answer?"

They said no.

Moraa said, "It does not make a difference in my answer. What if I look at it in a different way. What about if I try to look at it visually? Will that change anything?"

One student said, "If we had groups it will change the type of groups."

Moraa said, "Yes!" She picked up some marbles with magnets at the back to make them stick on the marker board from her basket and asked the students to "think about the number 6, how can I make the number 6, how many groups of what?"

One student said, “two groups of three.”

Moraa said to the students “Look at this,” and she arranged six marbles on the marker board as shown below.

Figure 10: 2x3

“What do I have?“

One of the students said, “Two groups of three which means you have six in total.”

“If I go upwards, how many do I have?”

The students said, “three.”

"What if I go side ways, how many do I have?"

The students said “two.”

Moraa then asked, “What if I take it and turn it over?” She turned the six marbles through 90°.

Figure 11: 3x2

"What do I have?"

The students said, “You have three groups of two.”

Moraa asked, "is there any other way I can make this?"

One student responded, “You can make six groups of one."

Figure 12: 6x1

"That means we are going up one, sideways six,” Moraa responded, "Is there another way to do it?"

Another student responded, “We can have one group of six”.

Figure 13: 1x6

"How many going up?"

The student said; “six.”

"And how many sideways?"

The students said “one.”

“Okay, now, from what we have discussed, how many ways have I visually shown you six?” Moraa asked the students. One student said; “four.” Moraa said, “Out of how many factors? We had 1x6 and 6x1. Even if they are the same on paper, they look different.”

Figure 14: Dimensions-1x3 and 3x1

Moraa continued to reiterate how 1x6 and 6x1 are the same amount but they look totally different. She said, “Can you see the similarity, what do they have similar?”

One student said, "They are all six units (marbles), right?"

"What else is similar?"

Another student said, “They are all groups.”

Moraa said, “Yes, this is a group, and this is a group. What do they have different? What is different about them?”

Another student said, “one goes upwards and the other goes sideways.” Moraa asked:

> Is that the only difference? Ok, 1x6 and 6x1 — do we get the same answer? We will go more in depth in just a minute. I will write two vocabulary words that I would like you to write down; Just two of them. First of all, tell me where this goes in your notebook? (The students responded:,'in the glossary section.') The first one is *a factor pair* and the other one is *square numbers*. Copy those down and the examples. These definitions are straight, right from the back of your book. Let me tell you something, we did different ways of representing 6. Let us try to use the graph grid to do it. If I have, let us look at 6. How do you tell me to get 6? 1x6, 6x1, 2x3, 3x2; all this will give you 6. If I have six squares, how can I show the first one?

One student said, “one row of sixes.”

"How many across?"

The student said, “six and one down.”

Moraa represented the combination of 6 in four different ways, using small squares on the grid paper. For example, 2x3 and 3x2 were represented as follows.

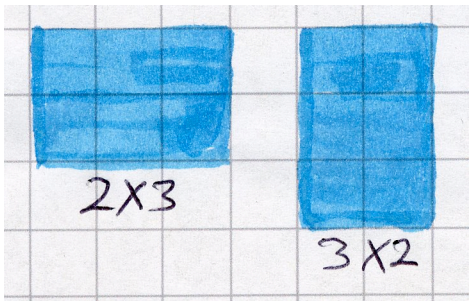


Figure 15: Dimensions-2x3 and 3x2

Moraa, wanting the students to have a hands-on activity, decided to offer that opportunity. She asked all students to discuss the number 5 in their groups and represent it in different ways. "So I can represent 6 in four ways. What about if I had 5, how many ways could I do it? How many going up and how many sideways?" Moraa represented 5 as 5x1 and 1x5 using grid paper, and she said, "With that in mind, this is what I want you to do. I will give you a piece of grid paper. On top on that grid, there is a number, which I would like you to write all the factor pairs." She told them that in the grid paper there is a number that she would like them to represent visually. She then distributed the grid papers. She encouraged student discussions among the groups. The students seemed to enjoy having a hands-on activity, which was noted by Moraa. As she put it: "Like the factor pairs of 6, they got to see the difference of 2 x 3 and 2 x 3, they could see it. Not just see it on paper but also they could actually see the models. A lot of students said this finally makes sense now" (Moraa 3rd_interview 11/03/05, line 64-66).

Moraa believes that the CMP materials can work for all students—lower and higher level students. As Moraa puts it:

> I like it for all of my classes, but three of them are real high level and we can go faster — we can go more in depth with the questions whereas my lower students — my two

> classes where the lower students are, we use more…we still do a few of the questions — not as many as the others but we pull the other stuff from the CMP web site. They got extra sheets from skills. We use a lot more numbers with them than the words in the book. All of the questions in the book, if a child is struggling to read, sees all of these words or especially for somebody who does not speak English very well, a lot of them immediately shutdown and do not even try (Moraa 3rd_interview 11/03/05, line 70-76).

Moraa noted most of her students are used to seeing a bunch of numbers and they are used to being told this is the process. This is what you get and this is how you get it; this is the process every single time. As Moraa explains;

> … in this, in this book what I love about it is just asking them to think, just asking them why. Explain. And they are, like, well, what's the answer and I say, well, what do you think? So I take what they already know so that I know what they don't know — so I know what to teach them (Moraa 3rd_interview 11/03/05, line 108-113).

Moraa has wanted her students to think and to explain why they were doing. In one of her classroom episodes — Moraa started her instruction with first reading the homework for the day to the students. She then asked them if there were any questions. The homework question was:

1) a) Make a table of all the possible first moves (numbers from 1 to 30) in the factor game.

   b) For each move, list the proper factors of the number, and record the scores you and your opponent would receive.

2) Describe an interesting pattern you see in your table.

She then distributed lab sheet 1.2 to the students

Table 3 (Table for Recording First Moves (labsheet 1.2))

POSSIBLE FIRST MOVE	PROPER FACTORS	MY SCORE	OPPONENT SCORE
1			
2			
.			
.			
30			

She started explaining lab sheet 1.2 as shown above:

> The possible first move; this is talking about the factor game. Possible first move; you have 1-30 just like the factor game. You look at your sheet you have 1-30. So any of those are your first move. The second column says proper factors. Remember the proper factors are the numbers you circle after your opponent circles the first number—your score will be here; your opponent score will be here. I'm going to skip 1, I will like you to think about it. Let us look at 3 (possible first move)—The possible first move is 3. What are proper factors of 3?

One student said, "1."

"One, why is it not 3?"

Another student said, "The proper factors are all factors except itself."

Moraa said "Did you all hear? Awesome answer-good job! Proper factors are all factors of that number except the number itself. Remember we went over that last week. And this is my proper factor — 1, and what will my score be?"

Another student said, "3."

Moraa said, "My score will be 3? Why?"

The student said, "because you circled 3 and proper factor is 1; so 3 is your score."

Moraa responded, "Great! What I circled is my score, right? What will my opponent's score be?" Another student said,"1."

Moraa asked, "Why will it be 1?"

The student said, "Because you circled 3 and the only other factor was 1."

Moraa said, "Let us look at 6. If I start, and the number I circle is 6, what are the proper factors?" One student said, "1, 2, and 3."

Moraa noted, "Great! You got it! You want to see this — 1x6=6, 2x3=6, so these are the only factors of 6 so we cross out 6 and be left with 1, 2 and 3, which are our proper factors. If 6 is my first move, what will my score be?"

Another students said, "6."

“6, and what will my opponent score be?”

Another student said, “6.”

Moraa asked, “Why will it be 6?”

Another student said. “Because the sum of the proper factors is 6.”

Moraa then gave another number,16, as the first move and invited the student to fill its row. She then asked if they had any questions concerning the three examples given. There were no questions raised so she said “you will do individually, by yourself, 1-15. Whenever you and your table are finished 1-15, I will want you to talk about them, 1-15—talk about them. See what you have, see if anybody has anything different, if you do talk about it. Think about it and talk about it. Ok, as soon as you talk about it, raise your hand; I will came by and check and see what you are doing, and then when you are done with that, we will start from 16-30. Do you have any questions?” One student raised his hand and asked, “For example the first one, will your score be zero because ….” Moraa said, “about number 1 think about it. Think about, like, playing the game. What will happen if you choose 1, what will be your score and what will be your opponent's score?’ She gave them 12 minutes to do that. She encouraged her students to share with each other, after they finished doing the numbers individually,fostering classroom discourse. She walked around and asked them to think about what they were doing. She also wanted the students to say why they did what they did. She said, "All of you are doing great." She then started going through the numbers from 2, but the bell rang and she said they would continue form there the next day.

Table 4 (Table for Recording First Moves (labsheet 1.2))

POSSIBLE FIRST MOVE	PROPER FACTORS	MY SCORE	OPPONENT SCORE
1	NONE	Lose a turn	0
2	1	2	1
3	1	3	1
4	1, 2	4	3
5	1	5	1
6	1, 2, 3	6	6
.			
16	1, 2, 4, 8	16	15
.			
30			

In the in-school professional development meetings held on August 16, 2005, Moraa shared this classroom episode with the other teachers. She pointed out that the students got it easily. Her students noticed that, "my score is the first move and my opponent's score is adding the proper factor together." She confidently told her colleagues that even her slow students got it easily. Moraa's classes were section-wise ahead of the other teachers' classes, the testimony she gave energized her colleagues and made them believe that the section was doable in spite of the kinds of students they had. They took time to share strategies related to classroom instructions. Moraa has voiced support of the in-school professional development that the mathematics coach runs. The act of coming together and sharing ideas has really helped them greatly. As she explains:

> Well it helps us. This is my first time with sixth grade. It gives me a vision of how sixth graders in the past have looked at certain standards, like, if the ones in the past did not get least common denominator they tell they should have gotten that in 4th or 5th grade — they should know this. Go a little bit faster, do this, or do this, and it helps us to know because we all got so many different students that we can get with each other and we can see what has worked and what hasn't worked. Like if Nyanchoka explained something one way and I explained it another way. My students didn't get it, maybe I would explain it the next day using the way she explained it. Even little things as the verbiage, the language that you use, anything like that, you know it helps you to know that you are not by yourself doing it (Moraa 3rd_interview 11/03/05, line 147-155).

The issue of teachers moving at the same pace was discussed at the in-school professional development session. Moraa noted that she was ahead of the rest in some of her classes. She gave a suggestion that she would try to go more in depth so that the other two teachers could catch-up. One subtopic she covered that was not covered by the other two teachers was the section of classifying numbers: abundant, deficient and perfect. In doing this section, she read for the students the following problem:

Draw and label three circles as shown below. The numbers 12, 15, and 6 have been placed in the appropriate circles. Use your factor table (lab sheet 1.2) to determine what each label means. Then, write each whole number from 2 to 30 in the correct circle. (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2005, P. 20)

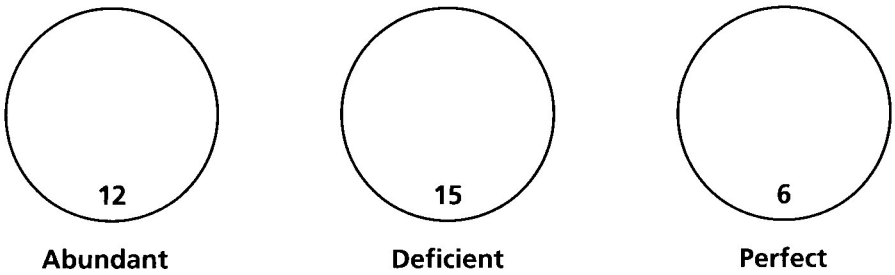


Figure 16: Abundant, deficient and perfect

She asked the students to pull out lab sheet 1.2. "It is going to have all our answers on it." She asked the students to draw three big circles. We are going to be talking about three words. The first word is abundant. "Who can tell me what abundant mean?" One student said it mean a lot.

"The second word is deficient. The third one is perfect. What does it mean? The first circle I'm going to have 12, the second (deficient) will be 15 and then the last one is 6." She asked the students to investigate why the first circle is labeled abundant, the second circle is deficient and the last one is perfect. Moraa told the students, "talk about it with your partner, talk about it with your group." One student said he thought 12 was abundant because it had a lot of

factors. He also thought that 6 was perfect because his score and his opponent's score were the same (6). He was not sure why 15 would be deficient.

Moraa then asked one of the students to discuss it on the board. The student explained by comparing a player's score and the opponent's score to say whether a number is abundant, deficient or perfect. Moraa then told the students to use lab sheet 1.2 to classify which moves are abundant, deficient, or perfect. The kid listed all of the numbers from 1-30 in the three circles. She then told everyone to pay attention and started going through the task. She told them if they had any one wrong, they should correct their answers. She called one student to the board and asked' "I have 5, what does my opponent get—1; where does 5 go? Deficient. I have 6, what is my opponent's score— 6, where does 6 go? Perfect." She continued, "I have 15, what is my opponent's score —9, where does 9 go? Deficient. I have 18, my opponent has 21— abundant. One of the students filled the circles as shown below.

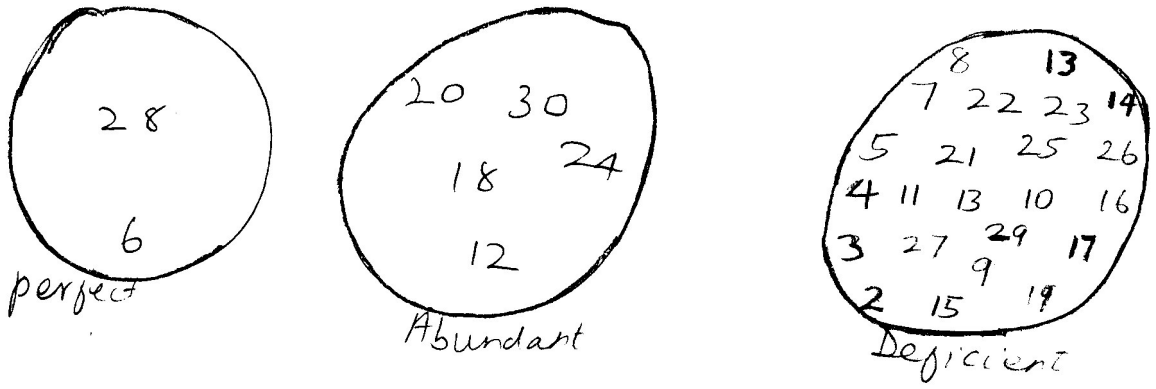


Figure 17: Abundant, deficient and perfect

Finally Moraa gave the definitions of the three vocabulary words, and she asked the students to write them in the glossary section of their notebooks.

*Abundan*t: The sum of the proper factors of a number is greater the number

*Deficien*t: The sum of the proper factors of a number is less the number

Perfect: The sum of the proper factors of a number is equal the number

This is the section that I noticed only Moraa covered with the intent of waiting for the rest of the team members to catch-up because she was ahead of the other two teachers.

In the in-school professional meetings, Moraa said that they usually talk about how things have gone in the past or how did this lesson go last week. They talk about how all of that has been, and then they talk about what needs to be done between then and the end of the nine weeks, and they talk about what they should be doing the next couple of weeks and how fast they should go. Moraa explained further that in the in-school professional development meetings, they take time to

> talk things out to see how we do different things with different students. That is the biggest thing, and Bochere is wonderful. I mean so is Kemuma and Nyanchoka. We all get along well; we all listen to each other. We are all open to the ideas and that is the best part. We learn from each other (Moraa 3rd_interview 11/03/05, line 338-341).

One of the ideas the mathematics coach (Bochere) reminded them about at the in-school professional development was how their instructor at Michigan during the summer taught the product game. The instructor first played with the whole class and then gave the opportunity to the participants to play among themselves. When I visited Moraa's class she started the product game by reviewing the product game rules.

She then said:

> In the factor game, you start with a number and find its factors. In the product game, you start with factors and find their product. The product Game board consists of a list of factors and a grid of products. The object is to mark four products in a row—up and down, across, or diagonally—before your opponent does.

She asked the students if they had ever played the game—connect four, where you can get four up, down, across, or diagonally?

> This is kind of the same thing. She said, in this game, you have the game board and two papers clips. Since I'm not playing you yet, let us have red pen versus blue pen. Red versus Blue player; blue take a paper clip and puts is in one of the numbers below the

product board. Then the second person (red) takes the second paper clip and puts it down on the number they decide to choose. Let us say the first one chose 1 and then I choose 8 we will have 1x8=8. I multiply the factors together to get my multiples. So the red will circle 8. Now blue's turn, you can only move one at a time. Blue wants to get four in a row while red does not want blue to get 4 in a row. I can only move one paper clip, I cannot move 2. It does not matter which one I move, I can move either of them. I can only move one; I cannot move both of them, one at a time. Let us say, I want to get 16. If blue want to get 16, what move should I make? —move 1 to 2 to get 16. So blue will circle 16. Now what do you think red will do again? Move 8 to 9 to get 18, circle 18. Get your own strategy — don't get my strategy, think outside the box. What will blue do?

1	2	3	4	5	6
7	8	9	10	12	14
15	16	18	20	21	24
25	27	28	30	32	35
36	40	42	45	48	49
54	56	63	64	72	81

Factors:
1 2 3 4 5 6 7 8 9

Figure 18: Product game board (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2005)

She pointed to one student, and the student said he would circle 30. She asked the rest of the class, "what are factor of 30?" One student said, "they are 2 and 15." Moraa noted "but 15 is not in the game board so we cannot use it. Will 9 time anything gives me 30?" The students said, "No."

Moraa said, "you need to rethink what you are doing. Remember you are trying to get 4 in a row. You can use your own strategy." She told them that if you can't think defensive think offensive. She asked then to think what could be done. "Think defensively." They went through the game, and finally the blue worn. She then asked, "are you ready to challenge me now?" The whole class said "yes".

They now started playing with Moraa. The students coordinated their strategy and won the game. The teacher and the class shared the winning strategy they used. Moraa then gave the game board and two paper clips to each group to play among themselves. In this lesson, Moraa used techniques that she learned from attending the summer institute and also from in-school professional development meetings.

Moraa feels that everything she needed was provided in helping her to implements the GPS. Right from the planning stage to summer institute and then the in-school professional development, a lot was provided. The only thing she had a big issue with is the way in which the CMP materials were delivered:

> If we would have had everything this summer, then I could have got my boxes ready for the whole school year. You know just got them ready to have things put in it. The manipulative, if we could have got them this summer we could have been playing with them ourselves and actually starting to go. Well what we wanted to do is sit down this summer and go through the book — all of us get together, go through the book, and have our stuff ready and have all of these done before school started. So that we would know what we were doing and know how to do it, instead of having to learn a week before we teach it. That was the biggest thing was not having the material earlier. And when we did the training in Michigan, it was on CMP1 not CMP2 (new version) and things in CMP2 some of the stuff changed (Moraa 3rd_interview 11/03/05, line 347-355).

One thing that they did not do in this meeting was discuss about sequencing of topics. This was taken care of several months before they started using the materials. As Moraa explained:

> …we did sequencing last summer, it is flexible as long as we get the standards met, it doesn't matter which nine weeks we get them in. But as a team, as the math team, we sat down and decided which ones would go with which ones in which nine weeks but with the sixth graders being the first time we have flexibility with that (Moraa 3rd_interview 11/03/05, line 318-321)

Moraa noted that so far the implementation has been going well. She was asked to say how their students have reacted to the new way of doing mathematics. In response to that, Moraa explained:

> With Prime Time (the CMP book) it took them a little bit of getting used to because they were not used to, like I said before, they were used to doing everything on pencil and paper with numbers and they weren't used to having to think for themselves, and they weren't used to having a lot of manipulative. Now when we use them, they get it. And I always hear them say, well, I wish they would have showed us this way before. Or this makes sense because I can see it and touch it (Moraa 3rd_interview 11/03/05, line 174-179)

When I attended Moraa's classes, I noted that a number of students very much enjoyed the new way of teaching mathematics, especially the product game. One student asked Moraa, "Is there a possibility that this year we will have a factor game tournament?" Moraa said that was a wonderful idea. The students seemed to enjoy doing mathematics that they could see, touch, and even play with. Moraa believes that all students can succeed using the CMP textbook series, especially if they get Spanish version books to help with language and reading.

Because of the language and reading issues, Moraa has used additional materials from other sources. The three teachers came up with supplementary materials in their in-school professional development. The issue of reading dominated a number of in-school professional meetings, and they decided to supplement the materials in order to accommodate non-English readers. As Moraa explains:

> My two lower classes, not my higher ones, but just for the lower ones, the ones that needed more of the skill because at the beginning some of them got discouraged because of all the words. And so to get their self-esteem up we would pull out a work sheet which — I hate work sheets. We would pull it out and we just did the skill stuff, and they would get it. And you could see their self-esteem get up higher and higher. Then they would go back to this. And that's when we decided to do a bit of it and then give them something else. Just a bit of it that way they would get used to it and they would be more open-minded to it than just shutting down (Moraa 3rd_interview 11/03/05, line 182-288).

In spite of challenges during the implementation process and the accountability system, Moraa has enjoyed the process. They have successfully implementing the GPS and they look forward to new ideas. As a matter of fact, Moraa noted her students' test scores went up. "Let me show you what my students did. My smallest increase was 32 points. My highest increase was 53 points.

So that is what my students did." (Moraa 3rd_interview 11/03/05, line 360-361) The test scores did not go up for Moraa alone, but for the sixth grade, there was an increase as shown in Figure 20. As their mathematics coach put it in her January 30, 2006 newsletter:

> Continued analysis of the percent gains from pretest to posttest over the past 5 quarters show continued improvement. We attribute this success to a number of factors. First, the math teachers are using both the past and current data to inform and improve instruction in key areas. We are celebrating achievement and identifying topics and students that need more or a different focus. Second, the generous budget provided to the math department this year allowed us to invest in some wonderful new resources, curricula, and manipulatives. Third, subject area specific time during extended and staff development days have provided invaluable time for grade level teams to share strategies that work and plan for future lessons.

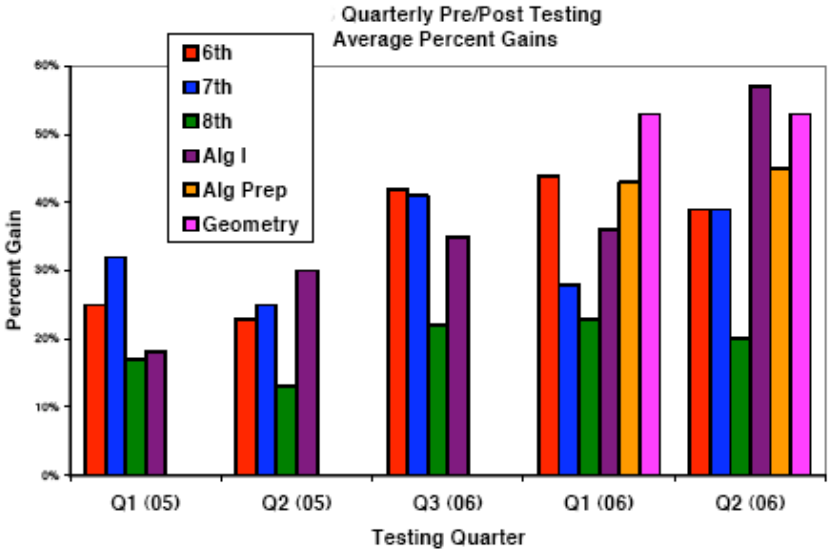


Figure 19: Quarterly Pre/Post Testing Average Percent Gain

Kemuma

Kemuma did not expect adoption of a textbook until two years after they adopted the CMP series. Kemuma was involved in the selection process to some degree, but more of the decision of selecting the material was done by the mathematics coach because of her knowledge about the materials and also the advice she got from experts. As Kemuma puts it:

> Bochere brought in several books and let us look through them and she kind of persuaded us toward this one and when we looked at it we said; ah, that looks great. So it was not like a long, drawn-out process where we had to study one and study another and she had

> told us some good things about this and we trust her judgment. So we all agreed upon it. Now if I had disagreed with the decision, then, you know, we could have chosen something else. But she wanted to make sure that everybody agreed, and we trusted her and we agreed with her (Kemuma 3rd_interview 11/03/05, line 10-16)

One of the elements that Kemuma liked about the materials was that they seemed to match with the GPS in the order they liked to teach them. She likes the book, which she found to be different from other types of books she was used to. She is used to drill and practice books. Kemuma noted that the program has good things to offer but at the same time, there are issues and concerns. As Kemuma puts it:

> I do like it though. I like it because the students have to pay attention and they have to read it and in order to do the questions they have to understand the process. They can't just guess and put something down and try to trick you into believing they know it. I guess that would be a benefit but the drawback would be the program that I teach in earth quest is—I would say 96% Hispanic and with that percentage of Hispanics, a lot of them have just gotten to the United States, and they don't read that well, and they do take the ESOL classes to help them with there English skills and their reading. And some of them just cannot—well they are not showing me, that they can read the question and really comprehend what it is asking. That is really a problem for them. So is not necessarily the book, it is the kind of students we have (Kemuma 3rd_interview 11/03/05, line 31-39)

The issue of reading due to the arrival of new immigrants is a challenge at Tabaka Middle School. To confront this problem, the mathematics coach and the reading specialist have been a great resource to the three teachers. In the in-school professional development meetings, the issue of reading has been discussed at length. The three teachers and their mathematics coach have suggested trying to read homework to students to make sure they understand it. To help the three teachers, the mathematics coach invited the school reading specialist to come and speak to them. In that meeting, the reading specialist suggested a number of strategies to help students read; for example, read for them or have an individual student read for the class. According to the mathematics coach, some of the sixth graders are reading at, 3rd, 2nd, 1st, or, in some cases, kindergarten level. This make work for teachers very challenging.

When I visited Kemuma's class, she was trying several strategies to help her students with reading and comprehension. One day Kemuma was teaching her students about factor pairs, dimensions, and square numbers. The students were supposed to write the three vocabulary words in the glossary section of their notebooks. A notebook, which is a big thing in the implementation of CMP, has been an improtant part of Kemuma's instruction. The students in her class keep notebooks and have notebook quizzes frequently.

In defining a factor pair, Kemuma noted; "A factor pair is basically two numbers you multiply together; if I say what is a factor pair of 36, what could say, 6 times what?"

The students said, "6."

"What about 12, what are the factor pairs of 12? 3 and what? "

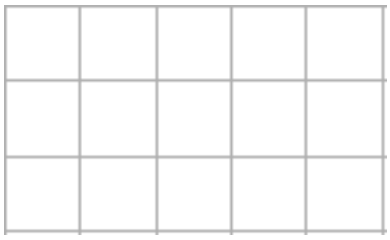
Another student said "4."

"Factor pairs are two numbers put together to get a product. If I say 12, the factor pairs can be 1 and 12 right? It can also be 2 and 6. Okay, what else can you use for 12? What is another factor pair of 12?" Kemuma looked around if any student would respond. "1, 12; 2, 6; and what?"

One student said, "3, 4."

"So does everybody see what a factor pair is?" The students responded in the affirmative.

Kemuma said, "The next word is dimension. Let us read the definition of dimension." She asked one student to read what dimension was from their textbook's glossary section at the back of their book. The student read, "The dimensions of a rectangle are the lengths of its sides. For example, the rectangle below has side length of 5 and 3. We can refer to this rectangle as a 5x3 rectangle."

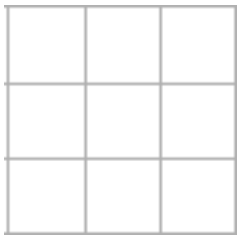


5x3

Figure 20: Dimension-5x3

After the student completed reading, Kemuma said, “Dimensions — you have probably dealt with length, height, and area — volume has to do with dimensions as well. So what it is saying is; if you have 15, the dimensions of 15 looks like a 3 by 5, it has the length and width.” She pointed to the figure 3X5 above. She demonstrated by saying; “there are 5 squares in a row and 3 in each column. So this 5 by 3, means there are how many squares here?” The students did not respond. She then said, “What is 5 by 3?” The students said, "15." “So make sure you know that because we will be doing dimensions in a few minutes.”

Kemuma then moved to the next vocabulary word — square number. She asked one student to read the definition from the glossary section of their textbook. The student started as follows, “A number that is a result of the product of a number eeeh…” she got stuck and Kemuma assisted her in reading the word multiplied. “… multiplied by itself (she continued reading) for expl…,” (she struggled to read the word example unsuccessfully until Moraa helped her read the word). The student continued struggling to read “...9 and 64 are square numbers because 9 = 3x3 and 64 = 8x8. A square number repreeends (Kemuma helped her read the word represents but the student still could not read it well) represents a number of square teeee (the student got stuck and Kemuma helped her read the word tiles) “…tiles that can be areeeee (she struggled to read the word arranged; Kemuma helped her again) arranged to form a square."



3x3

Figure 21: Dimensin-3x3

It took too much time for the student to read the definition. Kemuma explained what a square number is by giving examples. There were a number of instances that Kemuma asked students to read; sometimes some of them could read smoothly but in some cases, as just illustrated, they read with great difficulty. Some of the students were reading at kindergarten level, and those are some of the students the three teachers were dealing with. The students did not only have a problem with reading, they also had a big problem with basic punctuation, for example the usage of a full stop, a question mark that plays in establishing meaning in reading as evidenced in the following classroom episode. Kemuma read the following problem which came out of their textbook as:

> *Twenty-five classes from Martin Luther King Elementary School will play the Factor Game at their math carnival. Each class has 32 students. How many game boards are needed if each pair of students is to play the game once*?

Kemuma let the students try to solve the problem, but they got stuck. One student said, "It is 400," but he could not explain how he got 400. After students gave several answers that were not what the teacher expected, she decided to read the problem for them so that they could figure out what they needed to do. She started reading, "25 classes." She commented, "whenever there is a number in math, take note of that and wait for extra information that you might need that number for, we will find next." She continued reading: "*classes from Martin Luther King Elementary School will play the Factor Game at their math carnival.* So what do we know?" One student

said, “There is going to be a math carnival.” Kemuma then asked, “What is going to happen?” Another student said there would be a factor game.

"How many classes will be there to play the game?'

The students said, “25.”

Kemuma said, “Yes, that is what that sentence has told us. Each classes 32 students. So how many classes do we have?”

The students said, “25.”

“Yes, there are 25 classes, and how many students are in each class?"

The students said, “32.”

Kemuma continued reading, "How many game boards are needed if each pair of students is to play the game once?"

The students said, "it is 25 x 16 = 400." The student who had earlier suggested that 400 was the answer complained that Kemuma did not seem to regard his answer as correct, but Kemuma reiterated that he did not give an explanation how he come up with 400. In this episode, Kemuma was interested in their understanding of the problem.

In one of the assignments that Kemuma give her students, she realized they were not making a distinction between a multiple choice question, a question, and a question with more than one part. The assignment that Kemuma gave was:

> *(a) A prime number has exactly two factors, 1 and itself. If you circle a prime number in the Factor Game, your opponent will receive at most one point. Explain why. Give some examples.*
> *(b) A composite number has more than two factors. If you circle a composite number in the Factor Game, your opponent might receive more points than you. Explain why. Give some examples.*

Kemuma pointed out to the students that:

> it has got *a* and it has got *b*, it does mean it is a multiple choice question you choose a or b, it has part a and part b, ok?. So if you would have read the question, then you would know it has two parts to it, not just putting down a or b, when you do that, it shows me that you are even not reading it.

Kemuma not only wanted her students to know how to read but also to improve their comprehension. In a number of instances, she could ask students to explain what they had read. According to Kemuma, reading had been a great challenge to the implementation process and feels that CMP materials were basically designed for average students:

> They were targeting their own grade level students. In the program that I teach in, there may be 20% their own grade level or above and the other eighty percent are below grade level. Some are on kindergarten, some are on 1st grade, and some are on 2nd. So with a book like this, in order to read it and understand it and be able to do it, I think it was written with a sixth grade level, at least, in mind. The books have a lot of words and when the students see all the words on the page they just shut down. And they will use words that the students may not be familiar with and the positive thing about it is they do have vocabulary and this is the first time I have ever done vocabulary in math. They have to test on that vocabulary so they are getting an attitude, you know their personal vocabulary. I think it is just written above their level (Kemuma 3rd_interview 11/03/05, line 46-55).

When asked to comment as to why they are doing the professional development meetings and what has it produced, Kemuma explained that:

> The professional development meeting that I have with the other three teachers. We get together like we are going to do this, and, you know, they will often express the same concern — I have students that can't read this or don't know what this means so we come together and develop a plan for those students so they can be reached rather than just leaving them hanging out to drop. So we plan together, then we discuss what has worked, what didn't work — so we will know next time what we can change. One of us has a fabulous idea that just went great, you know, we get to share that with the others, that way we can all try it. When we are in there, we do go through, all of us go through chapter-by-chapter section and we will say, okay, this is what we will teach on Monday, this is Tuesday, this is Wednesday and we break it all out. If we do not get to it; if one person does not get to it, that usually means the other two didn't get to it as well. So that helps us all I think. I definitely believe the meetings are worth it. Because sometimes I just feel like this is just a horrible lesson I just didn't teach it well. They are just not getting it but then I will go ask the others and they will say the same thing with their students. So that makes you feel better knowing that you weren't the only one that didn't

> reach the students that day. So then we all three come up with ways to do it again (Kemuma 3rd_interview 11/03/05, line 67-87).

Kemuma reiterated that the act of meeting has helped them greatly. They share materials, more so for one of their colleague who is teaching sixth grade for the first time. "Last year she taught seventh and eighth grades and so she does not have any resources for sixth grade so we do — we all pull together and see what we have and we will decide on something that we all like." So they pool their resources together to see what they think will be best for the students to do to get the concept. Basically, the three teachers share a lot and their mathematics coach, according to Kemuma, has been absolutely fabulous. As Kemuma put it,

> Our math coach is absolutely fabulous, when we have problems when we don't know what else to do we will go to her and she will help us solve it, and, for example, if they are not quite getting it out of the text book you will go and say can we pull from another place and she will say, yes, do what you need to do in order to get them to understand it. So she understands that it is not going to be perfect and it is not going to be word by word by the book each day. So she is very supportive and she helps us with a lot of anything we need, resources, just support she's more than willing to help (Kemuma 3rd_interview 11/03/05, line 107-112).

The in-school professional meetings also provide opportunities for teachers to discuss what they learned in the summer institute. One thing that they learned at the institute was how to keep notebooks. In the in-school professional meetings, they shared how they were helping students organize and maintain their notebooks. They discussed what to include in the notebook quiz and how it should be administered; i.e., by timing it. Anything in the notebook, right from investigation/ACE to vocabulary in the glossary section was fair game in the notebook quiz. When asked if there were specific kinds of activities that she now regularly does in her classroom that she had not done before, Kemuma responded, "Yes, my students are having to write a journal entry, they have to do vocabulary and they have to keep a notebook. I've never

had them actually keep a notebook organized in sections before." Kemuma reiterated she learned the idea of notebooks when she attended a summer institute at Michigan. As Kemuma explained:

> I actually got the ideas from the professional development we did in Michigan this summer. Where other teachers have already taught this, some have taught it for 10 years. They were there to give us advice on how to go about doing it, doing this new series. So, you know, they said it is absolutely imperative that they keep a notebook. You know, one of the pages in the book after each chapter is a journal reflection. I believe writing is very important. All I usually see is just their numbers. And when they write their journals it gives me a chance to see their handwriting, how they write, and their thought process. Rather than just okay they can add two plus two but can they write a sentence? So I get to see another side of them (Kemuma 3rd_interview 11/03/05, line 219-226).

The days I visited Kemuma's class, she always had a start-up. In the start-ups, she had vocabulary words that students needed to know and wrote them down in the glossary section of their notebooks. She did assign journal reflection homework and took time to help students organize their notebooks. The students are expected to keep up their notebook, and they are assessed through a notebook quiz. As Kemuma explains:

> I think that would help in the aspect that the students know that they have to be responsible and they have to keep an organization about themselves and about their notebooks. The questions come from the notebook. If they just write it down they are going to have it. But you would be surprised at how many people that don't pass the test because they don't just write it down and keep up with it. So you have to let them know that you are serious about it. It might not be something that they would like to do, but they are going to have to do it, it is part of life to keep the organization of the notebook (Kemuma 3rd_interview 11/03/05, line 235-241).

Kemuma tries to put into use what she learned at the professional development meeting as much as she can. In her class, she uses groups as a way of promoting discussion among students. She arranged her class in groups of three that worked together in class. Having students working in groups is something Kemuma learned when she attended the summer professional development meeting that was also reinforced in the in-school professional meetings. One activity that I witnessed her use was groups to foster learning was in the product game. She started the class by distributing the product game board as shown below and two paper clips of

different colors. The students had to decide either to use X or 0 in making their products in the product game board.

1	2	3	4	5	6
7	8	9	10	12	14
15	16	18	20	21	24
25	27	28	30	32	35
36	40	42	45	48	49
54	56	63	64	72	81

Factors:
1 2 3 4 5 6 7 8 9

Figure 22: Product Game Board

One pair started their game, each looking for a winning strategy by either blocking the opponent or making a move that could enable them to win. One pair that I watched played the game as shown in the following game board blow:

Figure 23: Product Game Board

I moved from one group to another, and the students were really enjoying playing the game. They were speaking in Spanish, but sometimes I could request they use English so I could understand what they were doing. They seemed to enjoy the game — I noticed some of them played in between lessons, and some of them said that they had played the game with their parents.

Another hands-on activity that Kemuma used with her students was to enable students to come up with all possible dimensions of numbers. She gave them an example of the possible dimensions of 15—1x15; 15x1; 3x5; 5x3

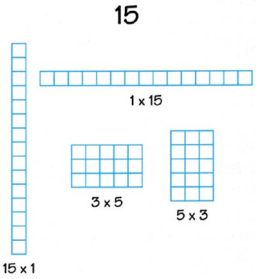


Figure 24: Dimensions-1x15; 15x1; 3x5; 5x3 (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2005)

Then she gave the students grid paper and asked them to come up with dimensions of 12. The students uses the provided grid paper and came up with all dimensions of 12 and represented them on the grid paper. One student had the following representation of dimension of 12:

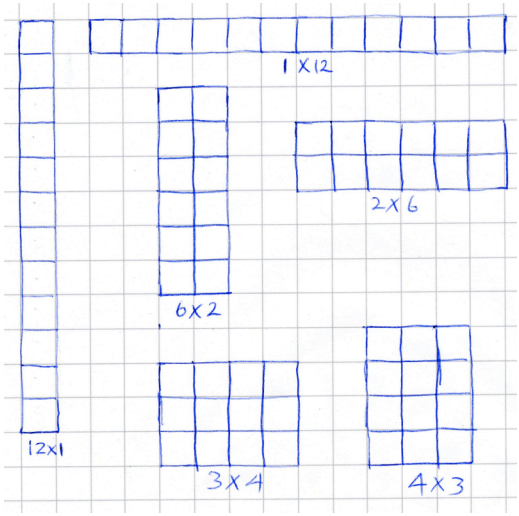


Figure 25: Dimensions of 12

Kemuma then gave an assignment. She said, "I will give each person a piece of graph paper. Then you will draw all the dimensions and cut them out and glue them on another paper." She showed them the model she wanted them to come up with. She then distributed the graph paper to each person. She asked them to work in groups and gave them a number, to come up with its dimensions. For those who did not finish the work in class, they had it as homework. Having students work in groups and using hands-on activities is a new thing for Kemuma, but she is very excited about the new approaches to teaching.

When Kemuma was asked to comment how it has gone so far, she pointed out that:

> ...some days I think it is going pretty good. Other days I wonder, and then I will have a parent come and say I love this new math you are doing. I have parents do that. There is a lady; there is a group of about 25 teachers who go out to eat on Thursday nights and she teaches at an elementary school but she tutors three students at this school and she sees me every Thursday. And she will always tell me I love that new math you are doing. I love it! It is just fabulous. So the way other people are seeing it outside of the classroom is more in a positive light. The word is getting out, and they are liking it so that makes me feel better, you know. Okay, good, we are doing something right here (Kemuma 3rd_interview 11/03/05, line 213-225).

Not only parents have had a reaction towards the new curriculum but students as well. Basically, students have had a positive response to the materials. As Kemuma puts it:

> It is funny because I will hear them say; Gosh, I get it now, I know how to do it, and, you know, maybe their maturity is as far as their mind is, going for another year from what they had it last year, but the process about doing it and they get to work in groups. Where before, I have never worked, they've never worked in groups in my classes just because that is something I heard that you didn't do in the math class. But I like doing that, and I think they enjoy it because they can interact with each other. Not get in trouble, but they are still working. The comments about the books they made would be simply why couldn't we write in it? Where is our workbook? Why do we have to get a new one every so often? Because when we switch topics we switch books. And other specific comments would be like come-on, we have to read all this, or I don't know what it is asking. It surely isn't that much that they have to read. They are just being lazy on that part. The sections are not very long at all (Kemuma 3rd_interview 11/03/05, line 136-146).

Kemuma believes that her students can be successful in using CMP materials if they can go beyond the reading issue of the language barrier, and think they all can be successful, but they need to put forth their effort as well. "A lot of times when they see the words, they will just shut down." The problem of reading is what every teacher at Tabaka Middle School is working on. The teachers have discussed the problem at various levels and come up with a number of recommendations aimed at helping their students. As Kemuma explains:

> Once again, the big barrier that I face is the words, and we talked about it in our professional development — what is another way? Is there a way we can break it down any further? And we talked about even previewing, maybe the day before we do something — tell them this is what is coming up, maybe they will read ahead. You know have the initiative to take it upon themselves and say I want to see what it is all about, and, you know, when you tell them instead of saying, oh, gosh, tomorrow we've got to add fractions. You say tomorrow we get to add fractions (More enthusiastic sounding). It is all in your tone, you know, if you are excited about it. They are going to pick up and they are going to pick up, and they are going to more tuned in and more excited about it. Like I say when we are in the professional development, we do talk about these things. And we talk about what we could do differently. And then when we go back we try it and see if it works (Kemuma 3rd_interview 11/03/05, line 197-207).

Because of challenges posed by reading, Kemuma sometimes feels she does not have enough drill and practice on what they are doing, and she did pull material from other places to supplement the CMP materials. So she is pulling the basic concept from another book that is just the problems until they get to a section that they are able to understand. "That way they are still getting the performance standard but just from a different book" (Kemuma 3rd_interview 11/03/05, line 257-258).

With the challenges of the implementation process that Kemuma and her colleagues have gone through, and the accountability system that they are subjected to, she proudly states that the implementation of GPS has been successful. As she puts it:

> Personally as far as my scores go, they went up about 40%, but I had one class that was a 77% and that was the highest they got, and to me that is not high. You know before they

would get up to 80 something or ninety something percent. That is where I want them. The principal has mentioned in meetings before that the sixth graders are doing a new curriculum and that he is pleased with the scores and it looks like they are really doing a good job and so he seems to be pleased with what we have done so far (Kemuma 3rd_interview 11/03/05, line 372-378).

CHAPTER 5

SUMMARY AND DISCUSSION

This study examined multiple change processes in one middle school. The school was simultaneously implementing a new mathematics curriculum, new performance standards mandated by the state, and a new accountability system. This has been the story of teachers and a mathematics coach dealing with these multiple challenges to improve mathematics instruction in one middle school.

Statement of the Problem

Understanding the implementation of the Georgia Performance Standards and the implementation of the Connected Mathematics Project curriculum judged to be consisted with the GPS standards in the context of accountability system has shaped my research questions:

1. How does the mathematics coach see the summer professional development activities, and how did it affect teacher practice? How do the three teachers see the summer professional development activities, and how do they think it affected their teaching practices?
2. How does the mathematics coach perceive the accountability system in the school district, and how does she interpret the Georgia performance standards in mathematics? How do the three teachers perceive the accountability system in the school distinct, and how do they interpret the Georgia performance standards in mathematics? How do these interpretation affected mathematics coach's practices (decisions about professional development activities)? How do the interpretations affect teacher practices?

3. How does the mathematics coach see the ongoing district-wide Connected Mathematics Project professional development activities, especially those she is responsible for, and how do the three teachers respond to them? How does this professional development affected teacher practices?

Review of the Method

The research reported here comprised a case study of a middle school following the work of the 3 three teachers and a mathematics coach during the coordinated implementation of the Georgia Performance Standards (GPS), the Connected Math Project (CMP), and the accountability system. This research used a qualitative approach, attempting to discern the meanings of events to the participants. The case study covered one week of the summer institute and weekly, sometimes daily, in-school professional development designed to help with the implementation of CMP. CMP is judged to be a middle school mathematics curriculum consistent with the GPS.

This case study relied chiefly on observations, interviews, and written artifacts. I interviewed each participant three times, with each interview lasting for 45 to 60 minutes. The first interview was about the experiences of the teachers and the mathematics coach at the summer institute, and the second interview discussed the impact and implications of the district accountability system. Finally, during the third interview, discussions were focused on the implementation process and the role of the in-school professional development in the implementation process. I observed each of the three teachers 25 times in their classrooms and also attended seven of the in-school professional development meetings run by the mathematics coach.

Summary of the Results

The results of the study were presented in three stages: the summer experience of the three teachers and their mathematics coach; what they had to say about the district accountability system and the Georgia Performance standards; and, finally, the in-school professional development and the actual implementation process of the Georgia Performance Standards.

Summer Institute Experiences

The three teachers and their mathematics coach attended the one-week summer institute. Their experiences were different and similar in many ways. For Bochere, the mathematics coach, the summer institute was a rich experience for her and also for the three teachers. They had the opportunity to have good discussions about the mathematics and pedagogical strategies, and they gained familiarization with the materials as they discussed seven of the eight CMP units. However, the institute failed to address some of the issues about managing the system of Connected Mathematics — for example, how to keep notebooks, how to grade homework, and how to manage groups. Bochere expected those issues from the classroom to be discussed, but they did not even touch those topics at the summer institute. She learned about some of those issues from other group members at the institute. Also, Bochere learned that CMP activities are connected in such a way that following the lessons in the proper sequence is vital, which seems to indicate that the aim and richness of the lesson and its connectedness might be lost if that sequence is not followed.

Next, Bochere noted that by attending the institute, she and the teachers learned to use cooperative groups as a classroom management strategy. The three teachers had not used cooperative learning before in their classroom instruction, but now it was part of their

instruction. Not all of the teachers interpreted cooperative learning as a way of classroom management but rather as another way of teaching. Finally, Bochere pointed out that by attending the institute, they learned there are multiple ways of assessing students. They did not learn this through their instructor, however, but rather by interacting with other participants. They learned from other participants about student notebooks, notebook quizzes, and how to assess students' homework.

For Nyanchoka, the institute gave her the opportunity to work through seven of the eight units of CMP. The teachers worked in groups at the institute, and the group members changed every day. Nyanchoka believed it was easier to give rules to her students and show them how to do the procedure and move on to the next topic rather to let them figure it out themselves. By attending the institute, she learned it is important to back off and let the students figure out the mathematics, which, she said, might be hard to do. Also, Nyanchoka learned of multiple ways to assess her students. She previously would assess her students by paper and pencil, but now she could use observation and their classwork to assess their understanding. She learned at the institute how to use students to assess each other. That was something she had not been doing but planned to try.

Nyanchoka also learned to use group work in her instruction. This was a new strategy for her — she preferred that students do their work individually. She saw that having students working in groups helped them share ideas and teach each other, but on the other hand, Nyanchoka thought that the group could be used as a place to socialize. She did not see group work as a necessary means of classroom management, because she was a tough teacher. Finally, she also learned the use of manipulatives, something that she had not used often before, because she had interpreted them as a distraction. Students used them as toys instead of as learning tools. But by

attending the summer institute and taking summer classes, the effective use of manipulatives has been an eye opener for her.

For Moraa, there were a number of things she learned from the summer institute. First, she learned how to use the CMP materials. The instructors walked the teachers through seven of eight CMP units, giving the participants a general understanding of the materials, and Moraa was very confident about using CMP. She learned that instead of giving formulas to her students, she could give them manipulatives and they could figure out the mathematics themselves. She seemed to suggest that appeared enabled students to understand mathematics conceptually. Also, Moraa learned about students working in groups; something she had not done before. She saw group work as a way of classroom management and a way for students to have activities together to promote collaboration among students.

Next, Moraa learned about the other assessment practices that she would adopt in her class. She would use notebook quizzes, class observations, and individual student work to evaluate her students. Finally, she noted that by attending the institute, the four teachers built bonds with each other that would be vital when it came time to collaborate. Collaboration was vital in the implementation process.

By attending the institute, Kemuma gained a better understanding of the CMP material and how it works. Also, in addition to gaining the content part of CMP, she also gained some pedagogical ideas. The teachers learned about the use of cooperative learning strategies by dividing into small groups. The idea of groups was very new to her; she had never used them before. She looked at groups as a way of engaging her students with the mathematics and, therefore, taking care of challenges of classroom management. Next, she learned that there is

more than one way of assessing students. Pen and pencil is not the only way of assessing their understanding.

District Accountability System and the Georgia Performance Standards

The district accountability system initiative was geared towards improvement of students' achievement. Bochere saw a number of good intentions of the accountability system. First, the accountability system required teachers to give pretest and posttests. The pretest could provide vital data to support instruction. It could tell the teacher what the students know and do not know so that the teacher could decide where to spend more time. Bochere explained that the posttest generated additional data to show how much students had gained. The three teachers and the Mathematics Coach agreed this kind of information would be very important to teachers in their instruction. The teachers very uncomfortable, however, with the decision of the administration of their school to display each teacher's class scores, indicate the pretest and the posttest results and how much the students had or not improved. This information was posted in the hallway and also on the Internet. That made the teachers very sensitive to the issue of accountability.

Also, the accountability system held teachers accountable for the materials they taught. The teachers knew what their students were going to be tested about, and it was their responsibility to get those the students ready. As far as the GPS was concerned, Bochere interpreted the new standards as an indication that the state wanted teachers to teach mathematics more conceptually and that the standards were worded in such a way as to make that possible. This means, the pretests and tests of the accountability system need to reflect GPS standards.

Nyanchoka pointed out qualities that made her like the accountability system. She saw the accountability system as a way of giving teachers an opportunity for self-evaluation, a way for teachers to improve their teaching. On the other hand, she voiced some opposition to the system.

She did not want to be put under a microscope; she did not like being judged by putting her students' scores on the walls of the school hallways. At the same time, Nyanchoka said that being put under a microscope could lead to weeding out bad teachers. She pointed out that when she signed a contract to work at Tabaka Middle School, she knew what she was walking into, and, therefore, this system should not come as a surprise. Additionally, Nyanchoka interpreted the GPS as a way in which the state had taken more objectives and compressed them into fewer objectives while requiring more mathematics in the process.

To Moraa, the accountability system was a good thing as long as it was not used as a way of evaluating teachers, and she had no problem with posting her students' scores in the hallway. She seemed to feel that parents, teachers, and students need to know what teachers are doing through their students' scores. According to Moraa, the main weakness of the accountability system was that it did not take into account the make-up of the student population. The school had a high population of immigrant children, who have real problems with reading. So when the scores were compared among teachers, some teachers who have majority native speakers in their classes would tend to do well, but that factor was not reflected when the scores were displayed. Also, displaying the scores in the hallway, might affect the self-esteem of those teachers whose students had low test scores and might force a teacher to abandon new, innovative ways of teaching in favor of old methods that worked well in the testing process.

Moraa interpreted GPS as a way the state seemed to have come up with fewer objectives than in the Quality Core Curriculum (QCC); but according to her analysis, that was not the case. They had simply combined a number of objectives to be taught at the same time rather than one at a time.

Kemuma saw the accountability system as the pretest and posttest with the results posted in the hallway and on the Internet. She saw the system as having both positive and negative implications. She suggested that one weakness was that when the scores are displayed with the teachers' names, it might lead to judgments about teachers without considering other factors that contribute to students' scores. She suggested that factors in a given class, such as language and students' ability to read, were never given as a factor in the analysis of the scores. On the other hand, she suggested that one strong point of the accountability system was that it could aid instructional planning by allowing teachers to use the pretest results. The pretest showed what the students know and do not know. Kemuma suggested it could help the teacher identify areas in which to spend more time. Kemuma interpreted the GPS and the QCC as pretty much the same, with the only difference being that the GPS were organized differently from the QCC.

Implementation Process

The implementation of GPS was done by using the CMP materials. The three teachers were supported in their implementation through the in-school professional development that was run by the mathematics coach. The mathematics coach and the three teachers gave their opinions about the in-school professional development program and how it might have worked for the three teachers.

For Bochere, there were a number of challenges in the implementation of CMP. First, she felt that the teachers were frustrated because of the pace at which they were covering topics. It was taking too long to cover each section. She believed that that would not be a problem the following year. Also, the issue of reading was a challenge. Half of the children at the school were immigrants with limited reading skills. To help with the issue of reading, the mathematics coach has used the in-school professional meetings to discuss ways to improve students' reading. Second, Bochere feels that that in-school professional development had helped the three teachers feel that they were not alone; that there was somebody to talk

to in case of a problem. It created a sense of togetherness, with the teachers sharing teaching strategies and self-reflection.

Nyanchoka pointed out challenges the teachers faced in the implementation process. First, she believed that the CMP materials required too much time to cover a topic, which made it difficult to finish the syllabus and get the students ready for the Georgia test, the Criterion Referenced Competency Test for Grades 1-8 (CRCT). Also, she was frustrated because the CMP materials were not geared toward nonreaders or children who speak a different language. She spoke about that challenge during the in-school professional meetings. In those meetings, the teachers sat and voiced their opinions of what they thought about the materials and shared teaching strategies. Nyanchoka thought the in-school professional meetings greatly helped her in that they created a sense of sharing and learning more about CMP. In those meetings, she learned a number of things. She continued to learn how to incorporate manipulatives and cooperative learning in her instructions. She also learned how to use student notebooks to help students learn mathematics and improve their reading. Her students were doing journal writing and reflections as part of the student notebook assignments.

For Moraa, there were a number of issues related to the implementation process. The issue of reading with ESOL students was a challenge. She expected to be supplied with Spanish versions of the CMP materials to help with reading problems, but that never happened. Also, not only did she not receive Spanish language CMP materials, she did not receive enough English copies for her students. In spite of the challenges, the CMP material provided an opportunity to teach mathematics conceptually. Some teachers learned to use manipulatives and hands-on activities in their classrooms. Also, she noted the in-school professional development provided a place for sharing teaching strategies and reflections.

Kemuma praised the CMP materials because they seem to match the GPS. But the CMP materials came with their own challenges — primarily, the reading challenge for ESOL students. The in-school professional development was valuable to Kemuma in trying to help her students improve their reading skills. Kemuma used several initiatives gained from the in-school professional development sessions to

make the implementation of CMP possible. She learned from her colleagues in terms of teaching strategies, the use of manipulatives, and cooperative learning.

Discussion of the Results

Interpretation

On the basis of this study alone, it is difficult to be certain about the value of the CMP summer institute experience and its impact on teacher practice and the implementation of the GPS As described above, the three teachers and their mathematics coach described the experience as an opportunity to have good discussions about the mathematics and pedagogical strategies and to become familiar with the materials. There is evidence from the kind of activities (e.g., factor game and product game) the teachers used in their classroom, the use of manipulatives, the kind of discussions in the in-school professional development sessions of the same activities and strategies they used/ will use, and from interviews I conducted that mainly two of the three teachers gained on understanding of the content and pedagogical strategies of the materials by attending the institute. Much of this is essential to implementation, the GPS standards. Research by Kent, Pligge, and Spence (2003) indicates that staff development targeting new content and how it might be taught enables teachers who are using standard-based curriculum materials to learn needed pedagogical and content knowledge in distinct and pleasant ways. Some of the strategies the three teachers used were cooperative learning and the use of manipulatives to foster student learning. The three teachers used new strategies in their classrooms, but not all seemed to buy into the new learning strategy as the best way to move forward.

The in-school professional development that was run by the mathematics coach played a significant role in supporting teachers to implement the GPS standards and use what they learned

at the summer institute. The fact that the mathematics coach was on site, meeting with teachers and discussing both content and pedagogical issues related with the materials, affected the teachers greatly. By having this support on-site, there was evidence that teachers had the immediate opportunity to try strategies learned in their classroom. The mathematics coach attended the in-school professional development session and played a key role in giving feedback. She also attended some classes of the three teachers and gave them feedback at the end of the lesson.

It was suggested by some teachers that sometimes giving rules to students and moving on seemed to work well. Such strongly held beliefs can be a challenge to reform unless there is sustained long-term professional development. Therefore, the efficacy of the teaching strategies used by teachers needs to be examined over a longer time to judge its sustainability. In this study, two participating teachers applied standard-based instructional techniques to a higher degree than did the third. Other than praising the CMP program, she still had strong reservations towards it and its effectiveness. The study highlights the need to have long-term professional development as a way to change deeply held beliefs. According to Borchers, Shroyer and Enochs (1992), new knowledge acquired through long-term professional development improves teaching. "They must also identify or develop local expertise to provide on-site assistance for their teachers. Only through continuous assistance, training, support, and funding can those changes be made" (p. 390).

Again the study underscores the need of having a on-site professional developer to support teachers in changing their beliefs and practices. As a matter of fact, the experience at the institute seems not to have had only a positive impact—it was inferred that some issues that the participants expected to be covered ended up not being addressed at the institute. Some

participants felt that they did not get all they had expected and therefore decided to seek help elsewhere by taking summer classes and also seeking help from the mathematics coach.

Prior to the summer institute, the teachers and mathematics coach were involved in the selection process of CMP for their school's mathematics curriculum and they believed it to be consistent with GPS. Even though teachers were not informed about the new middle grades standards-based curriculum, other than what they had learned from their instructional coach, they were given an opportunity to have their input in the selection process. They compared four middle school standard-based mathematics curricula, and all agreed they preferred CMP. The act of being part of the selection process gave the teachers a sense of belonging and not having decisions imposed upon them. Ball (1994) it is asserts that "Teacher development is especially productive when teachers are in charge of the agenda, determining the focus, nature, and kind of programming or opportunities" (p. 22).

The implementations of CMP went well, but were a number of challenges. First, CMP materials seemed to help teachers question their former instructional practices, and there is an indication that some of the teachers had come to the realization that they needed to teach mathematics conceptually. There were subtle signs, however, that the teachers still preferred to teach by rules and procedures—teaching mathematics by telling. As Smith (1996) explains, "Even when experienced teachers see the reforms as embodying changes that they want to make, the shift away from telling can leave them feeling uncertain, vulnerable, and out of control" (p. 396).

The current study indicates that sustained long-term professional development is the key to implementation of the GPS. On the other hand, there were issues such as reading that were not considered when the CMP materials were selected. The school had a large Hispanic population

of immigrants, most of whom had limited reading ability. The CMP material had more words than numbers, which was different from the way mathematics books were traditionally written. The students who had limited reading ability struggled with the materials as their teachers also struggled to help them. The in-school professional development meetings under the leadership of the mathematics coach provided an opportunity for the teachers to discuss the issue of reading. There were signs that teachers were using strategies learned in the in-school professional development, but the efficacy of the strategies needs to be studied in more depth. Also, the teachers lacked support materials such as Spanish versions of the CMP materials that could have been used to ease the reading problems. Hence, findings from the study highlight importance of providing of sufficient time and other resources to enable teachers to understand facts, reflect on student work, and try new approaches to teaching. The student's notebook is one of the key elements of CMP materials. Student notebooks seem to help students in mathematical vocabulary, organization skills, journal writing and reflections. The notebooks were also used as a means of assessing students through notebook quizzes that assessed them on their vocabulary and their homework.

The summer institute and the in-school professional development promoted a culture of sharing among the three teachers and their mathematics coach. There were signs that the three teachers needed each other — in planning, teaching, and also assessing their students. There was also some evidence that collaboration trickled down to what these teachers were doing in their classroom in terms of the activities they used and the way they presented those activities. Research by Kilpatrick, et al (1996) indicates that collaboration among colleagues that promote sharing can help to make curriculum development work.

Before the teachers attended the summer institute, they were involved in "unpacking" the standards. The main goal of unpacking the standards was to understand what was expected of the teachers. In this study, some teachers did not really make any distinction between the GPS and the QCC other than saying that GPS was another form of QCC, just worded differently. Since this was a case study, we should not assume this interpretation represents the way other teachers might interpret GPS. However, these teachers and the mathematics coach interpreted the GPS and determined that CMP should be used as a way to implement GPS. These teachers were in the process of the GPS and were using Connected Mathematics Program as a means of implementing the GPS.

The accountability system at Tabaka Middle School is a big thing. The school has been recognized by the Bush administration as a model of the No Child Left Behind initiative. This study uncovers issues worth noting. First, it seems that the issue of pretests and posttests made sense to the teachers as a way helping them make instructional decisions. Posting teachers' names with their students' test scores, however, was very demoralizing for some teachers. It seemed that the teachers did not object to having their names in the hallway as long as it was not used as a way of evaluating their performance. Similar findings were arrived at by the Kalamazoo (1974) study. One issue that this study cannot address is the impact the accountability system had on the achievement of students and to what extend the tests reflected genuine learning of mathematics. For that, more research needs to be done, but according to a study done by Newmann, King and Rigdon (1996),

> external accountability alone offers no assurance that a school faculty will have adequate technical knowledge and skills, sufficient authority to deploy resources wisely, or shared commitment to a clear purpose for student learning. Theoretically, both accountability and organizational capacity are required for high performance. But it is also possible that strong accountability can be achieved within a school community, without prescriptive mandates from a district or state. (p. 62)

Strengthening the school accountability system to reflect the GPS implementation at Tabaka Middle School should be carefully thought out and should incorporate input from the teachers.

The position of mathematics coach is a new phenomenon in this school district. The results of this study indicate that having a mathematics coach can have positive effects on the teaching staff. At this school, however, it seemed that the role of the mathematics coach was not spelled out clearly, and as a result, she sometimes had more to do than she was able to handle as evidenced from my observation and the interviews with her. She had the responsibility of making tests and co-teaching with other teachers, and she had her own class to teach. That seems to be a lot on her shoulders. She did not have as much time to co-teach with other teachers as she would have liked. Additionally, the problem was aggravated by the fact that the CMP publishers did not deliver supporting materials on the time schedule agreed upon earlier. The three teachers seemed to appreciate the kind of support their mathematics coach rendered, especially the in-school professional development that she provided.

Implication for Practice

Although a single case study cannot provide what needs to be known about the implementation process, this study (and other case studies with similar findings) would suggest that long-term professional development is critical to successful curriculum implementation. Also, the issue of accountability must be carefully thought out before it is put into practice. Teachers need to be held accountable, but that should be done in a way that promotes their instructional skill rather than simply assessing their performance. Next, teacher collaboration and reflection can greatly help teachers as they try to improve their teaching. Teachers need support not only among themselves but also from outside sources; they need to be given the opportunity

to attend professional development meetings wherever possible. Finally, in any decision-making, teachers need to be involved or consulted because they are the one to be directly affected.

Suggestion for Additional Research

Additional research seems needed on what teachers learn by using innovative curriculum material with sustained professional development. Additionally, more research needs to be done on the role of the mathematics coach in the implementation process and what alternative mechanisms for sustained professional leadership can be developed for schools that do not have someone to fill such a role.

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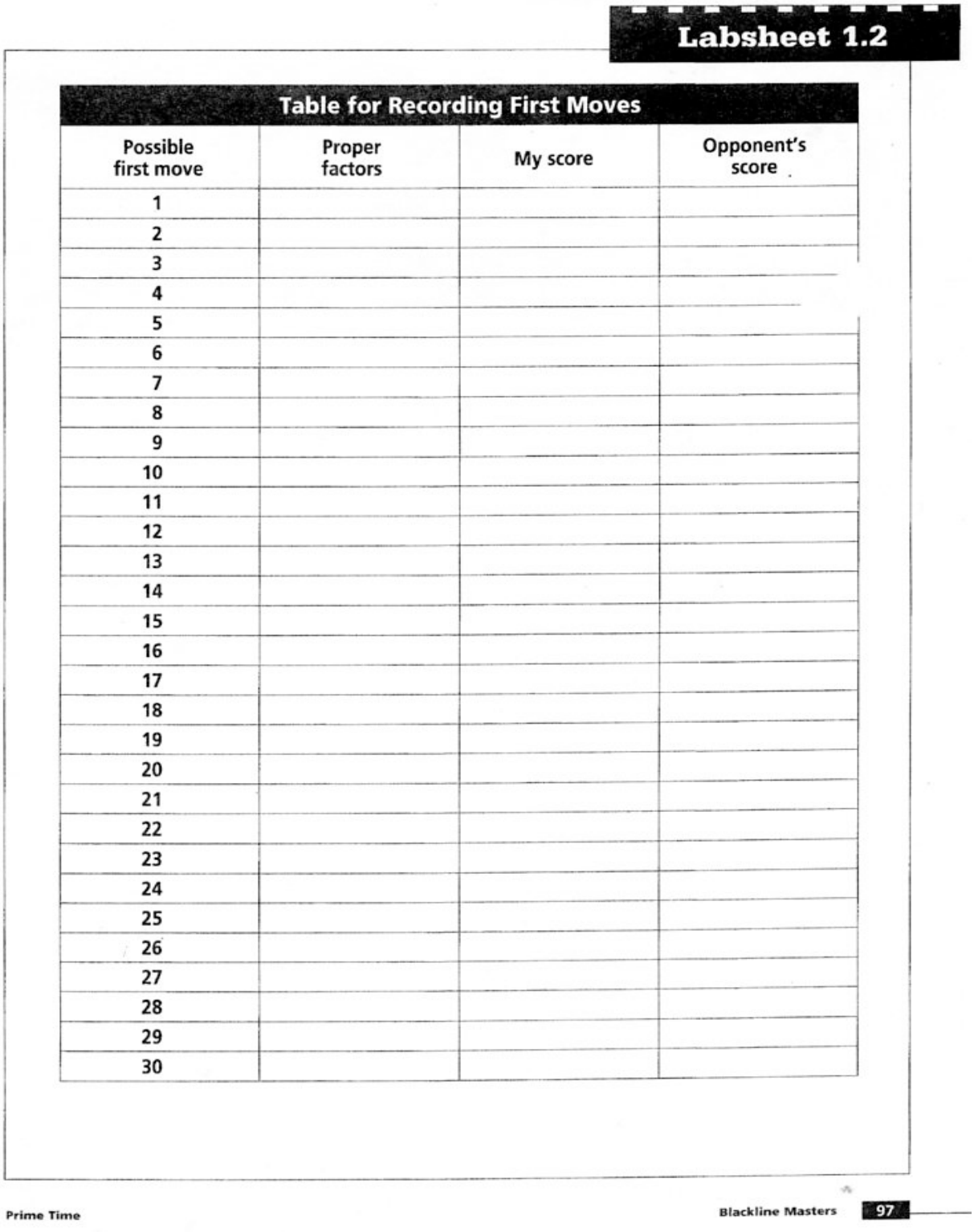
Labsheet 1.2



Labsheet 1.2

Table for Recording First Moves

Possible first move	Proper factors	My score	Opponent's score
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
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21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

Prime Time

Blackline Masters 97

Notebook Quiz no. 1

Notebook Quiz #1

Name:_____ Period:_____ Date:_____

1. Write the definition of a divisor.

2. Give an example of a prime number.

3. Write the proper factors of 24.

4. Using the possible first move of 28 in the factor game, write what the opponent's score should be.

5. From the text page 10, write the answer to question D.
(hint: see lab sheet 1.2)

6. List all possible ways to get a product of 60.

7. _____ X _____ = Multiple

8. By which of these numbers is 64 divisible? (Homework Sheet)

   a. 12 b. 16 c. 2 d. 6 e. 8

Investigation no. 1 Quiz

10

Prime Time Unit
Investigation #1
Quiz

Name: _____
Date: _____
Class Period: _____

Part One. Match each following term with its correct definition.

_____1. Composite Number	A. A number that is not a multiple of two
_____2. Prime Number	B. All of the factors of a number, *except* the number itself
_____3. Factor	C. A whole number with factors other than itself and 1 (that is, a whole number that is not prime)
_____4. Divisor	D. One of two of more whole numbers that are multiplied to get a factor
_____5. Multiple	E. A number that divides a given number leaving a zero remainder
_____6. Proper Factors	F. The product of a given whole number and another whole number
_____ Odd Number	G. A number that is a multiple of two
_____8. Even Number	H. A number with exactly two factors

Part Two. Write the answer the each question in the space below it.

9. What factor is paired with 7 to get 28? How do you know?

10. Find two numbers that have 2 and 5 as factors?

11. Circle the number that has the most factors?

20 30 15 21 23

12. If you were playing the factor game, which of the numbers in Question #11 would be the worst first move? Why?

13. Write a sentence using the words *product* and *multiple*.

14. Suppose you were playing the product game and for her first move, Lisa put the paper clip on the number 4. Name 3 possible squares on the board that you could "hit." Why can you make these moves?

15. Is the following statement true? Why or why not?

> *The number 9 has an odd number (three to be exact) of factors but an infinite number of multiples.*

APPENDIX B

Interview Protocol 1: Mathematics Coach

The following interview is aimed at understanding the implementation of CMP and GPS in your school district. If at any time, you feel uncomfortable and wish to quit the interview, you may do so. If you do not wish to respond to a question, that is fine. Your interview will be tape recorded and confidential. Only the researcher (Samuel Obara) will have access to your identity, and in the presentation of the data, it will be impossible for readers to connect your response to you. The researcher is not seeking to evaluate your program, but to understand the process and impact of implementing a new curriculum. Your complete, honest, and thoughtful responses are appreciated. They are needed to fully understand the process of implementation.

- Thinking back to before you attended the summer institute, what did you to gain from it? What did you anticipate the three teachers would gain from it?
- Please tell me in chronological order how events evolved during the institute? What were they?
- What was gained from the activity?
- What was your experience like attending the institute?
- Did the summer institute activity cause you to change any of the following aspects of your practice?
    - Planning
    - Classroom management
    - Teaching style
    - Assessment practices
    - Teacher collaboration

        If so, which ones?

        If not, why?
- For these three teachers, what are your expectations of the impact on their teaching practices? How do these expectation influence your decisions for professional development activities? What are the sources of evidence you will have for understanding the impact on teacher practice?

Interview Protocol 1: Teacher

The following interview is aimed at understanding the implementation of CMP and GPS in your school district. If at any time, you feel uncomfortable and wish to quit the interview, you may do so. If you do not wish to respond to a question, that is fine. Your interview will be tape recorded and confidential. Only the researcher (Samuel Obara) will have access to your identity, and in the presentation of the data, it will be impossible for readers to connect your response to you. The researcher is not seeking to evaluate your program, but to understand the process and impact of implementing a new curriculum. Your complete, honest, and thoughtful responses are appreciated. They are needed to fully understand the process of implementation.

- Thinking back to before you attended the summer institute, what did you to gain from it? What did you anticipate the three teachers would gain from it?
- Please tell me in chronological order how events evolved during the institute? What were they?
- What was gained from the activity?
- What was your experience like attending the institute?
- Did the summer institute activity cause you to change any of the following aspects of your practice?
    - Planning
    - Classroom management
    - Teaching style
    - Assessment practices
    - Teacher collaboration

        If so, which ones?

        If not, why?

Interview Protocol 2: Mathematics Coach

The following interview is aimed at understanding the implementation of CMP and GPS in your school district. If at any time, you feel uncomfortable and wish to quit the interview, you may do so. If you do not wish to respond to a question, that is fine. Your interview will be tape recorded and confidential. Only the researcher (Samuel Obara) will have access to your identity, and in the presentation of the data, it will be impossible for readers to connect your response to you. The researcher is not seeking to evaluate your program, but to understand the process and impact of implementing a new curriculum. Your complete, honest, and thoughtful responses are appreciated. They are needed to fully understand the process of implementation.

- Describe the district accountability system.
- What are the strengths and weakness?
- What do you think the three teachers perception is of the accountability system?
- Do you think the accountability system will have an impact on teachers when implementing CMP and GPS?
    - If so, what impact?
    - If not, why?
- What role do you think will GPS will play in your and the three teachers':
    - Planning?
    - Classroom management?
    - Teaching style
    - Assessment practices
    - Teacher collaboration
- What is your understanding of the GPS, how do you interpret them?

Interview Protocol 2: Teacher

The following interview is aimed at understanding the implementation of CMP and GPS in your school district. If at any time, you feel uncomfortable and wish to quit the interview, you may do so. If you do not wish to respond to a question, that is fine. Your interview will be tape recorded and confidential. Only the researcher (Samuel Obara) will have access to your identity, and in the presentation of the data, it will be impossible for readers to connect your response to you. The researcher is not seeking to evaluate your program, but to understand the process and impact of implementing a new curriculum. Your complete, honest, and thoughtful responses are appreciated. They are needed to fully understand the process of implementation.

- Describe the district accountability system.
- What are the strengths and weakness?
- Do you think the accountability system will have an impact on you when implementing CMP and GPS?
    - If so, what impact?
    - If not, why?
- What role do you think will GPS play in your daily:
    - Planning?
    - Classroom management?
    - Teaching style
    - Assessment practices
    - Teacher collaboration
- What is your understanding of the GPS, how do you interpret them?

Interview Protocol 3: Mathematics Coach

The following interview is aimed at understanding the implementation of CMP and GPS in your school district. If at any time, you feel uncomfortable and wish to quit the interview, you may do so. If you do not wish to respond to a question, that is fine. Your interview will be tape recorded and confidential. Only the researcher (Samuel Obara) will have access to your identity, and in the presentation of the data, it will be impossible for readers to connect your response to you. The researcher is not seeking to evaluate your program, but to understand the process and impact of implementing a new curriculum. Your complete, honest, and thoughtful responses are appreciated. They are needed to fully understand the process of implementation.

- Think back to the textbook adoption process this year, what was your initial reaction to this textbook series? Why? (Try to get specifics)
    - (If they say something else was better) What did you think was better about the other series?
- Now that you have been using the text for some time, what do you think of it?
    - What are the benefits and drawbacks of the program?
    - Why are we doing the professional development meetings and what has it produced?
- How has the professional development gone for you so far?
- What are some of the barriers you and the three teachers have with this series?
    - What are the benefits of the professional development meetings?
- Are there specific kinds of activities you are now regularly doing in your professional development session?
    - Where did you get the idea to do these (e.g., recommended by book, from professional development, etc.)
    - How have you made the decision to use them? (Did you try them out and like them, did you just like the idea, did someone else here recommend it, etc.)
- What are the benefits and barriers of this program?
- How have you dealt with sequencing and topic to be covered in professional development meetings that you run? How has sequencing and topic covered been influenced by the implementation of GPS?
    - How do you decide the order for covering the materials?
    - Is this a different order than you are used to using?
    - What have you thought about this new sequencing?
- What professional development activities are you responsible for and what are your expectations for their impact on teacher practice?

Interview Protocol 3: Teacher

The following interview is aimed at understanding the implementation of CMP and GPS in your school district. If at any time, you feel uncomfortable and wish to quit the interview, you may do so. If you do not wish to respond to a question, that is fine. Your interview will be tape recorded and confidential. Only the researcher (Samuel Obara) will have access to your identity, and in the presentation of the data, it will be impossible for readers to connect your response to you. The researcher is not seeking to evaluate your program, but to understand the process and impact of implementing a new curriculum. Your complete, honest, and thoughtful responses are appreciated. They are needed to fully understand the process of implementation.

- Think back to the textbook adoption process this year, what was your initial reaction to this textbook series? Why? (Try to get specifics)
    - (If they say something else was better) What did you think was better about the other series?
- Now that you have been using the text for some time, what do you think of it?
    - What are the benefits and drawbacks of the program?
    - Why are we doing the professional development meetings and what has it produced?
- How has it gone for you so far?
- How have your students reacted to the new ways they are doing mathematics?
    - Have they made any specific comments about these books?
    - How have they adapted to the new ways of doing mathematics?
    - Do you think all of your students can be successful using this textbook series? Why or why not?
- What are some of the barriers you have faced with this series?
    - How did you deal with those in your professional development meetings? How have you dealt with them in practice?
- Are there specific kinds of activities you are now regularly doing in your classroom that you had not done before? (e.g., journaling, reflection, toolkit…)
    - Where did you get the idea to do these (e.g., recommended by book, from professional development, etc.)
    - How have you made the decision to use them? (Did you try them out and like them, did you just like the idea, did someone else recommend it in your professional meetings, etc.)
- Have you supplemented the materials in the books at all?
    - What kinds of things have you supplemented with?
    - Why have you supplemented?
- We know that this curriculum is a different approach that what you have been used to. What are the benefits and barriers and how do you deal with those?
- How have you dealt with sequencing in your professional development meetings that you daily attend? How has sequencing and topic covered been influenced by the implementation of GPS?
    - How do you decide the order for covering the materials?
    - Is this a different order than you are used to using?
    - What have you thought about this new sequencing?
- What professional development activities so far have been provided for you and how have they helped or failed to help with your teaching practice?