Creating the Path Together: A Case Study of a Mathematics Professional Development Program for Teachers of English Language Learners

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CREATING THE PATH TOGETHER: A CASE STUDY OF A MATHEMATICS
PROFESSIONAL DEVELOPMENT PROGRAM FOR TEACHERS OF ENGLISH
LANGUAGE LEARNERS

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Educational Leadership Doctoral Program
Submitted in partial fulfillment
of the requirements of
Doctor of Education
in the Foster G. McGaw Graduate School

National College of Education
National-Louis University
March, 2008
Abstract

The purpose of this case study was to describe and analyze the Mathematics Access for Language Learners (MALL) professional development project. This project’s primary goal has been to provide teachers with the knowledge, strategies, tools, and materials to help make mathematics content accessible to their English Language Learner students. This study used case study methodology. Data was collected from archival records, participant observations, and interviews with project participants, facilitators, and the project director. The results and analysis of this study are provided through the framework of Bernice McCarthy’s 4MAT instructional model. The project is then analyzed to determine if it is an exemplary model for professional development, and the discussion of this study offers implications for leadership, recommendations for future research, and considers the role of leadership in supporting systemic change.
Dedication

This dissertation is dedicated to my parents,

James and Irene Whittington,

with admiration and gratitude

for always holding high expectations,

and always supporting their attainment.
Acknowledgements

Thank you to all of the teacher participants of the MALL project who graciously gave their time in granting me interviews and providing me the data that was the foundation of this study. Your energy, commitment, and thoughtfulness energize and inspire me. Thank you for allowing me to be part of this project and learn from each of you over the past four years.

A special thank you goes to the project director, who is a model of integrity, professionalism, and leadership. Without your help, thoughtfulness, and encouragement this study and this project would not be possible. It has been an honor to work with you and learn from you.

My sincere appreciation is extended to all the members of my dissertation committee. Your support and guidance have been an inspiration throughout this program. Most especially, I would like to thank my advisor, Dr. Linda Tafel, for tirelessly meeting with me and providing invaluable feedback and guidance in the preparation of this dissertation.

Thank you to my family and friends who have stood by me as I immersed myself in this work. Your support and understanding have meant the world to me. Thank you, too, to the entire Madison cohort for welcoming me with open arms. It has been a privilege to share this path with you.
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Chapter 1
INTRODUCTION TO THE STUDY

Introduction

I first became involved with the MALL program during the summer of 2004 as a project facilitator. I had just completed my first year as a mathematics specialist at a school in Midville Public Schools (MPS) with a large population of English Language Learners (ELLs). The principal of my school had heard about the MALL project from a friend and colleague of hers and knew that the project was looking for someone bilingual in Spanish and English with a strong background in mathematics to support teachers in the project over the summer. I did not know much more than that before accepting the summer position and beginning my work with the project.

Immediately, the project goals and its participants impressed me. Not only did I wish I had had the opportunity to participate in this project as a classroom teacher, as a teacher leader I recognized a tremendous need for quality professional development programs that address the specific needs of teachers of ELL students. This program seemed far more valuable than the typical one-shot workshops I had attended throughout my career as an educator. This program took the teachers’ needs seriously and approached head-on the challenge of helping teachers of ELL students make mathematics content accessible to their students.

Over the course of my career in a large urban public school district I have had held several different positions. I have worked as an elementary and middle grades bilingual teacher, mathematics specialist, and district facilitator. Throughout these
experiences, three themes have emerged—professional development, mathematics education, and teaching English Language Learners. I am passionate about each of these areas, and continue to work to develop my expertise in each of the three areas. I have had opportunities to study and learn about these areas separately, but for me, the Mathematics Access for Language Learners (MALL) project was a rare intersection of my three professional worlds and areas of interest.

I believe that professional development is an essential component of school improvement. Teaching is challenging and demanding work that requires professionals to continually develop and improve their practice. Without support and development for educators, we cannot expect schools to improve to meet the needs of the diverse student populations they serve. “We will fail, as we have failed so many times before, to improve schooling for children until we acknowledge the importance of schools not only as places for teachers to work, but also as places for teachers to learn” (Smylie, 1995, p. 92).

With the release of the NCTM Standards (1989, 2000), our conception of what it means to teach and learn mathematics changed dramatically. The underlying goal of the NCTM standards is to create mathematically adept students who can communicate, justify their position, and use complex thinking and reasoning strategies to solve problems. Making these new goals a reality for students has presented an enormous challenge for teachers who have been asked to take on roles and responsibilities that are inconsistent with the way they have been teaching, were taught to teach, and were taught themselves as students of mathematics (Smith, 2001). Professional development is necessary to provide teachers with the opportunity to improve their understanding of
mathematics and to reflect on their learning experiences (Hill & Ball, 2004; National Research Council, 2001; Smith, 2001; Stigler & Hiebert, 1999).

I believe that every child has the right to a high-quality and equitable mathematics education. Teachers should have high expectations and provide support for all students to learn mathematics. “Equity does not mean that every student should receive identical instruction; instead it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students” (NCTM, 2000, p. 12). In order to ensure equity for English language learner students, mathematics educators working with these students must be cognizant of what is known about the complex process of learning a second language (Cuevas, 1984). Quality professional development opportunities are even more necessary to help teachers develop their proficiency in meeting both the content and language needs of their ELL students.

I also believe that quality professional development programs are hard to find. In choosing the MALL project as the focus of my research I believed that the MALL project is a quality professional development project that meets the needs of content area teachers of ELL students. I believed this story needed to be told and held valuable lessons for school and district leaders about designing professional development programs to help teachers meet the content and language demands of the students they serve.

Purpose of the Study

This study is a case study that describes and analyzes the Mathematics Access for Language Learners (MALL) professional development project. This project’s primary goal has been to provide teachers with the knowledge, strategies, tools, and materials to
help participating teachers make mathematics content accessible to their English Language Learner students. My study focused on the implementation of this project between Summer 2004 and Fall 2007.

I believed that a deeper understanding of this specific professional development project could help district leaders and professional developers further explicate and understand the components of quality professional development programs. Ball and Cohen (1999) argue for building a collection of examples of practice-based professional development. They state, “having such instances would make it possible to engage the ideas in ways that are grounded in practice of professional development, concretizing the discussion. Those cases should be studied and distributed widely. . . . The materials should be vivid enough to be compelling, concrete enough to provide resources for others efforts, and open enough to avoid being converted into lists of abstract principles and ‘shoulds’” (Ball & Cohen, 1999, p. 29).

This case study attempted to fill that need. My study tells the story of a quality professional development program over time and helps to connect the current literature on professional development to practice. I believe that leaders will be able to identify with the challenges and reality of this project, and ultimately might begin to see how elements of a program like this could inform their own work in their own context.

Setting of the Study

The MALL professional development project serves teachers in the Midville Public School system. Midville is a large Midwestern city. The Midville Public School (MPS) system is a large urban school district. Nearly 15% of MPS students are
categorized as limited-English-proficient and almost 85% of the district’s students come from low-income families (MPS website, retrieved 5/31/07).

The MALL project is a professional development partnership between the Midville Public Schools and City Arts College (CAC). CAC is one of several universities in Midville. CAC is an undergraduate and graduate college whose principal commitment is “to provide a comprehensive educational opportunity in the arts, communications, and public information within a context of enlightened liberal education. [CAC]’s intent is to educate students who will communicate creatively and shape the public’s perceptions of issues and events and who will author the culture of their times” (CAC website). The project director for the MALL program, Dr. Katherine Johnson, heads the education department at CAC, and was formerly an MPS teacher.

Teacher participants for the MALL program voluntarily apply to participate. Teachers are recruited from schools within the district that have high ELL populations and implement standards-based mathematics curricula. The MPS system does not have authority to mandate curriculum, so individual schools make their own decisions about what curriculum to implement in all subject areas. In 2003, MPS launched its Science and Mathematics Initiative where schools are encouraged to implement designated mathematics and science instructional materials and the district provides support through centralized, grade-level specific professional development in each of the curricula, negotiated pricing, and other incentives. Many of the teacher participants in the MALL program have already completed up to 60 hours of professional development at their grade level for their respective mathematics curriculum. This professional development covered mathematical content knowledge, teaching strategies, and implementation tips
specific to the curriculum. This professional development did not address the needs of ELL students.

The MALL project’s primary focus is on teachers in grades three, four and five. These grade levels are targeted because they are the grade levels at which many ELL students transition to English-only classrooms. The most common program for ELL students in this district is a transitional bilingual program where students are increasingly expected to perform academically in the English language after only three years of schooling. In third grade, these students also begin taking annual state assessments in English.

Significance of the Study

Current national as well as individual state efforts to improve K-12 mathematics education are founded on the conviction that _all_ students deserve a rich mathematics program (National Council of Teachers of Mathematics, 1989, 2000). This includes students who are in the process of learning English as a second or new language. Rich mathematics programs are deeply connected to the National Council of Teachers of Mathematics (NCTM) standards emphasizing problem solving, reasoning and proof, communication skills, the ability to make connections, and the ability to represent mathematical concepts. Acquisition and application of such skills present challenges to all students, but even more so to second language learners, especially when the expectation is for them to demonstrate their use of such skills in a new language (Collier, 1995; Cuevas, 1984; Cummins, 1984; Gibbons, 2002; Olivares, 1996).

The number of English language learners (ELLs) in our schools continues to grow significantly, particularly in urban areas. One urban district alone reported in 2004 that
there were approximately 60,000 ELL students, representing almost 20 different languages. Statistics from the National Clearinghouse for English Language Acquisition (NCELA) indicate a 95% increase in the enrollment numbers of ELLs in school systems across the country from 1991-92 to 2001-02. Numerically, this increase represents more than 4.7 million English learners in K-12 classrooms (NCELA, 2006a). Most of these learners are in elementary schools. Spanish is the native language of more than three-quarters of Limited English Proficient (LEP) students in U.S. schools. No other native language exceeds three percent of the LEP population (NCELA, 2006a).

While many ELLs receive instruction in their home language or spend a portion of their school day in English as a New Language (ENL) classes, most ELL students learn alongside native English speakers in English-only classrooms. In many school districts, district guidelines mandate that all ELLs must transition into English-only classrooms after three years in bilingual programs. Typically, this transition occurs at or after third grade, and means that ELLs must learn content and academic language simultaneously. However, as indicated by research, the students’ English academic language skills may not be proficient enough at the point of transition to be able to meet the demands of a rich mathematics program (Collier, 1987; Cummins, 1984). Therefore, for English learners to be able to access rich mathematics curricula that reflect state and national standards, it is imperative that general classroom teachers understand how to prepare students for the transition to English-only classrooms and support both students mathematics learning and English language development.

Most teachers have little or no preparation for working with ELLs. Research on teacher preparation or professional development for work with ELL populations indicates
that only 12.5% of teachers have received eight or more hours of coursework or professional development for adapting instruction appropriately for ELLs (Gruber, Wiley, Broughman, Strizek, & Burian-Fitzgerald, 2002). This places English learners at substantial risk of not being able to access mathematical learning, and thus at greater risk for academic failure (Peske & Haycock, 2006).

For English language learners to be able to access rich mathematics curricula, it is important that the general classroom teachers understand how to prepare students for the transition into English-only classrooms, and understand how to simultaneously support the content and language development of ELL students. On both the local and national level there is a pressing challenge to integrate and increase teachers’ content-area knowledge and pedagogical skills. In many communities, the challenge extends to tailoring instruction and assessment to specific populations. The MALL project has tried to address this need for MPS teachers and students since its inception in 1998.

Education is a dynamic and professional field. Educational researchers are constantly discovering new knowledge about the teaching and learning process in almost every discipline. As this knowledge base continues to expand, new types of expertise are required of educators at all levels. Professional development is widely considered a crucial component for educational improvement (Ball & Cohen, 1999; Elmore, 2004; Fullan, 1995; Guskey & Huberman, 1995; Hawley & Valli, 1999; Ingvarson, Meiers, & Beavis, 2005). “Regardless of how schools are formed or reformed, structured or restructured, the renewal of staff members’ professional skills is considered fundamental to improvement” (Guskey & Huberman, 1995, p. 1).
Teachers must be given opportunities to grow and develop new knowledge, skills, and dispositions throughout their career. School and district leaders must work to provide opportunities for their staff to learn and develop through meaningful, high-quality professional development programs. Professional development is not an optional, add-on feature of schools, but rather, “continuous learning must be organically part and parcel of the culture of the school” (Fullan, 1995, p. 258). Professional development involves continuous teacher and administrator learning in the context of collaborative problem solving (Hawley & Valli, 1999).

Despite tremendous agreement by educational researchers on the features of effective professional development, very few examples exist which incorporate those features (Elmore & Burney, 1999; Guskey, 1995). In many districts, professional development continues to be seen as disconnected from classroom practice. Many teachers see conventional strategies for professional development as wasteful (Hawley & Valli, 1999). Although they frequently receive advice and recommendations on how to change their teaching, teachers also lack the opportunities to develop deeper understanding of these recommendations and reflect on their own practice (Stigler & Hiebert, 1999). At the present time, there is very little evidence of what constitutes effective professional development for teachers who teach mathematics to ELL students. Educational leaders must take the lead on opening the door to meaningful learning opportunities for both these teachers and these students.
Research Questions

The purpose of my case study was to describe and analyze the Mathematics Access for Language Learners (MALL) professional development project. I aimed through the presentation of the case study to answer the following research questions:

1. In what ways has the MALL project helped teachers of English language learners make standards-based mathematics learning accessible for their students?
2. How has the MALL project helped to develop leadership in teacher participants?
3. In what ways have the stated goals for teachers of the MALL program been met?
4. In what ways does the MALL professional development project meet the needs of the large urban district to support teacher growth?

Summary

The purpose of this dissertation is to provide a case study that describes and analyzes the Mathematics Access for Language Learners (MALL) professional development project between Summer 2004 and Fall 2007. A review of literature on professional development, mathematics education, English Language Learners, the value of integrating the arts, and Bernice McCarthy’s 4MAT instructional model is presented in Chapter Two. The methodology of the study is presented in Chapter Three. In Chapter Four the results and analysis of this study are provided for this case through the framework of Bernice McCarthy’s 4MAT instructional model. Finally, Chapter Five presents a discussion of the study and examines the question of whether the MALL project is an exemplary model for professional development. Chapter Five also includes implications for leadership, recommendations for future research, and my own learning
from this study about the role of leadership in supporting systemic change. A definition of terms used throughout this dissertation can be found in Appendix A.
Chapter 2

REVIEW OF LITERATURE

Introduction

This review of literature is divided four sections. The first section presents research on professional development including elements of quality professional development, components of teacher change, and information on the Japanese Lesson Study Model. The second section focuses on mathematics teaching and presents the research on the National Council for Teachers of Mathematics (NCTM) standards, standards-based instruction, professional development needs in the field of mathematics teaching, and issues related to the field including the math wars and minority access to quality mathematics education. The third section details the essential elements and best practices of teaching English Language Learner (ELL) students including using the arts as a vehicle to support language development. The fourth section of this chapter describes Bernice McCarthy’s 4MAT System.

Professional Development

The field of education is different now than it was twenty years ago. For most educators, their prior training and experiences have not adequately prepared them for the type of teaching that is expected of them today (Elmore, 2004; Guskey & Huberman, 1995). Educational researchers are continuously discovering new knowledge about teaching and learning processes. As this professional knowledge base expands, new types of expertise are required of educators at all levels (Guskey & Huberman, 1995). Standards-based reform and increased federal accountability measures, among other
changes in the cultural landscape of schools, have forced us to dramatically change our conceptions of teaching and learning. Education is a dynamic profession and as such, requires educators to enhance their professional learning across the continuum of their career (Sykes, 1999).

“The idea of learning to do the right thing—collectively, progressively, cumulatively over time—is at the core of the theory of standards-based reform” (Elmore, 2004, p. 74). The improvement of American education requires the development of a highly qualified teacher workforce imbued with the knowledge, skills and dispositions to encourage exceptional learning in all the nation’s students (Sykes, 1999). “Never before in education has there been greater recognition of the need for ongoing professional development. In-service training and other forms of professional development are a crucial component of nearly every modern proposal for educational improvement” (Guskey & Huberman, 1995).

Elements of Quality Professional Development

Not all professional development programs are good professional development programs. Complexities make it “impossible to make precise statements about what makes professional development program effective. The best that can be offered are general descriptions of factors that appear crucial to the professional development process” (Guskey, 1991, p. 240). Virtually every theory of quality professional development stresses the importance of opportunities to work with and learn from others of similar position or status (Smylie, 1995, p. 104). Various researchers have offered models of essential features or characteristics of quality professional development
programs (Elmore, 2004; Guskey, 1995; Hawley & Valli, 1999; Little, 1999; Smith, 2001; Stigler & Hiebert, 1999).

In The Essentials of Effective Professional Development, Hawley and Valli (1999) describe the consensus view of essential components for professional development programs. From their review of the pertinent research studies and national policy reports, they have identified the following eight characteristics of effective professional development programs:

- Professional development should be student-centered and driven by analysis of the differences between goals and standards for student learning and student performance
- Professional development should involve learners in the identification of what they need to learn and, when possible, in the development of the learning opportunity and the process to be used
- Professional development should be primarily school-based and integral to school operations
- Professional development should be organized around collaborative problem solving
- Professional development should be continuous and ongoing, involving follow-up support for further learning
- Professional development programs should be information rich and incorporate the evaluation of multiple sources of information
• Professional development should provide opportunities to engage in
developing a theoretical understanding of the knowledge and skills to be
learned

• Professional development programs should be part of a comprehensive change
process. There should be an organizational commitment to continuous
experimentation and improvement.

Teacher Change

It would be unreasonable to expect teachers to change simply because they are
told to do so. Significant professional development is crucial (Ball & Cohen, 1999).
Teachers need opportunities to reconsider their current practices and examine others, as
well as to learn more about the subjects and students they teach.

While it seems that most schools are constantly changing, basic conceptions of
teachers’ and students’ roles in the classroom have remained relatively static (Elmore,
2004). There is a widely held belief that teachers’ practices change as a product of
changes in curriculum, standards, and assessments (Ball & Cohen, 1999). This seems to
stem from an underlying cultural belief that “good curriculum and teaching practice were
self-explanatory, and self-implementing” which overlooks the complex process (Elmore,

In 2002, Spillane published a five-year study that investigated the implementation
of national and state policies at the district office and classroom levels. His findings from
studying nine school districts indicated that the manner in which state and federal policy
proposals are understood and disseminated by the district office influences their
classroom implications (Spillane, 2002). His work suggests that without learning
opportunities grounded in teachers’ attempts at implementing the mathematics standards and involving support and critique from peers teachers are unlikely to fundamentally reconstruct their practice. “Although not conclusive, the evidence suggests that district officials operating from a behaviorist perspective may not be as effective in supporting teachers’ implementation of the mathematics standards as those operating from a situated perspective” (Spillane, 2002, p. 410).

Spillane further found that districts and professional development that took a situated perspective were most effective. These programs focused on conversations with colleagues that were grounded in teachers’ attempts to put the standards into practice. This type of professional development enabled appreciation of the implications of the reform ideas for the core of their teaching and to learn the practical knowledge necessary for teaching in ways consistent with the mathematics standards (Spillane, 2002).

Other researchers have found that, “practice and values change in concert. Both are important and both should be the focus of new learning for teachers and administrators” (Elmore, 2004, p. 110). Learning and change are both individual and social processes. To promote meaningful changes in teacher practice, professional development should incorporate collegial interaction, shared responsibilities, commitment to shared purposes and improvement goals, ongoing support, and systematic feedback (Guskey, 1991; Ingvarson, Meiers, & Beavis, 2005; Mevarech, 1995). A substantial level of professional community is vital to significant change (Ingvarson, Meiers, & Beavis, 2005).

Even with support and a great design, fostering teacher change is still a lot of work. Change can be very threatening, even in a supportive environment (Guskey,
1991). “Learning is difficult, both for the teachers and for those who teach them, because the new disciplinary content and pedagogy represent such a tremendous shift from how teachers now teach and how they learned in school” (Spillane, 2002, p. 379). To change or to try something new means to risk failure (Guskey, 1991). However, any change that holds great promise for increasing individuals’ competence and enhancing their effectiveness is likely to be slow and require extra work, especially when beginning (Guskey, 1991). Teachers are more likely to persist in using new behaviors when they feel the support for colleagues and when they believe that professional risk taking is encouraged (Sparks & Loucks-Horsley, 1989).

In the United States, “by being in a hurry and taking the short-term view, we undermine the kinds of gradual long-term improvements that add up to real change” (Stigler & Hiebert, 1999, p. 120). Guskey (1991) states, “There is perhaps no easier way to sabotage change efforts than to take on too much at one time” (p. 241). He continues, “If there is one truism in the vast research literature on change it is that the magnitude of the change persons are asked to make is inversely related to their likelihood of making it” (Guskey, 1991, p. 241).

Elmore (2004) argues that the practice of improvement is about changing three things fundamentally and simultaneously:

1) the values and beliefs of people in the schools about what is worth doing and what it is possible to do;

2) the structural conditions under which the work is done; and,

3) the ways in which people learn to do the work. (p. 128).
Implementing the principles without culture will not work because management alone
cannot affect peoples’ deeply held values (Elmore & Burney, 1999). The change process
is slow, gradual and difficult to achieve (Mevarech, 1995).

Guskey (1985) found that the most effective strategy to helping teachers change is
to ask teachers to try out new practices and see the effects on their students, rather than
trying to change attitudes first in the hope that this will lead to change in practice.
Programs that model effective practice and invite teachers to try them out tend to be more
successful than programs that devote resources primarily to changing attitudes first. Only
when teachers see that a new program or practice enhances the learning of their students
will their beliefs and attitudes change in significant ways (Sparks & Loucks-Horsley,
1989).

The Japanese Lesson Study Model

Lesson study is a professional development model that has recently sparked a lot
of interest in the United States (Lewis, 2002) and is designed after the Japanese approach
to instructional improvement. “Lesson study is a cycle in which teachers work together
to consider their long-term goals for students, bring those goals to life in actual ‘research
lessons,’ and collaboratively observe, discuss, and refine the lesson” (Lewis, 2002, p. 1).
Educators have credited lesson study with bringing about Japan’s evolution of effective
mathematics and science teaching (Lewis, 2002; Lewis, Perry, & Hurd, 2004; Stigler &
Hiebert, 1999). The MALL professional development program began using lesson study
in the Spring of 2006.

Lesson study is a teacher-led instructional improvement cycle. In lesson study,
teachers work together to:
• Formulate goals for students’ learning and long-term development
• Collaboratively plan a research lesson designed to bring these goals to life
• Conduct the lesson, with one team member teaching and others gathering
evidence on student learning and development
• Discuss the evidence gathered during the lesson, using it to improve the lesson,
  the unit, and instruction more generally
• Teach the revised lesson in another classroom and study and improve it again
  (Lewis, 2002)

Figure 1 on the following page shows a model of the entire lesson study cycle. Lesson
study places teachers in an active role as researchers in their own classrooms. When
planning research lessons, teams of teachers draw on the best ideas from available
curricula and research, and devote more time to planning and discussion than is usually
possible in the frenzy of daily school life (Lewis, 2002).

The lesson study process has an unrelenting focus on student learning. All efforts
to improve and refine lessons are evaluated with respect to clearly specified learning
goals and data collected on student learning during the lesson implementation.
Refinements to the research lesson are always justified with respect to student thinking
and learning (Stigler & Hiebert, 1999).
Figure 1. Overview of lesson study cycle.

Research into the effectiveness of lesson study as a professional development model has indicated seven key pathways to improvement that underlie successful lesson study (Lewis, Perry, & Hurd, 2004). These pathways include increased knowledge of subject matter, increased knowledge of instruction, increased ability to observe students, stronger collegial networks, stronger connection of daily practice to long-term goals, stronger motivation and sense of efficacy, and improved quality of available lesson plans (Lewis, Perry, & Hurd, 2004).

“Lesson study is a process of improvement that is expected to produce small, incremental improvements in teaching over long periods of time” (Stigler & Hiebert, 1999, p. 121). By attending to teaching as it occurs in the classroom, lesson study
respects teaching as a complex system (Stigler & Hiebert, 1999). The aim of lesson study is not to create radical, rapid change, but rather to provide a structure for collaborative problem solving focused on improving student learning. Lesson study is a means to “enable continual growth of the knowledge, interpersonal resources, and motivation required to improve instruction in the classroom and beyond” (Lewis, Perry, & Hurd, 2004, p. 22).

Teaching Mathematics

The National Council for Teachers of Mathematics (NCTM) Standards

The NCTM’s (1989) Standards and the 2000 follow-up Principles and Standards for School Mathematics focused on new goals for society at large and for students in particular: “New social goals for education include (1) mathematically literate workers, (2) lifelong learning, (3) opportunity for all, and (4) an informed electorate” (p. 3). The Standards were oriented toward five general goals for all students: (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, p. 5).

The NCTM standards are grounded in assumptions about learning being an active process rather than one of memorization and practice. This constructive, active view of the learning process must be reflected in the way much of mathematics is taught.

The vision for mathematics education described in Principles and Standards for School Mathematics (2000) is highly ambitious. “Achieving it requires solid mathematics curricula, competent and knowledgeable teachers who can integrate instruction with assessment, education policies that enhance and support learning, classrooms with ready
access to technology, and a commitment to both equity and excellence” (NCTM, 2000, p. 3).

The NCTM standards are composed of five content standards and five process standards that should receive varying amounts of emphasis across all grades, Pre-K through 12. Figure 2 indicates the different level of emphasis each of the five content standards; Number, Algebra, Geometry, Measurements, and Data Analysis and Probability, should receive over each band of grade levels.

Figure 2. The NCTM content standards across the grade bands (NCTM, 2000, p. 30).

As is evident in Figure 2, all mathematics content strands should be a part of instruction at all grade levels. Some areas increase or decrease in amount of emphasis, as students get older. While Algebra is a significant emphasis in grades 9 though 12, it also receives some emphasis in pre-kindergarten through the second grade.

In addition to the five content standards, NCTM also included five process standards for students; problem solving, reasoning and proof, communication, connections, and representation (NCTM, 2000). Table 1 details the goals for each of the
### The NCTM Process Standards

Instructional programs from pre-kindergarten through Grade 12 should enable all students to:

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<th>Standard</th>
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<tr>
<td><strong>Problem Solving Standard</strong></td>
<td>• Build new mathematical knowledge through problem solving;</td>
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<td>• Solve problems that arise in mathematics and in other contexts;</td>
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<td>• Apply and adapt a variety of appropriate strategies to solve problems;</td>
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<td>• Monitor and reflect on the process of mathematical problem solving.</td>
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<td><strong>Reasoning and Proof Standard</strong></td>
<td>• Recognize reasoning and proof as fundamental aspects of mathematics;</td>
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<td>• Make and investigate mathematical conjectures;</td>
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<td>• Develop and evaluate mathematical arguments and proofs;</td>
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<td>• Select and use various types of reasoning and methods of proof.</td>
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<td><strong>Communication Standard</strong></td>
<td>• Organize and consolidate their mathematical thinking through communication;</td>
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<td>• Communicate their mathematical thinking coherently and clearly to peers, teachers, and others;</td>
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<td>• Analyze and evaluate the mathematical thinking and strategies of others;</td>
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<td>• Use the language of mathematics to express mathematical ideas precisely.</td>
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<td><strong>Connections Standard</strong></td>
<td>• Recognize and use connections among mathematical ideas;</td>
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<td>• Understand how mathematical ideas interconnect and build on one another to produce a coherent whole;</td>
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<td>• Recognize and apply mathematics in contexts outside of mathematics.</td>
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<td><strong>Representation Standard</strong></td>
<td>• Create and use representations to organize, record, and communicate mathematical ideas;</td>
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<td>• Select, apply, and translate among mathematical representations to solve problems;</td>
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<td>• Use representations to model and interpret physical, social, and mathematical phenomena.</td>
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five process standards. Each of these goals should be emphasized in all grades from pre-
kindergarten through the twelfth grade. According to Smith (2001), the underlying goal
of the NCTM standards is to:

Create mathematically powerful students who can communicate with their
teachers and their peers about the mathematics they are learning, who can argue
convincingly and provide mathematical justifications to support their positions,
and who can work alone and with peers to solve problems that require complex
thinking and reasoning strategies”(p. 1).

Math Wars

During the 1990s, the teaching of mathematics became the subject of heated
controversies known as the math wars (Schoenfeld, 2004). The origins of the conflicts
can be traced to the “reform” stimulated by the National Council of Teachers of
Mathematics’ Curriculum and Evaluation Standards for School Mathematics. The
NCTM Standards clearly articulated a democratic vision of school mathematics for all
children, which stood in contrast to the traditional view that mathematics was a field of
study reserved for the elite.

In the late 19th century, high school and beyond was reserved for the elite. Fewer
students graduated from high school in 1890 than earn master’s and Ph. D. degrees today
(Schoenfeld, 2004). In 1957, the Soviet launch of Sputnik spurred the American
scientific community into action. A range of modern mathematics curricula was
developed, which collectively became known as new math (Schoenfeld, 2004).

The 1970’s brought a theme of back to the basics, which was followed in 1980 by
NCTM’s publication of An Agenda for Action. NCTM proposed that an exclusive focus
on basics was wrong headed, and that the primary goal of school mathematics should be for students to develop problem-solving skills (Schoenfeld, 2004). The cognitive revolution of the 1970s and 1980s brought to light the idea that mathematical competence depended on a number of factors. These factors include:

- Having a strong knowledge base;
- Having access to productive problem-solving strategies;
- Making effective use of the knowledge one has and
- Having a set of productive beliefs about oneself and the mathematical enterprise (Schoenfeld, 2004, p. 263).

Current national as well as individual state efforts to improve K-12 mathematics education are founded on the conviction that all students deserve a rich mathematics program (National Council of Teachers of Mathematics, 1989, 2000). The 1989 release of the NCTM standards explicitly aimed to, “create a coherent vision of what it means to be mathematically literate” in a rapidly changing world and to, “create a set of standards to guide the revision of the school mathematics curriculum” (NCTM, 1989, p. 1).

On the basis of what was known by the middle of the 1980s, it was clear that goals for mathematics instruction had to be much broader than mere content mastery. Students needed to learn to think mathematically as well as to master the relevant mathematical content (Schoenfeld, 2004). The reform movement in mathematics pushed for mathematics curricula at all levels to introduce deeper and broader mathematics to all students (National Research Council, 2001).

State, national, and international assessments conducted over the past 30 years consistently indicate that, although U.S. students may not fare badly when asked to
perform straightforward computational procedures, they tend to have a limited understanding of basic mathematical concepts (National Research Council, 2001). The research evidence is consistent and compelling that U.S. students as a whole, are lacking in many areas of mathematics. Despite increased public school enrollment, there appeared to be little change in high school mathematics courses. These courses remained targeted at the college-bound elite (Schoenfeld, 2004). A Challenge of Numbers (Madison & Hart, 1990) shows that the attrition rate from mathematics, from 9th grade on, was roughly 50% per year; worse still, the attrition rate for Latinos and African Americans was significantly larger.

In many ways the NCTM Standards (1989), and its successor Principles and Standards for School Mathematics (2000), were both radical and conservative documents. The democratic language of these documents clearly situates core reform efforts under the goal that schools should serve the needs of democracy by promoting equality and providing training for citizenship and education for social mobility.

In contrast, the traditional curriculum, with its filtering mechanisms and high drop-out and failure rates (especially for certain minority groups) has had the effect of putting and keeping certain groups “in their place.” Thus the traditionalist agenda can (at least by its likely impact) be seen as situated under the umbrella of education for social efficiency (schools should serve the needs of the social and economic order by training students to occupy different positions in society and the economy). In a zero-sum game, those who hold privilege are best served by the perpetuation of the status quo (Schoenfeld, 2004, p. 281).
This reform movement also called for new teaching practices. Teaching in the ways envisioned by the authors of the reform documents is challenging. It calls for both increased knowledge and flexibility on the part of the teacher, who must provide support for students as they engage in mathematical sense making. This means knowing the mathematics well, having a sense of when to let students explore and when to tell them what they need to know, and knowing how to nudge them in productive directions (Schoenfeld, 2004). “The work that teachers are expected to do—use new curriculum materials, open their classrooms to wider mathematical participation by students, help students succeed on more challenging assessments—demands substantial mathematical skill” (Hill & Ball, 2004, p. 330).

In light of this mathematics reform movement, traditionalists fear that reform-oriented, “standards-based” curricula are superficial and undermine classical mathematical values; reformers claim that such curricula reflect a deeper, richer view of mathematics than the traditional curriculum (Schoenfeld, 2004, p. 283). Not until the late 1990s had full cohorts of students worked their way through the entire reform curricula. Only at the turn of the 21st century did large-scale data evaluating the impact of those curricula begin to become available. “As it happens, the evidence at this point is unambiguously in favor of reform (Senk & Thompson, 2003). But such data turn out to be largely irrelevant to the story of the math wars. When things turn political, data really do not matter” (Schoenfeld, 2004, p. 270).

Standards-Based Instruction

All students need access each year to a coherent, challenging mathematics curriculum taught by competent and well-supported mathematics teachers (NCTM,
Standards-based instruction demands a new vision of what it means to teach and to learn mathematics. Students are now expected to be active participants in their mathematical learning (Moschkivich, 1999). Making new goals for students’ mathematics learning a reality has presented many challenges because teachers “have been asked to take on roles and responsibilities that are not consistent with their current teaching practices, their professional education, or their own experiences as students” (Smith, 2001, p. 1).

As a result of the NCTM’s *Principles and Standards of School Mathematics* five major shifts have occurred in mathematics classrooms. These include shifts:

- Toward classrooms as mathematics communities and away from classrooms as simply a collection of individuals
- Toward logic and mathematical evidence as verification and away from the teacher as the sole authority for right answers
- Toward mathematical reasoning and away from mere memorizing procedures
- Toward conjecturing, inventing, and problem solving and away from an emphasis on the mechanistic finding of answers toward connecting mathematics, its ideas, and its applications, and
- Away from treating mathematics as a body of isolated concepts and procedures (Van de Walle, 2001).

For teachers of mathematics to be truly effective in teaching to these new standards and the new vision for school mathematics, teachers must bring together a genuine appreciation of mathematics, an understanding of how students learn and construct ideas,
the ability to select meaningful problem-based tasks, and the ability to integrate assessment with teaching processes to enhance leaning (Van de Walle, 2001).

“The work that teachers are expected to do—use new curriculum materials, open their classrooms to wider mathematical participation by students, help students succeed on more challenging assessments—demands substantial mathematical skill” (Hill & Ball, 2004, p. 330). To be effective, teachers must know and understand deeply the content they are teaching, and teachers must draw on that knowledge with flexibility (NCTM, 2000). This knowledge extends beyond just the content itself, but also to knowledge of curriculum goals and important ideas central to their grade level, knowledge of challenges students are likely to encounter. Students of mathematics make mistakes, ask questions, use models, and think of their own non-standard methods of solving problems. Teachers need to be able to explain the why of mathematics in addition to the what (Ball, Hill, & Bass, 2005).

Instruction based on the NCTM standards also requires an understanding of how students learn and construct ideas. Teachers must know how to use manipulatives, pictures, kinesthetic tools, body language to make mathematics learning accessible to their students (Olivares, 1996). Knowledge and understanding are unique to each learner, and teachers cannot simply transmit information to students. Teachers must help children construct their own knowledge and understanding (Van de Walle, 2001).

Teachers must be committed to their students as learners of mathematics and as human beings. Teachers should be skillful in choosing mathematical tasks that will promote the learning of each child. In a standards-based classroom teaching activities should be centered on problem solving (NCTM, 2000; Van de Walle, 2001). Teachers
must make informed and thoughtful decisions in selecting examples for instructional purposes (Ball, Hill, & Bass, 2005).

In addition, teaching requires reflection and continual efforts to seek improvement (NCTM, 2000). This requires teachers to analyze student errors and their source (Ball, Hill, & Bass, 2005). Reflective thinking is an essential ingredient for effective teaching and effective learning (Van de Walle, 2001). Assessing and understanding students thinking helps teachers to make good curricular judgments, respond to students’ questions, and look ahead to where concepts are leading and plan accordingly (NCTM, 2000).

The hallmark of reform curricula and standards-based instruction is student engagement (Van de Walle, 2001). Effective mathematics teaching must be a child-centered activity. Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well (NCTM, 2000).

Professional Development in Mathematics

No curriculum teaches itself, and standards do not operate independently of how professionals use them. Although the typical methods for improving U.S. instructional quality have been to develop curriculum, and to articulate standards for what students should learn, little improvement is possible without direct attention to the practice of teaching (Ball, Hill, & Bass, 2005). Specifically, “how well teachers know mathematics is central to their capacity to use instructional materials wisely, to assess students’ progress, and to make sound judgments about presentation, emphasis, and sequencing.”
Professional development beyond pre-service is critical for developing teacher’s proficiency (National Research Council, 2001).

Mathematical knowledge for teaching includes “common” knowledge of mathematics that any well-educated adult should have and math knowledge that is “specialized” to the work of teaching and that only teachers need to know (Ball, Hill, & Bass, 2005).

Although polished mathematical knowledge is an elegant and well-structured domain, the mathematical knowledge held and expressed by students is often incomplete and difficult to understand . . . teachers are in the unique position of having to professionally scrutinize, interpret, correct, and extend this knowledge. (Ball, Hill, & Bass, 2005, p. 17).

In the classroom life of mathematics teaching, specific problems cannot be fully anticipated. “Enmeshed in a mathematics of real-world context, knowers choose, apply, and invent ways of making sense” (Lampert & Ball, 1999, p. 35). In teaching school mathematics, teachers must work to develop their own knowledge of mathematics in connection to their knowledge of students and knowledge of instructional practices (National Research Council, 2001).

Teachers must learn to think of mathematics in new ways. In Hill and Ball’s study (2004), they concluded that, “how teachers hold knowledge may matter more than how much knowledge they hold” (p. 332). Knowing mathematics for teaching also entails more than knowing mathematics for oneself. Teachers certainly need to be able to understand concepts correctly and perform procedures accurately, but they also must be able to understand the conceptual foundations of that knowledge. “In the course of their
work as teachers, they must understand mathematics in ways that allow them to explain and unpack ideas in ways not needed in ordinary adult life. The mathematical sensibilities they hold matter in guiding their decisions and interpretations of students’ mathematical efforts” (National Research Council, 2001, p. 371). Professional development must challenge teachers’ current assumptions about what mathematics is, who can do mathematics, and what it means to be successful in mathematics classrooms (Smith, 2001).

Improving teachers’ mathematical knowledge and their capacity to use it to do the work of teaching is crucial in developing students’ mathematical proficiency (National Research Council, 2001). In their analysis of 700 first- and third-grade teachers, Hill, Rowan, & Ball (2005) found that teachers’ performance on their knowledge for teaching questions significantly predicted the size of student gain scores, even when they controlled for things such as student socioeconomic status, student absence rate, teacher credentials, teacher experience, and average length of mathematics lessons. The students of teachers who answered more items correctly gained more over the course of a year of instruction, the equivalent to two to three weeks of extra instruction (Ball, Hill, & Bass, 2005).

“Despite the common myth that teaching is little more than common sense or that some people are just born teachers, effective teaching practice can be learned” (National Research Council, 2001, p. 369). Unfortunately, standard college mathematics courses do not appear to help (National Research Council, 2001). Advanced courses alone do not emphasize the conceptual underpinnings of ideas needed by teachers whose uses of mathematics are to help others learn mathematics.
In order to meet the specific conceptual needs of teachers of mathematics, professional development programs must be carefully designed. Teachers must be a part of the process (Stigler & Hiebert, 1999). “Opportunities to reflect on and refine instructional practice—during class and outside class, alone and with others—are crucial in the vision of school mathematics outlined in *Principles and Standards*” (NCTM, 2000, p. 19). Examining students’ work can help teachers realize that children’s ways of interpreting, representing, and solving problems are different from the teacher’s, but their methods may be equally valid. In addition, it can help teachers develop the ability to interpret or make sense of students’ solution strategies and forms of representations (Smith, 2001). Professional development should also provide teachers with the opportunity to improve their understanding of mathematics content and to reflect critically on their learning experiences. “Although the knowledge that teachers bring to professional development must be acknowledge and appropriately used, teachers cannot be expected to be knowledgeable about all aspects of school reform, subject-matter standards, or professional practice” (Smith, 2001, p. 47). Collaboration with knowledgeable individuals outside one’s own immediate circle is crucial.

Results show that teachers can learn mathematics for elementary school teaching in the context of professional development (Hill & Ball, 2004). Professional development programs focusing on helping teachers understand both the mathematics of specific content domains and students’ mathematical thinking have consistently been found to contribute to major changes in teachers’ instructional practice that have resulted in significant gains in students’ achievement (National Research Council, 2001).
Minority Access to Quality Mathematics Education

The most urgent social issue affecting poor people and people of color is economic access. In today’s world, economic access and full citizenship depend crucially on math and science literacy. I believe that the absence of math literacy in urban and rural communities throughout this country is an issue as urgent as the lack of registered Black voters in Mississippi was in 1961 (Moses & Cobb, 2001, p. 5).

The National Research Council (1989) argues that mathematical literacy is essential as a foundation for democracy in a technological age. Civil rights leader Bob Moses declares that algebra is, “the gatekeeper for citizenship; and people who don’t have it are like the people who couldn’t read and write in the industrial age” (Moses & Cobb, 2001, p. 14). “We are at risk of becoming a divided nation in which knowledge of mathematics supports a productive, technologically powerful elite while a dependent, semiliterate majority, disproportionately Hispanic and Black, find economic and political power beyond reach” (National Research Council, 1989, p. 14). Unless corrected, many argue that innumeracy and illiteracy will drive America apart.

Current national as well as individual state efforts to improve K-12 mathematics education are founded on the conviction that all students deserve a rich mathematics program and that all students should be held to high expectations of mathematics proficiency (National Council of Teachers of Mathematics, 1989, 2000). Low expectations are especially problematic for students who live in poverty, students who are not native speakers of English, students with disabilities, females, and many nonwhite students have traditionally been far more likely than their counterparts in other
demographic groups to be the victims of low expectations. “Expectations must be raised—mathematics can and must be learned by all students” (NCTM, 2000, p. 13).

In their analysis of 700 first- and third-grade teachers (and almost 3,000 students), Hill, Rowan & Ball (2005) found that teachers’ performance on our knowledge for teaching questions – including both common and specialized content knowledge – significantly predicted the size of student gain scores. Given this data, the reality that higher-knowledge teachers tend to teach non-minority students (Ball, Hill, & Bass, 2005) becomes even more troubling. In high-poverty and high-minority middle schools, about 70 percent of math classes – seven out of every 10 classes – are taught by a teacher who does not even have a college minor in math or a math-related field (Peske & Haycock, 2006). Effectively, minority students are left with less knowledgeable teachers who are unable to contribute as much to students’ knowledge over the course of the year. The very children who most need strong teachers are assigned, on average, to teachers with less experience, less education, and less skill than those who teach other children (Peske & Haycock, 2006).

In her study, Moschkivich (1999) found the following characteristics of teachers who have been documented as successful with minority students:

(a) High commitment to their students academic success and to student-home communication,

(b) High expectations for all students,

(c) Autonomy to change curriculum and instruction to meet the specific needs of their students, and

(d) A rejection of models of their students as disadvantaged.
Similarly, from her own observations of teachers of minority children, Ladson-Billings (1994) cited the following learnings:

- When students are treated as competent they are likely to demonstrate competence
- When teachers provide instructional “scaffolding,” students can move from what they know to what they need to know
- The focus of the classroom must be instructional
- Real education is about extending students’ thinking and abilities
- Effective teaching involves in-depth knowledge of both the students and the subject matter

Becoming mathematically proficient is necessary and appropriate for all students (National Research Council, 2001). Well-documented examples demonstrate that all children, including those who have been traditionally underserved, can learn mathematics when they have access to high-quality instructional programs that support their learning (Griffin, Case, and Siegler 1994; Silver and Stein 1996). These examples should become the norm rather than the exception in school mathematics education (NCTM, 2000).

Teaching English Language Learner Students

Demographic Information

Children who come to school with no or limited proficiency in English are currently part of the educational landscape in many urban public schools (Genesee, 1994). Latinos are the second largest and fastest growing community of color in the United States. (Tatum, 1997) and English language learners represent the fastest growing segment of the school-age population (Hill & Flynn, 2006). There are ELLs in all 50
states as well as in Puerto Rico, the Virgin Islands, and Guam (Hill & Flynn, 2006). The ‘typical’ student is no longer white, middle-class, monolingual, and mono-cultural. Instead, “students in our classrooms come from many different national and cultural backgrounds, speak and understand a good sample of the languages of the world, and require specific kinds of instruction to enable them to reach their full potential as human beings” (Cummins, 2002, p. viii). The influence of an increasingly ethnically diverse population on the nation’s schools is, and will continue to be, enormous (Banks, 2001). The imposition of a single curriculum or one-size-fits-all teaching strategies becomes highly problematic in a context where many students are in the process of acquiring a basic knowledge of the language of instruction (Gibbons, 2002). With the increasing number of ELL students, all teachers, not just bilingual or ESL teachers, are being asked to modify their academic instruction so that academic content is more accessible to their second language students (Genesee, 1994).

Teaching ELL Students

The *Lau v. Nichols* (1974) Supreme Court decision has had a significant impact in defining the legal responsibilities of school serving limited English proficient students. This decision declared that schools should provide “meaningful education” for students of limited English proficiency (Ovando, Combs, & Collier, 2006). Key sources of federal law (Title VI of the Civil Rights Act of 1964, *Lau v. Nichols*, the Equal Educational Opportunities Act of 1974, *Castañeda v. Pickard*) prohibit discrimination against students on the basis of language and require that districts take affirmative steps to overcome language barriers (Valdés, 2001).
Language learning, in both the first and second languages, is a complex phenomenon and a lifelong process (Collier, 1995). “Much misunderstanding occurs because many U.S. policy makers and educators assume that language learning can be isolated from other issues and that the first thing students must do is to learn English” (Collier, 1995, p. 3). In fact, language learning is a multifaceted prism with many dimensions. Collier (1995) presents a model of language acquisition for school. Her model has four components: linguistic development, academic development, cognitive development, and social and cultural processes. She argues that these dimensions are each interdependent and complex, and each critical to supporting ELL students in the acquisition of a new language in school.

Clearly, English Language Learner students, by definition, are in the process of acquiring the English language while in school. Studies have shown that, while students vary tremendously in the rate at which they learn a new language, it takes from four to twelve years of second language development for the most advantaged students to reach deep academic proficiency and compete successfully with native speakers (Collier, 1995; Cummins, 1994). This pattern exists across many student groups, regardless of the particular home language that students speak, country of origin, socioeconomic status, and other student background variables. Given the extensive length of time, educators must understand the complex variables influencing the second language process and provide a socio-cultural context that is supportive while academically and cognitively challenging.

It is no longer believed that language learning and, therefore, language instruction are effective if they occur in isolation (Genesee, 1994). Languages are acquired more
effectively when they are learned in conjunction with meaningful content and purposive communication (Cummins, 1994; Gibbons, 1991, 2002; Genesee, 1994). Research has shown that postponing or interrupting academic development is likely to promote academic failure. Students cannot afford the lost time (Collier, 1995).

Students can, and must, develop content knowledge at the same time as they develop language skills (Met, 1994). Concurrent teaching of language and content allows ESL students to continue learning as they are developing their second language (Gibbons, 2002), and prevents them from falling behind their peers.

The third component of Collier’s model is cognitive development. Students need access to age appropriate learning materials and teaching. ELL children need to confront cognitively challenging content, which reaches beyond the memorization of facts to the exercises of higher-order thinking skills such as analysis and evaluation. “The curriculum content needs to be pitched at least at the same level as that designed for their already fluent native-speaker peers, or they will soon fall behind those peers in both academic achievement and intellectual development” (Handscombe, 1994, p. 334). Second language educators in the U.S. mostly neglected cognitive development until the past decade. Collier (1995) summarizes:

In language teaching we simplified, structured, and sequenced language curricula during the 1970’s, and when we added academic content into our language lessons in the 1980’s, we watered down academics into cognitively simple tasks. We also too often neglected the crucial role of cognitive development in the first language. Now we know from our growing research base that we must addresses
all of these components equally if we are to succeed in developing the deep academic proficiency in a second language (p. 5).

Students’ social and cultural development is also an important component of langue acquisition in school. Students need a socially and culturally supportive environment in which to learn. Instruction for second language children should be first and foremost child-centered (Genesee, 1994). “Children who do not experience . . . comfort around the second language speakers in their environment, as well as some desire to interact with them, are unlikely to make any headway with either academic learning or social integration” (Handscombe, 1994, p. 335).

Acquiring a language for the purpose of succeeding in school is an extremely complex process (McKeon, 1994). Schools must work to find ways to build in the academic strengths and end the isolation typically faced by ELL students. All school personnel must contribute to creating a context in which English language learners have access to both interpersonal and academic language (Valdes, 2001).

Using the Arts to Support Language Development

Reported benefits of art education include the development of the imagination, the elevation of students’ intrinsic motivation to learn, the improvement of students’ spatial reasoning abilities, and the development of higher levels of self esteem (Greene, 1995; Heath & Roach, 1999; Catterall, Chapleau, & Iwnaga, 1999). Greene argues that “The arts provide new perspectives on the lived world” (Greene, 1995, p. 4). She continues, “Of all our cognitive capacities, imagination is the one that permits us to give credence to alternative realities. It allows us to break with the taken for granted, to set aside familiar distinctions and definitions” (Greene, 1995, p. 3). “It is imagination—with
its capacity to both make order out of chaos and open experience to the mysterious and strange—that moves us to go in quest, to journey where we have never been” (Greene, 1995, p. 23).

Many researchers highlight the importance of incorporating the arts into our school curricula. “We must make the arts central in school curricula because encounters with the arts have a unique power to release imagination” (Greene, 1995, p. 27). Additionally, recent American studies report increased academic achievement for students involved in the arts (Catterall, Chapleau, & Iwanaga, 1999).

Catterall, Chapleau, and Iwanaga (1999) found “substantial and significant differences in achievement and in important attitudes and behaviors between youth highly involved in the arts on the one hand, and those with little or no arts engagement on the other hand” (p. 3). According to their study, high arts participation seems to make a more significant difference to students from low-income backgrounds than for high-income students.

Shirley Brice Heath spent a decade studying dozens of after-school programs for disadvantaged youth. These programs were broadly categorized into three groups—sports/academic, community involvement, and the arts. This research indicated that the youth in the arts programs were doing the best academically. She found that the arts programs enable students to “develop motivation, skills, and habits of mind necessary to contribute to solo and group projects while holding high standards of achievement . . . [and] sustain focus through sufficient practice to reach peak levels of proficiency and pride” (Heath & Roach, 1999, p. 33).
The arts should be acknowledged for their ability to expand, complement, and activate learning (Heath & Roach, 1999). Clear evidence exists that involvement in particular art forms are highly correlated with success in mathematics and reading (Catterall, Chapleau, & Iwanaga, 1999). The arts can also provide tremendous benefits for students who are in the process of learning English.

Best practices for teaching ELL students include using a variety of activities to help students to formulate nonlinguistic representations (Hill & Flynn, 2006). These nonlinguistic representations allow students to elaborate on knowledge (Hill & Flynn, 2006). By allowing ELLs students to express and develop their understanding in a variety of ways, students are able to learn grade level content while still developing their English language proficiency.

During the initial phases of language development, students often want to communicate, but do not have the necessary language skills. The arts can help to bridge that gap (Richard-Amato, 2003). Chants, music, poetry, drama, and other art forms often produce lower anxiety in second language learners. Beginners are often able to internalize chunks of language, allowing them to participate in social situations early on (Richard-Amato, 2003). Additionally, storytelling, role play, and drama through their attention to the human experiences are likely to have much appeal in the language classroom. “When students lose themselves in the characters, plots, and situations, they are more apt to experience lower anxiety, increased self-confidence and esteem, and heightened awareness” (Richard-Amato, 2003, p. 230). Because they are absorbed in playing out life’s experiences, second language students can overcome the self-
consciousness generally associated with learning in a new language (Richard-Amato, 2003).

Not only can the arts help to improve students’ abilities to comprehend and produce the target language, but they also enable students to learn to work cooperatively in group situations toward mutual goals. (Richard-Amato, 2003). Incorporating the arts into classroom instruction can provide numerous opportunities for cooperative learning. Cooperative learning can be a powerful tool for fostering language acquisition (Hill & Flynn, 2006). ELLs working in small groups have many more opportunities to speak and negotiate meaning in the new language than they do with whole group activities. Small groups offer numerous advantages to ELL students including allowing for the repetition of key words and phrases, using functional, context-relevant speech, they provide feedback and correction in the context of actual conversation, and small group environments can greatly reduce student anxiety (Hill & Flynn, 2006).

Professional Development Needs for Teachers of ELL Students

“When newcomers arrive, a school district’s first response is usually to provide additional staff development training . . . but the issues are complex and difficult to present in a short training session” (Collier, 1995, p.3). Many teachers are who are teaching ELL students have had very little support or training in how to best meet the needs of these students. Research indicates that, for the most part, few mainstream teachers are prepared to work with ELLs. The 1999-2000 Schools and Staffing Survey by the U.S. Department of Education (n.d.) indicated that of the 41.2 percent of teachers who taught ELLs, only 12.5 percent had had eight or more hours of training to do so in the last three years. There is a significant need for professional development for teachers
on how to address the complex needs of this student population (Handscombe, 1994). Schools and district must be prepared to make long-term commitment to support teachers in learning to meet the needs of all students (Cummins, 1994; NCTM, 2000).

Teachers who work with language minority students must learn to recognize and appreciate the unique strengths and needs of the students they serve (Handscombe, 1994; McKeon, 1994). Teachers need to examine and recognize their own perceptions and behaviors toward children from different linguistic and cultural backgrounds, and be given opportunities to reflect on their own teaching practice (McKeon, 1994). Teachers of ELL students must learn to see that, even when their language puts children at a potential disadvantage at school, ELL students continue to have the same capacity for learning as all other children. Given appropriate school experiences and intervention, and high expectations by their teachers, they can and do achieve at the same levels as their peers who are already familiar with the language of school (Gibbons, 1991).

Teachers of ELL students also need professional development and support in learning how to use language in meaningful and purposeful ways (McKeon, 1994). Teachers need support in learning how to integrate concrete learning experiences like manipulatives, hands-on materials, context clues, and modified speech to facilitate the language learning of their students (Met, 1994). Students learn language best by using it in meaningful and productive ways. But, productive talk does not just happen on its’ own. It needs to be deliberately and systematically planned (Gibbons, 2002). “Effective teachers plan with precision, identifying what they and their students will be doing in each part of the lesson, anticipating areas that may cause difficulty, and ensuring that time and materials needed for the lesson will be available” (Met, 1994, p. 161).
Teachers of ELLs must also learn to view every content lesson as a language lesson (Met, 1994). In every content area, teachers of English Language Learners are not just expected to present cognitively challenging content, but also must work to make that same content accessible to students who are still developing their language proficiency (Handscombe, 1994; McKeon, 1994; WIDA, 2004). The demands of this task are enormous. For teachers to provide experiences to their students that are both context-embedded and cognitively demanding is no small feat. As we continue to raise the expectations for these students and teachers, the need for quality professional development for these teachers also increases.

All students need access each year to a coherent, challenging curriculum taught by competent and well-supported teachers (NCTM, 2000). Teaching ELL students demands an understanding of the students, strategies to teach both language and grade-appropriate content, and strategies to integrate each of these into comprehensible and accessible lessons on a daily basis. If we truly are committed to developing the full intellectual potential of all of our citizens and future citizens, then the challenge before us is enormous (Valdés, 2001).

The 4MAT System

The 4MAT System is an instructional design model created and developed by Bernice McCarthy (1987, 2000a, 2000b, 2003). The name 4MAT comes from the idea that there are four major learning styles and that the four quadrants present different formatting possibilities in return (McCarthy, 2000a). In this section I provide an overview of the learning styles research that provided the foundation for this model.
Then I look at the model itself, and lastly present McCarthy’s perspective on what it means to teach around the 4MAT cycle.

Learning Styles

The definition of learning styles according to Dr. Bernice McCarthy (1987, 2000a, 2000b), the founder and author of the 4MAT System, derives in part from the theoretical constructs completed by Kolb (1983). Figure 3 provides an overview of Kolb’s model.

![Figure 3. Kolb’s four quadrants.](image)

According to Kolb, there are two major differences in the way people learn: how they perceive and how they process information. People hover on a continuum of perceiving from sensing or feeling (concrete) to thinking things through (abstract). “In new learning situations, some of us sense and feel our way, staying with our direct experiences. Others think things through, preferring to move quickly to abstractions” (McCarthy, 2000b, p, 34). An example of this difference in how people perceive information would be in looking at how students formed a mental picture when introduced to the concept of fractions. To understand the concept of one-half, the learner
who favors the concrete end of the continuum would need to experience one-half of an orange or one-half of another tangible item. The more abstract learner could see a picture or a simple problem and formulate the concept by thinking it through and forming her own mental images.

The second major difference in how we learn is in what we do with what happens to us. There are differences in how individuals process the new information. In Kolb’s model, people hover on a continuum of processing from active experimentation to reflective observation. Some people prefer to jump right in and try things, while others prefer to watch what happens and reflect on it before jumping in (McCarthy, 2000b). For example, when introduced to a new electronic gadget, some people prefer to read the manual or have someone explain to them how to use the tool, while other people prefer to start pushing buttons and experimenting with the gadget right away making and correcting their mistakes as they go.

Learners differ in how they take in an experience and in how they act on what they take in (McCarthy, 2000b). People fall somewhere on the continuum of perceiving, from concrete to abstract, and on the continuum of processing, from reflecting to acting. Where one falls on these two continuums constitutes a person’s learning style (Kolb, 1983).

In addition to the four learning styles of Kolb’s model, research on brain hemisphere preferences was taken into consideration for the development of the 4MAT learning cycle. The two hemispheres of the brain process information and experiences in identifiably different ways. Individuals tend to have a preference for processing information in one hemisphere over the other, and this preference has a supportable
relationship to cognitive processing (McCarthy, St. Germain, & Lippitt, 2002). The learner whose operational tendency is the right hemisphere “operates out of being, intuits feelings, sees wholes, forms images, seeks and uses patterns, relationships, and connections” (McCarthy, 2000a, p. 161). The learner who prefers the left-brain hemisphere, “operates with analysis, examines, cause and effect, breaks things down into parts, seeks and uses language and symbols, abstracts experience from comprehension, generates theory, creates models, and is sequential” (McCarthy, 2000a, p. 159). A learner does not, however, use one hemisphere in its entirety. On the contrary, he or she switches from one hemisphere to the other dependent upon what the situation or problem calls for. As explained by McCarthy,

Human brains continually blend analysis and synthesis although different individuals tend to favor one mode over the other. How we structure tasks, set expectations, simulate or impoverish the environment, and most of all honor these differences creates the balance or imbalance in learners. If we continue to focus on only one mode of processing we do great harm to the whole brain (McCarthy, 2000a, p. 189).

McCarthy’s 4MAT Model

In considering this research on learning styles and right and left mode processing, Bernice McCarthy developed the 4MAT model (McCarthy, 2987, 2000a, 2000b, 2003; McCarthy, St. Germain, & Lippit, 2002; McCarthy & McCarthy, 2006). This cycle of learning moves through four quadrants. “The movement around the 4MAT cycle represents the learning process itself. It is a movement from experiencing to reflecting, to
conceptualizing, to tinkering and problem solving, to integrating new learning with the self.” (McCarthy & McCarthy, 2006, p. 11).

McCarthy (1987) lists the following major premises guiding the 4MAT system:

- Human beings perceive experiences and information in different ways.
- Human beings process experiences and information in different ways.
- There are four major, identifiable learning styles, and they are all equally valuable.
- Type One learners are primarily interested in personal meaning.
- Type Two learners are primarily interested in the facts as they lead to conceptual understanding.
- Type Three learners are primarily interested in how things work.
- Type Four learners are primarily interested in self discovery.
- All students need to be taught in all four ways, in order to be comfortable and successful part of the time, while being stretched to develop other learning abilities.
- The sequence is a natural learning progression.
- The development and integration of all four styles of learning and the development and integration of both right-and left-mode processing skills should be a major goal of education.
- Students will come to accept their strengths and learn to capitalize on them, while developing a healthy respect for the uniqueness of others, and furthering their ability to learn in alternative modes without the pressure of “being wrong.”
The more comfortable learners are about who they are, the more freely they learn from others.

Figure 4 on the following page shows a model of the 4MAT cycle. The cycle is divided into four quadrants, each containing two steps. The first quadrant of the learning cycle is focused on building personal meaning (McCarthy, 2000a). “All learning begins with the self. The cycle moves from personal connections, to the knowledge of experts, and back to the self as the learning is personally adapted. This process transforms the learner through new understanding and skills” (McCarthy & McCarthy, 2006, p. 13).

Quadrant One of the 4MAT cycle focuses on answering the “Why?” questions for learners (McCarthy & McCarthy, 2006).

- Why do I need to know this?
- Why is this material valuable in my life?
- Is there a larger context?

Learners move from concrete experience to reflective observation in this stage (McCarthy, 1987). The role of the teacher is to act as a motivator and witness to student learning. “Giving them a reason, a need of their own for proceeding, is so simple and fundamental that one can only marvel that it is not done” (McCarthy, 1987, p. 94). The objective is to enter into the experience, to engage the self, and to integrate personal meaning with the experience. This first quadrant includes the Connect step, which is focused on right mode processing. In this step, learners “place themselves in the presence of newness by connecting it to our personal experiences” (McCarthy, 2000a, p. 227). The Attend step is also included in this quadrant, but is focused on left mode
processing. In this step, learners attend to and reflect on their experiences (McCarthy, 2000b).

Figure 4. The 4MAT cycle of learning

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Quadrant Two of the 4MAT cycle focuses on answering the “What?” questions (McCarthy & McCarthy, 2006).

- What do my students need to know to master this content?
- What are the core concepts that will lead them to understand?
- What parts of the content do I need to emphasize so they will understand this at this core level?

In this quadrant, learners move from reflective observation to abstract conceptualization (McCarthy, 1987). The teacher’s role in this quadrant is the traditional role of “teacher” where he or she presents the acknowledged or expert knowledge to the students. However, like in all of the quadrants, the emphasis is on including opportunities for both right mode and left mode processing. Therefore, in the right mode, Imagine stage, the focus is on forming pictures in our minds and thinking about the expert knowledge in less traditional ways. The left-mode Inform step is focused on examining the expert knowledge and may include lectures or other means of sharing this knowledge with students.

In the third quadrant of the 4MAT cycle, the focus is on answering “How?” questions (McCarthy & McCarthy, 2006).

- How will my students use this in their real lives?
- How will this content affect their power?
- How does this work?

Learners move from abstract conceptualization to active experimentation (McCarthy, 1987) and begin tinkering with their learning and trying it themselves. The role of the teacher in this quadrant is to act as a coach and encourage and support the
experimentation of the students. First learners move through a left mode step of practicing the skills as the experts do it (McCarthy, 2000a, 2003), and then move to a right mode step of extending their learning and adding their own unique use of it.

In the fourth and final quadrant of the 4MAT cycle, learning is focused on answering the “If?” question (McCarthy & McCarthy, 2006).

- If my students master this learning, what will they be able to do that they cannot do now?
- If they learn this, what new questions will they have?
- What can this become? What can I make of this?

Learners move from active experimentation back to concrete experience (McCarthy, 1987) where the learning cycle began. The role of the teacher is to act as an evaluator and remediator. In this quadrant, learners first refine their learning by using left-mode processing and adapting and modifying their work. In the last step, students perform their learning, creating and integrating and completing the cycle while it begins anew (McCarthy, 2000a).

Teaching Around the Cycle

Bernice McCarthy believes that teachers must understand and apply brain research in their teaching. Teachers need to “intentionally design instruction to incorporate the processing skills of both hemispheres in order for learning to be complete. They must understand the right and left mode functions of the brain and they must do so as mindfully as possible” (McCarthy, St. Germain, & Lippitt, 2002, p. 1.17). “We need to teach children to reflect and to act, to feel and to think. We need to honor both modes of perceiving and processing” (McCarthy, 1987, p. 15).
Teachers, like students, need to learn to “move around the circle” (McCarthy, 1987), and provide opportunities for all types of learners to be successful and engaged in a lesson or unit.

If you successfully guide your learners through this cycle, you will have accomplished something very real. All your students will experience learning. They will experience comfort, and they will be required to stretch. Such is all learning. There are places where we are graceful and places where we stumble. The stumbling places offer opportunities for growth (McCarthy & McCarthy, 2006, p. 36).

Learners and teachers will naturally be more comfortable in some steps of the learning cycle than others. However, the focus of the 4MAT cycle is on moving through the entire learning cycle. “The 4MAT cycle is more important than any one segment” (McCarthy, 2000b, p. 15). As we all have our own preferences and learning styles, the cycle is a stretch for all who travel it. “This is true because we are comfortable in some places but challenged in others. Mastering the entire cycle is a challenge, but well worth the effort” (McCarthy, 2000b, p. 25).

McCarthy and her associates have conducted extensive research on the effects of the 4MAT model. Their work demonstrates that 4MAT: (1) validates learners, (2) increases learner motivation; (3) improves academic performance, and (4) encourages personal development by intentionally representing experience and knowledge in varied yet connected ways (McCarthy, St. Germain, & Lippitt, 2002).

There are many validated studies that provide convincing evidence that 4MAT can have positive and significant effects on student performance and attitude (McCarthy,
Dissertations and action research investigating the specific effects of the 4MAT model indicate that when appropriately used, 4MAT positively impacts the following:

- Levels of student involvement on academic learning tasks
- Attitude and achievement in science
- Student self-esteem and behavior
- Attitude and achievement in fine arts
- Acquisition of study skills strategies
- Performance in geometry
- Performance on standardized tests
- Teacher implementation if teaching innovations
- Teacher attitudes toward diversity and employment of diverse learning sets
- Teacher purposefulness and planning
- Incorporation of creativity in teaching
- Adult learning and retention

(McCarthy, St. Germain, & Lippitt, 2002, p. 1.23)

Summary

This review of literature examined four areas of study. The first section looked at professional development and examined elements of quality professional development, components of teacher change, and the Japanese Lesson Study Model. The second section focused on mathematics and presented research on the NCTM standards, standards-based instruction, and issues related to the field including the math wars and minority access to quality mathematics education. The third section detailed best
practices of teaching ELL students including using the arts as a vehicle to support language development. The fourth section of this chapter explained Bernice McCarthy’s 4MAT System. The case of the Mathematics Access for Language Learners project presented in the rest of this dissertation will integrate all of these areas of study as it tells the story of mathematics a professional development project for teachers of English Language Learner students.
Chapter 3
RESEARCH DESIGN AND METHODOLOGY

Introduction

This research used case study methodology to describe and analyze the Mathematics Access for Language Learners (MALL) professional development project. This MALL project’s primary goal has been to provide teachers with the knowledge, strategies, tools, and materials to help participating teachers make mathematics content accessible to their English Language Learner (ELL) students. This study focused on the implementation of this professional development project between Summer 2004 and Fall 2007.

This chapter outlines the research methodologies and procedures of this qualitative research study. A description of the setting of the study, research design, data collection and data analysis are included in this chapter.

Description of Setting

The MALL professional development project serves teachers in the Midville Public School system. Midville is a large Midwestern city. The Midville Public School (MPS) system is a large urban district and nearly 15% of MPS students are categorized as limited-English-proficient. More than 80% of the district’s students come from low-income families (district website, retrieved 5/31/07). Many of the schools in this district are currently receiving sanctions from No Child Left Behind for failing to make Adequate Yearly Progress.
The MALL project is a professional development partnership between the Midville Public Schools and City Arts College (CAC). CAC is one of several universities in Midville. CAC is an undergraduate and graduate college whose principal commitment is “to provide a comprehensive educational opportunity in the arts, communications, and public information within a context of enlightened liberal education. [CAC]’s intent is to educate students who will communicate creatively and shape the public’s perceptions of issues and events and who will author the culture of their times” (CAC website). The project director for the MALL program, Dr. Katherine Johnson, heads the education department at CAC, and was formerly an MPS teacher.

Teacher participation in the MALL program is voluntarily. Teachers apply to participate. Teachers are recruited from schools within the district that have high ELL populations and implement standards-based mathematics curricula. Many of the teacher participants in the MALL program have already completed up to 60 hours of professional development focused on their grade level mathematics curriculum. This professional development covered specific mathematical content knowledge, teaching strategies, and implementation tips specific to the curriculum. This professional development did not address the needs of ELL students.

The MALL project’s primary focus is on teachers in grades three, four and five, the grade levels at which many ELL students transition to English-only classrooms. The most common program for ELL students in this district is a transitional bilingual program where students are increasingly expected to perform academically in the English language after only three years of schooling. In third grade, these students also begin taking annual state assessments in English.
The MALL professional development program was first implemented in 1998 in partnership with another local university, but phased out in 2000 with the expiration of the grant funding. The project was reincarnated in the summer of 2004 through grant funding issued to the City Arts College, and has been in operation ever since. In its current form, the project provides more than 100 hours of professional development for each teacher in standards-based mathematics, strategies for working with English language learners, arts integration, and Bernice McCarthy’s 4MAT model. Teachers attend summer workshops and also participate in Lesson Study teams at their grade level.

Research Design

I explored my research questions by using case study methodology. This research sought to answer the following questions through the presentation of the case which appears in Chapter Four of the study:

1. In what ways has the MALL project helped teachers of English language learners make standards-based mathematics learning accessible for their students?
2. How has the MALL project helped to develop leadership in teacher participants?
3. In what ways have the stated goals for teachers of the MALL program been met?
4. In what ways does the MALL professional development project meet the needs of the large urban district to support teacher growth?

This study used case study methodology to collect and analyze data. Case study research is a qualitative approach in which a bounded case is explored over time, through detailed, in-depth data collection involving multiple sources of information (Creswell, 2007; Yin 2003). Data for this study were collected from interviews with participants
and the project coordinator, archival records, participant-observations, and surveys administered to all teacher participants.

I explored my research questions by developing an in-depth description and analysis of the case of the Mathematics Access for Language Learners (MALL) professional development project. My unit of analysis for this study was the single case of the MALL professional development project from Summer 2004 through Fall 2007. The research for this case study was conducted over an eight month time period. In this study I attempted to present and preserve multiple realities of the teacher participants in order to understand how the participants saw and experienced the MALL professional development program.

Data Collection

I collected data for my study from six interviews, participant observations during the summer and fall of 2007, and archival records of the program between 2004 and 2007. The project director for the MALL program generously granted me access to numerous archival records of the program, including attendance data, grant reports from the project evaluator, transcripts of focus groups conducted by the project evaluator in the spring of 2007, and survey data from the survey administered by the project director at the end of the summer sessions in 2007. A timeline of my data collection is included in Appendix B.

All teacher participants and facilitators in the MALL project are Midville Public School teachers, mostly in grades 3-5 (some teachers have changed grade levels during or after participation in the program) and work in approximately 20 different schools. The coordinator of the program is a professor and chair of the educational studies department
at City Arts College. I conducted six interviews during the summer and fall of 2007. I chose to interview three teacher participants, two teacher facilitators, and the project director. I have been involved with this project for several years, and have worked directly with all of the people I interviewed. They all know me well, and based on our relationships, they were willing to volunteer their time and perspectives. Participation in all of these interviews was voluntary and participants were guaranteed that their identities would be protected. Each person I interviewed signed a copy of the Informed Consent form that is included in Appendix C.

I interviewed three teacher participants who completed the entire MALL program in the 2006-2007 cohort. These teachers began the initial professional development in the fall of 2006, and participated in an entire lesson study cycle in grade-level teams during the spring of 2007. This was the most recent group to complete the entire program, and the first to participate in the lesson study portion of the project. I elected to interview one teacher from each of the three grade level teams; third, fourth, and fifth. All participants that I asked were willing to participate, and these three teachers were selected based on their availability during the summer of 2007. In each teacher interview I used a semi-structured interview protocol which appears in Appendix D.

In addition to interviewing teacher participants, I also interviewed two teacher facilitators of the MALL project. Each of these facilitators participated in the program two to three years ago, and then served as facilitators in the program during the 2006-2007 cycle, as well as the current 2007-2008 cycle. I again wanted each grade level group’s voice to be represented, so I interviewed a fourth grade and a fifth grade facilitator. In 2006-2007 I served as the facilitator with the third grade team of teachers.
The teacher facilitators provided descriptions of the project over time, described the ways in which the project has helped them develop as leaders, and also discussed how the role this professional development has played in their teaching. These interviews were conducted during the summer of 2007. During each facilitator interview we discussed the questions that appear in Appendix E.

I also interviewed the project developer and coordinator, Dr. Katherine Johnson. I believed that she was able to give the most comprehensive overview of the project’s development, design, and evolution over the years. Dr. Johnson generously shared her time for this interview during the summer of 2007 and was available for follow-up conversations throughout the study. In our interview, we discussed the questions that appear in Appendix F.

In addition to these interviews, I collected data as a participant observer during the summer 2007 professional development sessions and the fall 2007 lesson study team meetings.

I also was given access to numerous archival records from the program in past years. I reviewed evaluation reports of the project submitted as requirements for the grant funding, teacher attendance data, teacher reflections, end of session surveys, and transcripts of focus groups conducted in the spring of 2007 by the project’s external evaluator. A complete list of the archival records collected and analyzed for this study appears in Appendix G. Together these various data sources were used to inform the case study and provide a more complete description of this professional development program.
Data Analysis

The data analysis occurred both during and after data collection. The data collection for this study occurred over an eight month period and generated a considerable amount of data. Field notes were taken during participant observations of professional development sessions and while reviewing archival records. Reflective notes were recorded immediately after each interview, and again after the interviews were transcribed. Transcripts of each interview were shared with each participant and a follow-up conversation allowed for any necessary clarification of the data. My participation in the project, and my relationship with the data sources allowed easy access for follow up data that were needed.

Merriam (1988) states, “There is no standard format for reporting case study research” (p. 194). In organizing my data and selecting my approach to the analysis, I decided to present this case study using a framework that I designed and constructed based on Bernice McCarthy’s 4MAT model (2000a, 2000b, 2003, 2006). McCarthy’s experiential learning model, called the 4MAT model, has been adapted and used by teachers who have participated in the MALL project. MALL project designers believed that the 4MAT model would address teacher need for a manageable framework to integrate the project’s three major curriculum areas—standards-based mathematics, English-as-a-new-language strategies, and the arts. Using a four-quadrant “wheel,” the model provides a framework for the development of lessons which begin with concrete experiences, followed by reflection on those experiences to lay the foundation for students to be able to integrate their prior knowledge with the new concept being presented. The teacher then draws on students’ prior knowledge to inform them about
the concept, and provides guided practice and opportunities for students to creatively apply the new concepts to other situations. The 4MAT model is described in further detail in Chapter 2.

The MALL project uses the 4MAT instructional model as a guide for designing student instructional tasks, and also as a template for organizing the professional learning experiences of teacher participants. I believed the 4MAT model could be used as both as the framework for data analysis and as a framework for presenting the case study. In each section of Chapter Four I examine the project through the lens of one of the eight steps of the 4MAT model: Connect, Attend, Imagine, Inform, Practice, Extend, Refine and Perform.

Summary

This case study employed qualitative research methods to collect data on the MALL professional development program since the summer of 2004. Data was collected from participant observations, interviews with teacher participants, project facilitators, and the project director, and from an analysis of project artifacts during the time period studied. The data is presented and analyzed in Chapter 4 of this study. Lessons learned from this study and implications for leadership are discussed in Chapter 5.
Chapter 4

FINDINGS OF THE STUDY

_Caminante, no hay camino, se hace camino al andar._

[Traveler, there is no path, the path is created by walking]

_Antonio Machado_

Introduction

There are three passions I have as an educator, areas of developing expertise where I hope to continue to focus my career. These three areas are mathematics education, educating English Language Learner students, and supporting the professional development of teachers. I have had experiences throughout my career that have allowed me to explore and develop my knowledge, skills, and dispositions in each of these three fields. That said, there have been only a few opportunities for me to work on all three of these interests simultaneously. One of these experiences has been my work with the Mathematics Access for Language Learners (MALL) program.

I first became involved with the MALL program during the summer of 2004 as a project facilitator. I had just completed my first year as a mathematics specialist at a school in Midville Public Schools (MPS) with a large population of English Language Learners (ELLs). The principal of my school had heard about the MALL project from a friend and colleague of hers and knew that the project was looking for someone bilingual in Spanish and English with a strong background in mathematics to support teachers in
the project over the summer. I did not know much more than that before accepting the summer position and beginning my work with the project.

Immediately, I was impressed by the project goals and its participants. Not only did the project address so many of my interests simultaneously, it also connected me with a network of passionate and talented professionals who shared these interests with me. My own experiences in the project over the past four and a half years have consistently reinforced for me that I was a part of something good, and the evaluations conducted by external evaluators confirmed many of these opinions.

When I began this study my purpose was to describe and analyze the Mathematics Access for Language Learners (MALL) professional development project. I had hoped that a detailed case study of the project would tell the story of this program and share this work with a wider audience. I believed that a deeper understanding of this specific professional development project could help district leaders and professional developers better understand the components of quality professional development programs. I also believed that this qualitative study would support the findings of the evaluative reports that already existed around the project, providing a more complete picture of this project.

This study did provide me with the deep understanding of the project that I had anticipated. Less predictably but perhaps more importantly, I gained a deeper understanding of myself as a leader and participant in this project. My research has transformed my vision of leadership and professional development and has had both an immediate and anticipated long-term impact on my career.

Denzin and Lincoln define qualitative research as “a situated activity that locates the observer in the world, it consists of a set of interpretive, material practices that make the
world visible” (Creswell, 2007, p. 36). In conducting this study and constructing the case, I could not push aside the knowledge and experiences that I have in order to be an objective observer of the MALL project. I was not an outside researcher merely studying this project. I have an ongoing relationship with the project and with all of my data sources. This relationship worked to my advantage—allowing me to see and analyze aspects of this project that might not have been visible to someone without this connection to the project. I had extraordinary access to the project leaders, participants, and archival data on the project. My personal connection to the project and the participants both influenced the quality of the data I received and influenced the lenses through which this data was analyzed.

Heifetz and Linsky (2002) describe the importance of leaders getting off the dance floor and onto the balcony. In my presentation of this case I attempt to both describe and analyze the components of the project as experienced by the participants I interviewed, and also to step up onto the balcony and analyze the project from a broader leadership perspective.

Organization of Data

My study took place in Midville, a large Midwestern city. My data collection focused on the program and its participants from Summer 2004 through Summer 2007. I collected data through surveys, interviews, participant observations, and archival records. All participants that I interviewed were Midville Public School teachers; mostly in grades 3-5 (some teachers changed grade levels during or after participation in the program). The coordinator of the project was a professor and chair of the educational studies...
department at City Arts College. My interviews were conducted during the summer of 2007.

After collecting my data, I faced a challenge. Merriam (1988) states, “There is no standard format for reporting case study research” (p. 194). I wanted to write the case in a way that honored the MALL project and its design—I wanted my case to in some way “mirror” the project, its design and the teachers’ work. I knew that I would be discussing McCarthy’s (1987, 2000a, 2000b, 2003) experiential learning model, called the 4MAT model, that has been adapted and successfully used by teachers who have participated in the MALL project (Project Narrative, 2006). Project designers believed that the 4MAT model would address teacher need for a manageable framework to integrate the project’s three major curriculum areas—standards-based mathematics, English-as-a-new-language strategies, and the arts. The 4MAT® system model is based on the premise that “humans learn and develop through continuous, personal adaptations as they construct meaning in their lives” (McCarthy, 2003, p. 233). Figure 5 provides a diagram of McCarthy’s 4MAT model as it is used with teachers in the MALL project.

Using a four-quadrant “wheel,” the model provides a framework for the development of lessons which begin with concrete experiences, followed by reflection on those experiences to lay the foundation for students to be able to integrate their prior knowledge with the new concept being presented. The teacher then draws on students’ prior knowledge to inform them about the concept, and provides guided practice and opportunities for them to creatively apply the new concepts to other situations. The MALL project uses the 4MAT instructional model as both a guide for designing student instructional tasks, as well as a template for organizing the professional learning
experiences of teacher participants. A detailed description of McCarthy’s 4MAT model as an instructional model was presented in Chapter Two.

Figure 5. The 4MAT model as used with teachers in the MALL professional development project.

After organizing my data, I decided the same model would provide a useful framework for data analysis. Figure 6 provides an overview of how this model was used.

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as a framework to analyze and construct the case of the MALL project. As I worked my way through the multiple data sources, I used eight questions, aligned to the 4MAT model, as an organizational tool. After completing the data analysis, I realized that I could also use the 4MAT model in one more way—to construct and present this case study. The case, then, is presented in eight “chapters,” each tied to one of McCarthy’s steps and guided by one of the eight questions represented in Figure 6.

The resulting MALL Project: Case is organized into eight “chapters” which answer the questions posed in Figure 6 and labeled Connect, Attend, Imagine, Inform, Practice, Extend, Refine and Perform. Certain of the chapters include thick description of various MALL Project components. For instance, a description of how this model was used to organize the summer professional development workshops for the MALL project is included in the Step Four: Inform chapter of the case.
Figure 6. The 4MAT model as an analytic framework and case-construction organizer\textsuperscript{3}.
The MALL Project: The Case

Step One: Connect

co nectere – to bind with

The goal of the Connect step of the 4MAT model is to establish a relationship between learners and content and connect the content to their lives (McCarthy, 2000b). In this section, I analyze how the Mathematics Access for Language Learners (MALL) project connected with the professional learning needs of the teacher participants.

The MALL project is a professional development project designed to support teachers in integrating mathematics with the study of language and with the arts in order to increase the probability of academic success for students who are English language learners (ELLs). This project addresses a pressing challenge in education programs nationwide: to integrate and increase teachers’ content-area knowledge and pedagogical skills. On both the local and national level, the challenge extends to tailoring instruction and assessment to specific populations” (Project Background, 2006).

Current national as well as individual state efforts to improve K-12 mathematics education are founded on the conviction that all students deserve a rich mathematics program (National Council of Teachers of Mathematics, 1989, 2000). This includes students who are in the process of learning English as a second or new language. Central to rich mathematics programs are the National Council of Teachers of Mathematics (NCTM) standards emphasizing problem solving, reasoning and proof, communication skills, the ability to make connections, and the ability to represent mathematical concepts. Acquisition and application of such skills present challenges to all students, but even
more so to second language learners, especially when the demand is for them to demonstrate their use of such skills in a new language.

National statistics indicate that many teachers have little or no preparation for working with ELLs (U.S. Department of Education, National Center for Educational Statistics, n.d.). Teachers report their frustration with their lack of knowledge of the means to make content comprehensible for their students (Bongolan, 2005; Carrier, 2005; Villareal-Carman, 2005). Research indicates that only 12.5% of teachers have received eight or more hours of coursework or professional development for adapting instruction appropriately for ELLs (Gruber, Wiley, Broughman, Strizek, & Burian-Fitzgerald, 2002). This places English learners at greater risk of not being able to access mathematical learning, and thus at greater risk for academic failure (Peske & Haycock, 2006).

Most teachers in the Midville Public Schools (MPS) also have little preparation for working with ELL students. The MPS system is a large urban district that serves more than 50,000 children who are categorized as limited-English-proficient (District website, 2007). The MALL project’s primary focus is on teachers in grades three, four and five, the grade levels at which many ELL students transition to English-only classrooms. The most common program for ELL students in the district is a transitional bilingual program where students are increasingly expected to perform academically in the English language after three years of schooling. In third grade, these students also begin taking annual state assessments of reading and mathematics in English.

Teachers are recruited for this voluntary project in both formal and informal ways. Applications to participate in the MALL project are sent to schools within the district that have high numbers of ELL students. Schools are invited to send teams of
teachers in grades three, four, and five, along with a fine arts educator and/or an ESL teacher. Priority is given to schools that have experience using standards-based mathematics curricula. The hope is that by sending a team of teachers, instead of just individuals, there will be more transfer of program components into the individual school as there will be a network of support within their building.

As a voluntary professional development program, the teachers receive a monetary stipend of $35 an hour for their participation. When participants were asked how they heard about the project, most stated that their building principal had asked them to apply. One fifth grade teacher stated, “I heard about it from my principal. He said, ‘I want you to sign up for this, I think you’ll be good for it.’ He said it was something for bilingual students, some strategies . . . and I did not know what I was going to learn, I did not know what was involved with the project. I didn’t know how long it was going to take. I did not know all the hours that were going to go into it.” This teacher went on to say, “I had hoped to learn some strategies. Because I know that it is always good to have other strategies for bilingual students in addition to what you have in the text books or the teachers editions are never enough.”

In addition to principal recruitment, word of mouth recruitment is increasingly bringing more people to the program. As teachers complete the project and return to their schools to share their experiences, the project is beginning to attract more teachers from those same schools to apply for future cycles. Additionally, many of the former teacher participants elect to continue on with the project and accept leadership positions within the project as teacher facilitators. One teacher participant stated, “Whenever you are talking to another faculty member it is totally different than the administrators saying you
should go to this PD.” Of the fifty-two teacher participants in the summer of 2007, fourteen were teachers from schools where teachers had previously participated in the program.

The project participants reported various reasons for persisting with the Project. When asked why he decided to continue with the program, a third grade teacher stated, “I have always liked math and anything that is related to math. Plus, I teach bilingual students, so the whole idea of finding new ways to support their learning and finding new ways to teach them was something that I felt was very helpful to me, so I just decided to stay. I said ‘I want to do this.’”

Similarly, another teacher described her reasons for continuing in the program: “I think because every year my ESL population has increased in my classroom and I never finished my endorsement. I feel like math is not one of my strengths and I thought this would be a good opportunity to strengthen my teaching skills in mathematics, and also get some tips on how to gear it more towards some of my English as a Second Language learners.” She continued, “I think people appreciate not being forced into it. I think when it is not forced people are more open to it; it is a level of respect. The dollar signs definitely help, too.”

In each of the years of the project there has been some drop off among teachers who start the project, but do not continue. In the fall of 2006, thirteen teachers completed the initial forty hours of professional development, but only 10 teachers continued on to the lesson study portion of the program. In the summer of 2007, fifty-two teachers attended the 40 hours of summer training. Thirty-three of these teachers continued on to the lesson study sessions in the fall of 2007.
When asked about the challenges in recruiting and retaining a group of teachers, the project director commented, “I buy into the idea that more people need to have this kind of approach, but you really have to want to do this. You can’t mandate that people are going to sit down and are going to listen to each other. You have to start off with, ‘I want to hear what you have to say. I don’t agree with it right now, but I want to listen. Then maybe I will change or move a little inch over.’”

The leaders of the MALL project believe strongly that for teachers to put the time, energy, and thought into this type of professional learning they need to feel a connection and a commitment to what they are doing. Teachers need to want to be there and want to learn. Despite encouragement from the local district to scale up to involve significantly more teachers, the project has grown in size, but remained small and personal. The project director states, “You really need to have a certain teaching mind and learning mind and want to continue to learn more to become a more effective teacher. And not everyone is there. So if anything the question is how can we spark that kind of interest to want to be that kind of teacher? And that is a slow process. It has to become part of the culture. And when that is a part of the culture, that is the kind of people you attract.”

Teacher participants are more articulate concerning the specific details of the project than most administrators. Having gone through the training first hand, teacher participants know the time commitment, benefits, and challenges better than anyone. At times, the project has found that teacher participants come to the project knowing very little about it. As one teacher described in an interview, “My principal sent me to this project. He said he wanted me to be a part of this program. At first I said, ‘Sure, no problem. Initially we came and I thought it was going to be something short. But then,
as soon as we found out about the length of the whole project, initially it was like, ok this seems kind of long.
Some of the participant drop-off in the project can be attributed to this type of communication gap.

For those who decide to commit to the project, however, the response continues to be very positive. Teachers are able to gain strategies for working with ELL students, and integrating the arts. Teachers also gain the experience of working in lesson study teams to collaboratively plan and reflect on a research lesson. One teacher participant I interviewed said, “[The program] actually went over my expectations because I met so many interesting people and I feel like I met other people in my profession that I feel like I can call at any time and get support.”

Step Two: Attend

ad tendere – to stretch towards

The second step of McCarthy’s 4MAT system, Attend, is designed to engage students to reflect upon their existing level of knowledge and experience (McCarthy, St. Germain, & Lippitt, 2002). In this section I attend to the existing knowledge and experiences of the MALL professional development program, and analyze the history of this program from its inception in 1998 through the time of this study.

The primary goal of the Mathematics Access for Language Learners (MALL) program is to provide teachers with the knowledge, strategies, tools, and materials that can be used to help their language minority students succeed academically, because they will be able to access the kind of mathematics learning linked to such success. Many of the approaches and materials used in this project were first tested and refined over three
summers (1998 – 2000) in programs jointly sponsored by the State University at Midville (SUM) and the Midville Public Schools Department of Language Education. Since 2004, this project has been sponsored by City Arts College in collaboration with MPS, building on and extending lessons learned from the implementation of that project during the first three summers.

The MALL Project Begins

The MALL project was initially conceived by David Martin, who at the time was working for State University at Midville. Martin collaborated with administrators in the Midville Public Schools’ Department of Language Education to write a proposal for grant monies from the federal government through the Eisenhower Mathematics and Science Education Program. Dr. Katherine Johnson, the current project director, was on the original planning team with Martin along with two colleagues from State University at Midville—one specializing in English as a Second Language, and one specializing in elementary mathematics education. Dr. Johnson remembers, “David Martin came up with this idea. Then he pulled together a group of us . . . and we kind of just sat down and started brainstorming how many sessions and who is going to do what. And that is how it started, with Eisenhower funds and David wrote the proposal.”

In 2002 David Martin became the director of the Midville Public Schools Department of Science and Mathematics. Original funding for the MALL project had expired, but he asked Katherine Johnson to consider writing a proposal to renew the project through her university, City Arts College. This funding was secured in 2004 from the State Board of Higher Education’s No Child Left Behind Improving Teacher Quality grant monies. The project was approved early in 2007 for a second three-year funding
cycle, which began in the summer of 2007. A timeline for the MALL project is included in Table 2.

Table 2

**Timeline of Mathematics Access for Language Learners Project**

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>State University at Midville (SUM) receives grant funding to begin MALL Project</td>
</tr>
<tr>
<td>1998 – 2000</td>
<td>Summer programs jointly sponsored by SUM and the Midville Public Schools’ Department of Language Education.</td>
</tr>
<tr>
<td>Summer 2004</td>
<td>Summer laboratory program model at City Arts College</td>
</tr>
<tr>
<td>Summer 2005</td>
<td>Summer laboratory program model at City Arts College continues</td>
</tr>
<tr>
<td>Spring 2006</td>
<td>Lesson study piloted in two MPS schools</td>
</tr>
<tr>
<td>Fall 2006</td>
<td>Workshops for teachers from six MPS schools</td>
</tr>
<tr>
<td>Spring 2007</td>
<td>Lesson study cycles for fall 2006 participants (3 teams)</td>
</tr>
<tr>
<td>Summer 2007</td>
<td>Workshops for up to 60 teachers for fall Lesson Study</td>
</tr>
<tr>
<td>Fall 2007</td>
<td>Lesson study cycles for summer participants (4 teams)</td>
</tr>
</tbody>
</table>

The MALL Project at CAC

When the project moved to the City Arts College in 2004, several changes were made to the original program model. When asked to describe some of these changes, Dr. Johnson, the project director, explained, “Certainly, right on the surface, the incorporation of the arts. Because that was not in any shape or form a part of what we were trying at SUM. At SUM we were focusing more on the use of literature. And we were trying to bring that to the teachers’ attention as a way of going beyond or putting the math into a context. Also, at SUM I don’t think we formally introduced the 4MAT the way we do now. We did not put as many hours into the front end of the professional
development part of it. Certainly nothing like 40 hours up front before getting into schools.”

More time and content in both mathematics and English-as-a-new-language were added to the professional development sessions for the teachers. The arts were integrated as vehicles for teaching both mathematics and English as a new language (ENL). In the spring of 2006, the Japanese Lesson Study model was added to promote implementation of the ideas and activities presented during the professional development sessions, as well as to increase the sustainability and dissemination of use of the instructional model (Project Narrative, 2007). The current (2007) distribution of professional development time is described in Table 3. In addition to completing one full lesson study cycle in the fall, teachers are invited to continue on for another lesson study cycle in the spring of 2008.

Table 3.

*Breakdown of Professional Development Activities for 2007-2008 MALL Cohort*

<table>
<thead>
<tr>
<th>Hours</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>42 hours</td>
<td>Summer professional development workshops</td>
</tr>
<tr>
<td>3 hours</td>
<td>Introduction to Lesson Study approach</td>
</tr>
<tr>
<td>3 hours</td>
<td>Workshop of mathematics content (algebraic reasoning)</td>
</tr>
<tr>
<td>20 hours</td>
<td>After-school or weekend Lesson Study meetings</td>
</tr>
<tr>
<td>12 hours</td>
<td>Research lesson presentations and discussions</td>
</tr>
<tr>
<td>6 hours</td>
<td>Follow-up whole group sessions</td>
</tr>
<tr>
<td>32 hours</td>
<td>Spring lesson study cycle</td>
</tr>
</tbody>
</table>

The following content is covered during the summer professional development sessions:
According to the 2007 grant evaluation report, the MALL program goals for teachers are:

1. To improve teacher practice through an extended professional development program that addresses extending and deepening mathematical content knowledge, as well as extending pedagogical knowledge to include use of effective approaches for teaching math in conjunction with art-supported strategies and materials for teaching English as a new language (ENL).
2. To facilitate teacher use of the strategies and materials introduced during professional development workshops.
3. To prepare a cadre of teachers with the knowledge and confidence necessary to provide leadership related to professional development and classroom support for other teachers in their implementation of standards-based math curricula with English language learners (ELLs); and
4. To develop an articulated and integrated math, English as a New Language (ENL), and arts curriculum for each of the three grade levels (Grades 3-5) that will positively impact student learning.
During the summers of 2004 and 2005, the MALL program worked with new groups of twenty-five to thirty teachers in grades 3-5 of ELL students. All of these teachers worked in MPS schools with high populations of ELLs. Each participating school sent a team of three teachers, one at each grade level – 3, 4, and 5. Nine schools participated in the summer of 2004, and ten schools participated in the summer of 2005.

In each of these years, the participating teachers attended a weeklong institute focused on integrating ENL strategies, the arts, and standards-based mathematics lessons. Teachers also taught a four-week summer school program and met twice a week in the afternoon to collaboratively plan lessons and continue their professional development on key strategies. The focus was on improving teacher practice by extending and deepening mathematical content knowledge and pedagogical knowledge to include the use of effective approaches for teaching mathematics in conjunction with art-supported strategies for teaching English as a New Language. During each of these summers, teachers attended 34 hours of summer planning workshops, 22 hours of afternoon study groups, and taught summer half-day sessions with their students for an additional 57 hours. Teachers were compensated for their instructional time as well as their time spent attending professional development.

Project evaluation reports for 2004 and 2005 indicated that teachers found the MALL project valuable. However, an opportunity for improvement on the program design was identified in the spring of 2006. Some teachers reported that they were not able to transfer much of their learning from the project to their regular classroom teaching. Some teachers saw the program work as a special situation, not relevant in their day-to-day teaching. Given the daily curricular and logistical demands of their
classroom, several teachers reported struggling to transfer their new strategies. It became clear that changes to the program model were necessary to increase transfer into classroom practice.

In the spring of 2006, the Japanese Lesson Study model was piloted as part of the MALL program. In reflection meetings with teachers who participated in the summer program in 2004 and 2005, they reported enjoying the professional development and stated that they had hoped to use some of the strategies in their own classrooms. However, they found that they were not able to do so given the constraints of their regular mathematics curriculum and curricular mandates from the district and building administrators. During the summer program, teachers were able to try out the strategies they learned in professional development, but mathematics was the sole focus of their summer school program. Teachers had several hours each day to spend teaching mathematics and supporting language development. They were struggling to make the adaptations necessary for the model to fit into their regular classroom practice.

Lesson study was introduced in an attempt to more closely tie the program to classroom practice. A team of nine teachers from the 2005 MALL program met together to pilot the lesson study process and determine how it would fit within the program. This group of teachers met together for approximately 20 hours and planned a lesson using the 4MAT model and integrating the math, arts and ESL strategies that they had developed through the program the previous summer. The research lesson was implemented in two teachers’ classrooms, with the rest of the team present to observe, collect data, and reflect following the lesson implementation. In follow-up meetings, the teacher participants indicated that they found this experience most valuable, and agreed that the lesson study
model would help teachers connect the program more closely to classroom practice. Six of these nine teachers became the first group of facilitators for the lesson study cohorts beginning in the fall of 2006.

The third year of the MALL project at City Arts College began to take on a different look. As in Years 1 and 2, the summer component was a professional development program for all the teachers including an introduction to the 4MAT planning model, practice with ENL strategies, introduction to activities in the visual arts, music, movement, and drama, and in-depth study of one mathematical area per grade level. Professional development modules were conducted by City Arts College faculty and MPS Department of Science and Mathematics staff. In Year 3 this component was offered in Fall 2006.

Offering the first component of professional development in the fall, instead of the summer, was not the first choice of the project leaders. The program had planned to begin this professional development over the summer of 2006, but funding delays, scheduling conflicts, and communication struggles within the MPS school district made the fall scheduling the only feasible option. Incorporating more than 40 hours of professional development into the first few months of the school year was a challenge for both project leaders and participating teachers. Teachers met on Friday evenings and Saturdays for five consecutive weeks through November and December 2006. This scheduling, to a large degree, accounts for the small number of participants in the Year 3 cohort. This group began lesson study cycles in February of 2007.

Evaluation results from three years of implementation indicate that the program had significant impact on the performance and dispositions of teacher participants. The
project’s three-year evaluation report noted positive effects on teacher practices as a result of participation in the project including the following:

- Teacher implementation of the strategies and materials introduced during the professional development workshops, as reported by teacher facilitators from their classroom observations.

- Teacher engagement with the program as demonstrated by attendance rates at the workshops and comments in their evaluation of the professional development component, such as the sampling below:
  
  o The professional development in the arts made me feel more confident in conducting activities with students.
  
  o Planning sessions with the teacher facilitator was very supportive and very organized.
  
  o I never realized how important movement was in my lessons.
  
  o The 4-Quadrant planning approach helped me focus on all the components of math, fine arts, and language arts all together.
  
  o What’s great about the “strategies” is that they can be used across the curriculum.
  
  o The [MALL] Program has definitely expanded my knowledge of how to effectively teach math strategies to ELL students. It has stretched me as a teacher. It was a very good experience.

Year four of the program began in the summer of 2007 with two cohorts of teachers, more than fifty in all, completing the initial professional development. One group of
teachers met for seven days in June and another cohort of teachers met in July. The groups joined together and divided into lesson study teams in the fall of 2007. The grant funding was renewed with the intention to “significantly increase the number of teachers who are prepared to adapt standards-based mathematics instruction to match the linguistic needs of students enrolled in bilingual or English-as-a-new language (ENL) programs and to build more sustainability into the program” (Project narrative, 2006).

The current 2007-2008 cohort of teachers is the largest group of participants, to date with more than fifty teachers participating. In addition to teachers from MPS, a group of teachers and one administrator from a nearby suburban district also participated in this latest cycle of the project.

Lessons Learned to Date

The project’s three-year evaluation report issued in January, 2007 cited the following lessons learned since the inception of the project:

- Positive changes are sustained when a designated time is set aside for practice and reflection.
- Opportunities for collegial sharing increase the likelihood that individual teachers will take risks in trying new practices in their own classrooms.
- Teachers, initially reluctant to change in isolation, become willing to try new strategies with the support of their colleagues.
- Adoption/ownership of specific strategies increases the likelihood that the strategy will become a permanent part of the individual teacher’s professional repertoire.
• A good indicator of change in practice is when teachers become less concerned about their ability to implement program components and more interested in the consequences of their action on student learning.

• When teachers are provided the opportunity to express their challenges and successes with colleagues, they are emboldened to try strategies with which they are less familiar.

• When provided with a strong support system of colleagues, evidence of mutual respect and appreciation, teachers are more willing to engage in new learning and more eager to try out new ideas.

• The partnership allows teachers to see the interest and desire for success that the several entities showed throughout the program’s implementation.

• Probably the most important lesson learned from the partnership was that teachers, who are armed with new strategies and willing to risk implementing them, provide positive attitudes that permeate the classroom and its learners (3-Year Evaluation Report, 2007).

Since its inception at State University, the MALL project has undergone many changes. Some of these were intentional, and others happened in response to external factors. The leadership of the project has been proactive in anticipating challenges, and remained flexible in reacting to them. In one conversation with Dr. Johnson she described her approach to challenges by saying, “If you can’t go this way, then try another way, go around. There is some way that you can figure this one out. Nothing is impossible.”
That approach has helped the project continue and grow to better meet the needs of program participants. Dr. Johnson stated, “Even when I might have stopped and said we failed there, I generally take the approach that there might be some good in this.” She continued, “When we got the small numbers, last year [2006], for example, after the many hiccups of trying to get started . . . we just kept bumping right along. But look at how cohesive that group has become. We decided we were going to stick this out. We were in this so far, and it was very good for those that did stick it out. Even for those who did not come back, I don’t see those as complete losses. . . . I saw that people learned from that, so that was a learning experience for everyone.”

As the project continues to try to help teachers make this a part of their regular classroom practice and works to increase the scale of the project, it is anticipated that there will continue to be modifications made to the program design. Discussions are already taking place about how to more explicitly develop teacher leaders to facilitate the project, how to work towards building some of these cohorts within individual schools, and how best to arrange the scheduling to accommodate the most teacher participants. The continual growth and reflection modeled by the leadership of this project is an asset to the MALL project and may contain valuable leadership lessons for all professional development projects.

Step Three: Imagine

*imaginen* – to create a mental picture

When teachers signed up for the Mathematics Access for Language Learners project, they probably did not expect to be performing an interpretive dance, staging a
tableau, clapping rhythmic patterns, or designing and building a model of a welcome center for a nearby park. In fact, unless they had read the program description carefully, they may not have even considered that the arts would be a focus of this project at all. Imagine is the third step in McCarthy’s 4MAT system. This step is designed to allow students to move from reflective observation to abstract conceptualization and picture a concept as they understand and have experienced it (McCarthy, 2000b). In this section of the chapter, I describe and analyze the arts integration component of the MALL professional development program.

During the summer workshop portion of the project, teacher participants spent almost twelve professional development hours working with artists in each of the four main art forms; music, movement/dance, drama, and visual arts. Each of the four artists worked with the teachers on the basic elements of their art form and shared specific activities that teachers could use to support language development in their students, or help teach the mathematical concepts of algebraic reasoning. Teachers then worked to integrate the arts into their practice lesson plans and later into their research lesson study plans using the 4MAT model. The arts were particularly emphasized to support the Imagine and Extend steps of these lesson plans.

In the surveys administered at the end of the summer 2007 sessions, all of the teachers responded that the professional development activities that addressed the arts were beneficial or very beneficial. Some teachers added that the best feature of these sessions were, “Practicing using the arts to explore math, i.e., looking at art, making dance moves, acting and building,” and “The implementation and incorporation of Fine Arts into the lesson design for classroom instruction.” Another teacher commented, “I
liked the fact that you connected visual arts, music and dance to teaching math concepts. I had never experienced anything like it.”

The interactive nature of the arts, where learning emerges from doing or making the art form dovetails with both research-based approaches for second language learning which advocate providing children with real communication about interesting, relevant subject matter in low-anxiety environments (Richard-Amato, 1996, p. 378) and approaches that support a standards-based mathematics curricula, which demand that students do mathematics (Van de Walle, 2004). The findings from the MALL project are consistent with recent studies in public schools support the use of the arts to further learning in other subject areas (Fiske, 2000; Catterall, Chapleau, & Iwanaga, 1999; Burton, Horowitz, & Abeles, 1999).

Within the MALL project, teachers gradually recognized the value of incorporating the arts into their instruction for English language learners to support language development as well as mathematical understanding. One participant I spoke with noted the ways the arts can enhance math instruction, particularly for ELLs, by stating, “Many times math concepts are taught in abstract ways. If we give them the opportunity to act, draw, or represent concepts, they will internalize and understand them in more deep ways.” In a focus group session, another teacher commented that using the arts “is an advantage, especially with ELLs. It validates what they already know, without the constraints of the language . . . that is a great chance for them.” In the same focus group, another teacher detailed the advantages of arts integration, “ELLs always need extra support when it comes to presenting different concepts to them. And the way to show their understanding when they are exposed to art and different ways, they are not
restricted to just one way of doing it. . . . They see many ways to represent what they got.”

Teachers also noted the benefit of using the arts to support mathematical concept development. In a final reflection, a third grade teacher explained, “Arts such as drama, movement, help students to grasp math concepts. Many times math concepts are taught in abstract ways. I think if we give the opportunity to [use various art forms] they will internalize and understand them in a more deep way.” Similarly, another teacher noted, “Before I attended this workshop, I always thought of math as problems to solve and memorization of steps and rules. Now, I can see that the integration of the arts can be included and makes math more interesting – I want to solve problems now and use my imagination to solve them. When I went to school, imagination and math were not integrated.”

All of the teachers interviewed for this study affirmed that they were trying to integrate more arts activities into their mathematics instruction. For example, one teacher stated, “I did start incorporating some tools in my classroom and I saw my children engage immediately and they liked it very much and I enjoyed it very much. Because I know it was a good way to guide them to the point I wanted them to be . . . I feel the art in this case has helped me a lot.” Another teacher explained, “I tried to use some of the dancing activities, and the kids really loved it. This project has really made me think more about using the arts in the classroom.”

Teachers seemed eager to try the arts integration strategies and activities that they had learned in the workshops. Even teachers will little background or experience in the arts tried to put these ideas to work in their classrooms. A fourth grade teacher noted, “I
have implemented a lot of the art in the classroom. I have implemented where students would dramatize or use movement to dramatize a vocabulary word, which I did not do prior. I am not much of an artist, but I . . . try to incorporate that.” Another teacher commented, “It was extremely helpful to have someone show us many different ways in which art can be used. It is a good starting block when you are unsure of what to do.”

The goal in the workshops was not to create arts experts, but rather to introduce teachers to the idea that the arts can be an important vehicle for supporting student development in both the English language and mathematics. The artists prepared several activities that teachers could readily use in their classrooms, and continuously emphasized that for each art form there are only a few basic ideas or elements to keep in mind. In the end-of-summer survey, one teacher in the July cohort commented, “The activities presented were things I could do right away in my classroom with little or no materials”

In addition to getting ready-to-use activities, teacher participants themselves were challenged to create and demonstrate their own understanding using the different art forms throughout the summer sessions. As one teacher stated, “The fine arts activities were introduced to us in a way where we were challenged as teachers, however, we were also able to see how we could modify it for our students. I liked the fact that it gave me ideas in way to incorporate the fine arts which I never would have thought I could incorporate into math” (Summer survey, 2007). Another teacher stated, “The dance challenged me the most, I have absolutely no skills. I found it encouraging that even without skills I can incorporate movement into my plans, I feel confident enough to do that at this point.”
The arts integration was not a component of the program when the project began at State University in 1998. This component was not added until 2004 when the City Arts College took the lead in coordinating the project. The project director explained that the idea to integrate the arts initially began as a program addition to satisfy the request of one of the grant writers at CAC. Dr. Johnson explained, “She asked, ‘how are you going to make this a City Arts College project? How are you going to put our stamp on it?’ She is the one who pushed me to think about how to make the arts a part of it . . . I would not have been reading the different pieces about the arts if she had not pushed me in that direction.”

What began as something of an add-on feature to the project has now become one of its more remarkable and signature elements. Not only has the arts piece helped to tie this project to the core mission of CAC, but it has also been an important component in supporting teacher development. Through the arts, teachers are provided with useful tools in helping their students accomplish both mathematical and language development goals. Additionally, teachers are pushed to think about their own understanding in new ways. They must go beyond knowing the content to using and demonstrating that understanding.

In our interview, the project director commented, “I think this is one of the big pieces of learning for me because I am not an artist. Just like we have Antonio Machado, we are all traveling together, creating this road as we go. I have been watching and I have become more and more appreciative of what the arts do for our thinking.” She continued, “I wouldn’t have been as motivated to go read more if I didn’t watch the teachers grappling with the math. I know in the end for me it is about how is this
promoting understanding of the math . . . it has just been a great way to promote learning."

After one of the July sessions, the project director made this comment, “I appreciated [the arts integration] even more as I watched how having to think about using the arts pushed the teachers to deepen their understanding of the mathematical concept that they were considering for their lesson. It was like one of those pieces you hear about the left-brain and the right-brain. But I think it goes beyond that. It is the synthesis. It really pushed them to synthesize. It pushed them to go all the way back and ask what do I understand here? What don’t I understand?”

As the project moves forward the arts will undoubtedly continue to play a significant role in the project design. During the summer of 2007 fine arts teachers were invited to participate in the program alongside their colleagues. The integration of these ideas throughout the project cycle provided valuable insight, and is something that the project personnel hope can continue. Few teachers had negative comments about the arts integration portion in this project, however, one teacher did note that the “Artists could do a better job of connecting with the math concept” (Summer survey, 2007).

Additionally, one teacher commented, “I loved the arts integration, but we have so much to do in [the textbook]” (Summer survey, 2007). Within the demands of their day-to-day curriculum some teachers struggle to see how they could find the time to add these new strategies. This concern was noted infrequently, but nonetheless should be considered in future iterations of this project.
Step Four: Inform

*in forma* – to bring form into

*Inform* is the fourth step in the 4MAT model where learners examine expert knowledge on a subject (McCarthy, 2000a). This is the “telling” or information-giving time, the phase of the learning experience where learners are informed of the content they need to understand (McCarthy & McCarthy, 2006). In this section I analyze the summer workshop portion of the MALL program where teachers receive professional development on a variety of topics.

In addition to professional development in the arts described in the previous section, teachers also received professional development during their summer workshops in Bernice McCarthy’s 4MAT planning model, mathematics, and ELL strategies. Together, the City Arts College faculty members and the teacher facilitators worked to deepen teacher understanding of the mathematics they teach at their grade levels; introduce them to strategies for teaching and integrating mathematics, English as a new language, and the arts. Additionally, the project leaders introduced and provided practice with use of the project’s instructional model.

In the Summer of 2007 teacher participants began with 40 hours of professional development which occurred over a period of two consecutive weeks. These sessions were designed and organized using Bernice McCarthy’s 4-MAT instructional model. Figure 7 shows an overview of the organization used for these workshops. Table 4 provides a breakdown of the professional development activities for the summer sessions.

To provide participants with an initial common experience with the 4MAT model, the professional development sessions began with teacher facilitators modeling the
Coffee and Cream lesson. This lesson was modified from the research lesson created by the pilot lesson study team in the spring of 2006. Most of the teachers who were on the planning team for this lesson now work with the project as facilitators. Like many research lessons, this lesson has been continuously modified and improved based on data collected during each implementation. The complete lesson as it was used during the summer 2007 professional development sessions is included in Appendix H.

The Coffee and Cream lesson gave participants a personal experience with the 4MAT model that they could use as a point of reference throughout the program. As the lesson was being implemented by facilitators, teacher participants were asked to reflect on the lesson and record their predictions about the purpose of each of the eight steps in the model. Throughout the summer sessions, and even into the lesson study planning sessions in the fall, teachers continuously referred to the Coffee and Cream lesson when discussing the 4MAT model or various strategies they were working to implement. One teacher participant commented, “I go back to that Coffee and Cream lesson that we have done. Just when we did the part with same and different and showing the same with the clapping and the beat. I would never have thought about that.” Experiencing this lesson helped teachers to develop a common language and reference point that they could connect to their new learning about the program model and its components.

Next, teacher participants were asked to attend to the planning model and to the NCTM process standards. The teachers did this by analyzing the Coffee and Cream lesson using the 4MAT framework. Participants were formally introduced to this model and shown how each piece of the lesson met the goals of each of the eight steps in the
Figure 7. Plan for summer professional development activities using the 4MAT planning model.
Table 4.

*Summer Professional Development Activities by Session*

<table>
<thead>
<tr>
<th>SESSION</th>
<th>LENGTH</th>
<th>CONTENT</th>
</tr>
</thead>
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| 1        | 4 hrs  | • Introductions, Community Building, Norm Setting  
           |        | • Overview of Project  
           |        | • Experiencing a 4MAT Lesson  
           |        | • Analyzing the Lesson Using the 4MAT Framework |
| 2        | 4 hrs  | • Lesson Analysis for:  
           |        | o Math Content  
           |        | o Math Vocabulary  
           |        | o English Language Structures  
           |        | • Practice Identifying the Steps of the 4MAT model  
           |        | • Review of the NCTM Process Standards |
| 3        | 4 hrs  | FOCUS: Quadrant 1  
           |        | • Math through Problem Solving  
           |        | • Explanation of Quadrant 1 of 4MAT wheel  
           |        | • Designing Content for Quadrant 1  
           |        | • Developing Vocabulary Using Drama or Movement |
| 4        | 4 hrs  | Developing Vocabulary Using Drama or Movement |
| 5        | 4 hrs  | FOCUS: Quadrant 2  
           |        | • Explanation of Quadrant 2 of 4MAT wheel  
           |        | • ESL Strategies for Developing Vocabulary  
           |        | • Designing Content for Quadrant 2, Using ESL Strategies, Drama, and Movement |
| 6        | 4 hrs  | FOCUS: Quadrant 2  
           |        | • The Teacher’s Role as “Informer”  
           |        | • Designing More Content for Quadrant 2 |
| 7        | 4 hrs  | FOCUS: Quadrant 3  
           |        | • Explanation of Quadrant 3  
           |        | • Planning for Use of the Math Textbook for Student Practice of Math Content  
           |        | • Music Applications |
| 8        | 4 hrs  | FOCUS: Quadrant 3  
           |        | Visual Arts Applications |
| 9        | 4 hrs  | FOCUS: Quadrant 4  
           |        | • Explanation of Quadrant 4 of 4MAT wheel  
           |        | • Journal Writing Strategies  
           |        | • Oral Language Delivery Techniques  
           |        | • Designing Activities for Quadrants 3 & 4 |
| 10       | 4 hrs  | SHARING PRODUCTS  
           |        | • Refining Lessons  
           |        | • Sharing Ideas Across Grade Levels |
4MAT instructional framework. Teachers were also formally introduced to the NCTM Process Standards and were asked to analyze the lesson for mathematical content, vocabulary and English language structures. Teacher participants were also formally introduced to each of the quadrants of the 4MAT model through PowerPoint presentations and discussions, and were given opportunities to practice strategies learned for each quadrant.

As demonstrated in Figure 7, participants then moved into focusing on supporting vocabulary development for their English Language Learner students. An experienced ESL teacher with expertise in working with ELL students presented this portion of the professional development. During the summer professional development a three hour session was devoted to focusing on key research and strategies for working with ELL students. ESL topics focused on academic language acquisition or cognitive academic language proficiency, often called CALP (Cummins, 1979). Research indicates that acquiring such vocabulary can be difficult because it is often presented in reduced contexts within formal academic learning environments where there are few cues as to the meaning of abstract vocabulary apart from the words themselves (Thomas & Collier, 1995). For ELLs to experience academic success in math, it is extremely important for them to acquire this level of language in order to be able to communicate effectively about mathematical concepts. All of the teachers participating in the MALL project have significant numbers of ELL students in their classrooms. Helping teachers to understand the research and best practices for teaching their ELL students is an important component of this project. The background information was presented during the early part of the
summer professional development, and teachers were asked to consider the needs of their ELL students throughout their work within the project.

As the professional development moved to focusing on Quadrant 2 of the 4MAT model, teachers considered the Imagine portion of the model while working with four artists. As the skills of comparison, classification, analysis, synthesis, inference, and evaluation are all involved in the acquisition of academic vocabulary, the arts—visual, sound, movement, and drama—were used to support such acquisition (Project Narrative, 2007). This component of the summer professional development was discussed in greater detail in the Step Three: Imagine section of this chapter above.

The workshops continued to focus on the second quadrant of the 4MAT model as teachers looked at steps four and five of the model, the Inform and Practice sections. The project leaders continued to weave together specific information about the 4MAT model with experiences using the model. In this portion of the workshops, teachers read professional articles focused on algebraic thinking and participated in a variety of algebraic reasoning tasks. Teachers worked in groups to solve mathematical problems and consider how the arts might help to support learning of these concepts. Teachers again revisited the NCTM process standards and discussed cooperative learning strategies that could support the language and mathematical development of their students.

Next, teachers practiced using the 4MAT model to modify a lesson on algebraic reasoning for ELL students as they moved into the Extend, Refine, and ultimately the Perform portions of the professional development summer workshops. The teachers worked with their grade level teams to adapt a lesson using the 4MAT model to meet the needs of their ELL students. These lessons were then refined and shared with the entire
group through a gallery walk, where each group of teachers posted their lesson at designated stations in the room and then circulated around the room, spending time looking at the products of each teams’ work. The artists continued to work with participants to provide concrete examples of lessons that integrated vocabulary strategies, arts integration, and mathematics. The project facilitators each worked with a group of teachers to guide them through the lesson planning process using this instructional model. This portion of the summer workshops is discussed in greater depth in the Practice section of this chapter.

The summer workshops were time-intensive. Teachers spent 40 hours together participating in professional development in mathematics, strategies for working with ELL students, arts integration activities, and the 4MAT instructional model. These sessions were designed to lay the groundwork for the lesson study component of the program that would take place during the academic year.

Overall, the sessions were well-received by teachers. Teacher participants in the third year of the project responded to twenty survey items addressing the project’s professional development activities, materials, and evaluation tools, on a five-point scale from “no benefit” to “very beneficial.” Of the thirteen items specific to professional development workshops and applicable to all respondents, all workshop elements were rated beneficial or very beneficial. Survey and interview data indicated that teachers benefited from the professional development on the 4MAT model, mathematics, and strategies for working with ELL students.

Though the 4MAT model was new to most of the participants, several of the teachers noted that they appreciated the structured framework for considering their
lessons. One teacher reported in her end-of-summer survey, “This instructional model was new to me. I found it extremely helpful in breaking down a lesson to ensure excellent instruction and authentic activities for my students. Thank you for introducing it to me.”

Through the survey, interviews, and conversations, other teachers reported liking the experiences of following the 4MAT model while they were attending the professional development. In the end-of-summer survey, another teacher stated that the best features of the professional development were, “The fact that we followed the structure of the quadrants while we learned. And groups worked together for several days, we got to know one another and we were able to work as a team.” In an interview, one teacher facilitator commented, “Following that four-quadrant model really helps you put things in perspective.”

Teachers’ feedback toward the mathematics components of the professional development was also very positive. At the end of each summer 2007 cohort, teacher participants completed a survey about their professional development experience during the summer workshops. In these surveys, 100% of teachers responded that the professional development activities that addressed mathematics strategies were very beneficial. In particular, one teacher noted the benefit of having facilitators work with each small group of teachers, “The use of coaches at each group was very effective. It kept us informed, centered, and on task” (Summer survey, 2007).

In addition to benefiting from the mathematics professional development and the introduction to the 4MAT model, many teachers reported feeling as if they had new strategies and tools to use to support their ELL students. In my interview with one
project participant, he stated, “You can know the concept but sometimes you struggle to address so many issues that ELL’s have, and when I say issues I mean language-related issues. I felt that this program gave me tools to try new things and see some other ways to try to deliver that knowledge to my students.”

In particular, teachers seemed to walk away with new awareness about the vocabulary development needs of their ELL students. One fourth grade teacher reflected, “My ideas in lesson presentation geared toward ESL students have changed. I need to really examine each lesson and reflect on the amount of vocabulary I assume my students understand” (Grade 4 reflections, 2007). A project facilitator stated, “I am more sensitive with the ESL students. I am more aware of how to connect with them through their prior knowledge or some topic that will get their interest right away. I think we just take for granted everyday vocabulary. But, ELLs may not know it. So, that I have changed.”

Teachers reported in interviews and focus groups that through this project they were challenged to reflect more on how they specifically address vocabulary in their mathematics lessons. One teacher summarized, “My ideas on lesson presentation geared towards ESL students have changed. I need to really examine each lesson and reflect on the amount of vocabulary I assume my students understand.” This was a typical response from all of teachers that were interviewed about this project.

In order to address this challenge, the summer professional development sessions were used as a vehicle to present teachers with many different strategies to support vocabulary development, including the use of the arts. These tools were introduced to specifically support mathematics instruction for ELL students, but many teachers saw how these strategies could benefit their instruction in other curricular areas as well. One
teacher highlighted her new understanding: “Finding different ways to present the vocabulary instead of just . . . going over the definition. Through the use of pictures, of acting, I noticed how the kids understand the words. . . . and it’s something I can use in reading as well.”

One of the greatest challenges the project has had to face is the teachers’ limited content knowledge in both mathematics and ESL strategies. While a few teachers began the program already holding an endorsement in ESL, many teachers did not. Very few third, fourth, and fifth grade teachers in the MALL program hold endorsements in mathematics.

Another challenge is the amount of content to process in a limited time. While the number of hours of professional development seems to be quite large, the project leaders quickly realized that they are pressed to fit in all of the content teachers need to support their ELL students in mathematics. The project director stated, “There is just so much. . . . When do you have time to introduce it all? There is no time. You almost want to say that you need one whole course just in ESL, and now one course in math content knowledge. Maybe you need six credit hours to go through everything. That is huge. How do you do that without alienating people? So that they are learning it because they feel that they need to know this now?”

Some teacher participants already struggle with the time commitment required in the MALL project. Of the teachers who completed the summer trainings in 2007, nineteen of sixty-three teachers decided not to return in the fall for the lesson study component. For many of these teachers, the time commitment was a primary reason for not continuing. As one teacher stated, “My school is already overwhelmed with too
many different programs” (Summer survey, 2007). Many of the schools participating in the MALL program are also participating in a variety of other district initiatives which place demands on teachers’ time.

At the end of the summer professional development a handful of teachers expressed concerns about implementing some of the strategies they learned in professional development because of time constraints within their school day. One teacher noted, “I think that I have changed my way of thinking about math instruction but I have found it difficult to incorporate it because of pacing and testing. I have incorporated more vocabulary instruction in math lessons” (Grade 4 reflections, 2007). Another teacher echoed this comment, “Time is a great factor and at times this model may not be practical when trying to follow a [mathematics curriculum] pacing chart” (Summer survey, 2007). The lesson study component was added to the project to help address some of these concerns. Teachers who participated in the lesson study reported less tension around this issue after completing that phase of this project.

When I spoke with the project director about what her hopes for the summer program were, she stated, “In terms of instruction to their students, that it becomes second nature for them to ask, ‘Is this a problematic task, or am I just spoon-feeding them and giving them a formula.’ So always starting out with, ‘How is this task problematic? How am I getting the students to think?’”

In addition to this focus on mathematics, the project director also has hopes for how the teachers begin to approach teaching ELLs.

I hope that teachers begin asking themselves, ‘What am I assuming about what students are going to understand? Especially with English Language Learners.
This pushes it back to the teachers to analyze constantly, to just constantly think about what they are teaching from the standpoint of the students. Rather than thinking ‘Here is what I am going to say,’ [teachers consider] what is it that [students] are going to understand or not understand. So how am I going to have to adapt the lesson that I have? And then that they think about multiple avenues for getting the student to make sense of the problem that they are going to be working on and then showing how they understand it.

Time for this type of professional reflection was integrated throughout the summer professional development sessions, and continued into the fall through the lesson study work. Much time is devoted during the summer professional development sessions to developing a community of learners and building professional relationships among teachers. Grade level teams are provided time to work together, to get to know one another, and to complete a variety of tasks collaboratively. While not an expressed goal of the professional development, this time seemed to provide a strong foundation for much of the professional learning that happens in this project.

Step Five: Practice

praktikos – capable of being used

Before innovating or adapting new knowledge, learners must first practice their new learning as the experts do it (McCarthy, 2000b). In this Practice step, learners move through activities with the support of a facilitator to help them achieve mastery (McCarthy & McCarthy, 2006). In this section I analyze the practice component of the MALL project.
During the summer professional development workshops, teachers worked in grade level groups to modify an algebra lesson based on the NCTM Standards (NCTM, 2000). A specific lesson was chosen for each of the three target grades—third, fourth and fifth. Teachers were divided into groups of four to six teachers according to grade level, and each group was assigned a facilitator. Several groups were given the same lesson and asked to work with their group to modify the lesson to meet the needs of the ELL students using the 4MAT model.

These teams met together for designated periods several times throughout the summer workshops. After each new step in the 4MAT cycle was introduced (Connect, Attend, Imagine, etc.), teachers would return to their groups to focus on that part of the cycle using their algebra lesson. In the end, each team of teachers had completed an algebra lesson for their grade level that used the 4MAT cycle and integrated the arts.

This process provided an opportunity to practice planning a lesson using the 4MAT model, but also served as preparation for the lesson study planning that lie ahead in the fall. Teachers’ collaborative work provided an opportunity to build professional relationships. During the June 2007 cohort, I worked with a fourth grade team of eight teachers from different schools. As my team worked to develop their lesson and integrate ESL strategies, I observed them brainstorming together, sharing ideas on teaching practice, and asking questions of one another.

This practice in creating a lesson plan using the 4MAT model was a new feature of the summer professional development in 2007. Previous cohorts had not had this opportunity to begin to practice what they were learning in the professional development prior to the lesson study phase. Overall, teachers were very receptive to this addition. In
a survey conducted at the end of each of the summer sessions, all of the teachers responded that the grade level planning sessions for the lesson were beneficial or very beneficial.

Several teachers noted this algebra lesson planning as the best feature of the summer professional development. Their comments included, “I liked that we got to create a lesson together with our grade level teams. I liked that [the facilitators and project director] introduced each step, reviewed the important keys and goals before we actually had to use it to plan that part of the lesson. It was great to have facilitators . . . to lead us and answer questions.” Another teacher commented, “I thought it was very practical for us to apply the knowledge learned to an actual problem. Working with a group helped to clarify any misconceptions about working with the 4MAT model.”

Teachers valued the opportunity to practice the model and saw this practice as an essential step in becoming confident and efficient with the program model. When asked how this professional development experience was different from other professional development she had participated in, one fifth grade teacher stated, “I think this one has made me think a lot more. Because . . . [with other PD] it is all done for us. With this one we had to think about how are we going to do this step, how are we going to do the second step, how are we going to do the third step. So I think that it definitely made me think more, become more creative.”

At the end of the summer 2007 sessions, teachers were asked to reflect on the seven sessions they had spent together. Teachers shared the lesson plans they had created using the 4MAT model through a gallery walk. Teachers from different groups had an opportunity to see the lesson plan that was created by each group, and make
commendations and recommendations on what they saw. At the end of the final day, teachers were asked to chart their ideas about what they were taking away from the seven-session summer workshop. The following list was created by the June cohort:

7 sessions later, we…

- Have a better understanding of how to integrate arts into math
- See the importance of stressing vocabulary
- Need to make connections to the material
- Know that ELLs’ needs are similar to general program students
- See how arts make activities more interactive
- Will never have students just sit for seven hours, they need to be active!
- Realize this is not so overwhelming. The 4 quadrant model is doable and doesn’t have to take days
- Need to engage students by using different learning styles
- Know interpretive dance can prepare students for [state tests]!

This summary indicates that teachers were beginning to see the model as doable and believed they had a better understanding of how to meet the needs of ELL students in their mathematics classroom. The planning of the algebra lesson gave teachers an opportunity to make a real connection between the model being introduced and their practice as professional educators.

Both the teacher participants and the facilitators had an opportunity for authentic practice while engaged in the lesson planning. The new project facilitators were able to practice guiding a group of teachers through the planning cycle. While each facilitator
was guiding her group, there were veteran facilitators and the project director nearby for support as questions or concerns arose. This supportive environment helped these new, emerging leaders develop the confidence and skills they would need in the next phase of the project. During the upcoming lesson study phase, these facilitators would be on their own working with their group.

Focusing on algebraic reasoning helped reinforce the mathematical content knowledge that was emphasized throughout this cycle of the MALL project. Teachers worked on a lesson that related directly to the mathematics content they were being introduced to during the summer sessions. While these activities were well received, overall, some teachers suggested that the directors consider using examples of lessons taken directly from the core curricula that the teachers were using in their schools (Summer survey, 2007) instead of starting with the lesson from the NCTM standards. While this seemed a practical and logical recommendation, it was not feasible with this specific group of teachers who came from eighteen different schools, and two different school districts. In this mix, teachers were using at least three different core mathematics curricula in their regular classrooms. In future years, if the participation numbers increase, or if the program can be directly tied to specific curricula, then this additional tie to classroom practice and the teachers’ regular curriculum would be a worthwhile consideration.
Step Six: Extend

ex tendere – to stretch out of

In the Extend step of the 4MAT System, learners are encouraged to tinker with ideas, relationships and connections, and add their own unique use of their new knowledge (McCarthy, 2000a; McCarthy, St. Germain, & Lippitt, 2002). In this section I analyze the lesson study portion of the MALL program from the spring and fall of 2007, where teachers work in grade level teams to apply their new knowledge and strategies by meeting together to design a research lesson that will be implemented in at least two team members’ classrooms.

After the initial forty hours of professional development, teachers moved into the lesson study phase of the project. The Japanese Lesson Study model (Stigler & Hiebert, 1999; Lewis, 2002; Watanabe, 2002) was introduced into the project during the spring of 2006 to increase the likelihood of transfer of training to classroom practice and therefore the sustainability of the approach (Joyce, Showers, & Fullan, 2002). All teachers in the project from both summer cohorts joined together on a Saturday morning in September to kick-off this phase of the project.

The kick-off session began with an overview of the Japanese Lesson Study model, presented by Dr. Johnson. Teachers also viewed a short video and read an article, which provided a glimpse of one group of professionals moving through the lesson study cycle. Next, teachers transitioned into their grade-level teams to discuss the article and begin their own planning for the lesson study cycle.

The purpose of including the lesson study phase in the MALL program was to help reinforce standards for collaborative relationships, reflection and personal growth,
instructional delivery, and assessment (Final Report, 2007). Each team of four to eight teachers was paired with two teacher facilitators, teachers who had participated in lesson study and the MALL project in previous years. Teams of teachers met together for eighteen to twenty-four hours to collaboratively plan a single lesson, which would later be implemented in two of the group members’ classrooms while the remaining team members observed the lesson implementation and collected data on student learning.

All of the teacher participants I interviewed noted how valuable the time was for planning collaboratively with a team and discussing a lesson in depth. When asked what the most valuable part of the MALL project was for him, Antonio, a third grade teacher participant gave a response typical of many of the teachers interviewed, “I would say the chance to work with other teachers. To develop and plan our own lessons, to collaborate with them, and gain so much from the different experiences they have. That, to me is the most important part of it.” He also shared this reflection on the lesson study process; “Just being able to sit down and plan the lesson for ourselves was new to me. I have never done it before . . . . It was great, because usually you just follow a curriculum. And you just do it because you know you have to follow it . . . but in this case it was that we were creating what we are going to do. We decided on what we are going to do, when we are going to do it, and how we are going to do it. So that was, to me, the crucial part of this project.”

Another fifth grade teacher participant shared, “It was valuable just to talk to somebody else. Your lesson plans kind of get stale after a while. . . . So, bringing in some different people to tell me ‘Why don’t we try this, or let’s try this and let’s do that,
and this might be a good idea’. That was good, just working with other people at our grade levels because we do not really get a chance to do that. No one ever has time.”

In the spring of 2007, each lesson study team selected its own topic to focus on for the research lesson. A math specialist from the university was hired to work with each group and support the teams in their development of the content knowledge they had elected to focus on. One teacher describes how the fourth grade team selected its topic this way, “We picked a component of Math Trailblazers that I was not comfortable with. . . . If it was September, we might have chosen something different. We talked about what we had not covered. We wanted something that would not be overkill for the students. We wanted something that would be coming up in that semester. We all came together and said that this would be a good idea. . . . I wish with mathematics we could have done that with every subset of the subject area!”

During the fall of 2007, all lesson study groups were asked to focus their lesson on algebraic reasoning. With the increased number of participants and lesson study groups, this eased the strain on the mathematics specialist, and pushed the teams to consider a field of mathematics that may have been less familiar or comfortable to them. This change also allowed for that content knowledge to be embedded in the summer professional development hours prior to breaking off into their separate groups to plan the lesson.

Each team spent significant time working together to create their lesson plan. Grade level teams worked together to discuss the content, strategies, and components of their lesson. Participants then shared in the responsibility for coordinating the logistics of the lesson implementation, such as scheduling, obtaining or creating materials, and
writing up the parts of the lesson. As the external evaluator noted in her preliminary report (2007), “The process allowed for results that would be difficult to achieve as an individual.”

Teacher participants felt invested in this lesson study process. In a focus group with teacher participants, one fourth grade teacher stated, “So what I’m taking away from here is I’m actually going to be able to use the lesson that I helped produce, with my own students, and hopefully even repeat it next year if, God willing, I’m still in the same grade. So personally, I thoroughly, thoroughly put 120% into this, because I knew it was going to benefit my teaching, and my children. It was personal.” A third grade teacher reiterated this sentiment, saying, “Usually, even though you create your own lessons, you’re following in a way . . . but coming as a group and putting in your part, creating your own lesson, being able to deliver and then to reflect on it, just the whole process, you’re proud of it.”

The lesson study component is a highly personalized, teacher-driven complement to the summer professional development. While teachers were provided with valuable strategies and ideas during the summer workshops, this component pushed them to put these strategies into action, and allowed them to collect data on the success of their implementation. Teachers seemed to take ownership of the lesson and of their professional learning. As one project facilitator noted in her interview, “This lesson study piece is more personalized . . . actually doing it, and being a part of that lesson planning, it is much more intimate.”

The personalized nature of lesson study allowed for the experience to meet the specific needs of the teachers participating in the project, and their students. Another
teacher facilitator stated in an interview, “The most valuable thing about my experience was the teacher collaboration that went into creating a lesson. The lessons were well thought out and created for each group of students. They were not copycat lessons; they were selected specifically for groups and modified to fit their needs.”

Through this process teachers became more reflective during their planning and anticipated the challenges for ELL students. Through the lesson study discussions, I noticed several of the teachers asking thoughtful questions about what could be done differently, or what might work better for their students in a given situation. In a written reflection, one fifth grade teacher noted, “The lesson preparation discussions have allowed me to spend more time thinking of my ESL/ELL students. I am more aware and in tune with what will benefit their success in math.” Similarly, a fourth grade teacher noted, “It has made me think more in depth about planning a math lesson--about how to connect the students, how to integrate the arts, and how to imagine how the learning process will occur in my class” (Fourth Grade Reflections, 2007).

The biggest challenge for project personnel and teachers during this component of the MALL project was time. The lesson study model requires a great deal of time for planning and analyzing data for a single lesson. Finding the time to meet together was a challenge for many groups. Teachers emphasized and understood the need to move towards professional learning communities, but the time demands for shared planning, teaching, observation, reflection, and analysis—even in the space provided by this project—were intense. In the data I examined, teachers and facilitators stressed the need for structured time and resources to work together. The project originally planned twenty hours for each group to plan a single lesson. While for some groups this was sufficient,
other groups needed additional hours to prepare adequately. The flexibility of the grant funding and of the participants and facilitators allowed for this accommodation.

It would likely have been easier to handle meeting logistics if teachers were more geographically centered. Some lesson study groups struggled with central meeting location sites since some teachers were in far north and others in far south parts of the city. Meeting in geographic clusters might have simplified logistical considerations, if such an arrangement were feasible. Ideally, these types of groups could be organized among teachers within an individual school building. This would not only simplify the logistical considerations, but also connect the experience more closely to teachers’ own work environment.

Lesson study does take a lot of time and energy. It is an intense professional development experience for teachers. In a written reflection, a fourth grade teacher noted, “It is a lot of work and at times frustrating, but at the end it’s worth it.” Another teacher participant concluded, “Imagine if we all sat together and said this is where we feel weaknesses in teaching, and then got together and did [lesson study] and had the time for that, I think that schools would be much stronger.”

Step Seven: Refine

*re fin* – back again, to explore the limit or boundary again

In the *Refine* step of the 4MAT System, learners step back and evaluate their extension and adapt or modify it if necessary (McCarthy, 2000a, 2000b). In this section I continue to analyze the lesson study portion of the MALL project, this time focusing on
the debriefing conversations after the implementation of the lesson study research lessons.

After each lesson study cohort completed the planning for their lesson, one of the teachers from the team taught that lesson to his or her class as a “research lesson.” During this research lesson, the other members of the lesson study group were present to watch the lesson implementation and collect data on student learning and specific research questions created by the group. Following the first research lesson presentation, the cohort member met for the next component of the project: to reflect on the effectiveness of the lesson, using both their observations and a study of student work. Based on these reflections, changes were made to the lesson plan, and a second teacher from each team taught the lesson to his or her class. Again, cohort members observed the lesson and repeated the process of reflecting on and improving their lesson. Following the second lesson implementation, the team members met to discuss what they had learned collectively about incorporating ENL strategies and the arts into their math instruction and the impact on student learning.

All of the teachers who responded to the end of program surveys after the 2006-2007 cycle responded that they found the observation and debriefing conversations very valuable. Teachers seemed to appreciate the opportunity to visit other schools and classrooms, and to have the time to reflect on their practice as educators with their team members. One fifth grade teacher commented, “It’s just like reading a book, then you have your book club to discuss it. It was nice to see what the teachers learned from their own students” (Fifth Grade Focus Group, 2007).
The value of the time and opportunity to reflect on teaching practice were mentioned by all participants who were interviewed or in the focus groups as the particular strengths of the lesson study component. One teacher stated, “I think as a model we all agree that reflecting on your teaching practices [is] of great benefit to you as teachers, so just the fact that this model allows you to do so . . . you have the chance to go back and reflect on what’s happened.” Another teacher added, “It was just great to really reflect on what did work, and see the changes in action--realizing that reflection should be done a lot more, because there’s a lot to be improved on.”

Teachers highlighted the importance and value of having time to do this type of reflection after each research lesson, noting that otherwise time that might not be available to them in their regular work day, outside of this project. Comparing these discussions to her regular grade level meetings at her school, one third grade teacher stated, “We were not as rushed. We had time to talk about the subject . . . at grade level [meetings], you’ve got to say so many things so quickly, so fast, that you really don’t have time to deepen your knowledge of what you’re doing, or to really focus on what we’re trying to accomplish.”

Teachers who implemented the research lessons seemed to appreciate the opportunity to be observed and receive feedback. One teacher reacted to the process of being observed by a group of colleagues this way: “It’s kind of scary. But when it happens, it’s not that they critique our teaching, it’s how our kids are learning.” A second teacher noted, “As a teacher, when you have quite a few people coming into the classroom and helping you observe the students . . . you get to see what is it that the group has been lacking.” A third teacher explained how colleagues’ feedback changed
her practice, “[The observers noted] that girls in my classroom did not participate much. Now, I’m seeing this aspect of them flourishing. If we had not had that time for reflection . . . I would just have continued the way I always do” (Focus Group transcripts, 2007).

Some of the teachers who implemented the research lesson in their classrooms felt nervous about having other teachers observing them, but quickly found that there was tremendous benefit to this type of experience. The lesson study research lessons were challenging for observing teachers as well. As one teacher noted, “It’s challenging, looking at every child . . . looking [to see if] we accomplished what our goals were, because here we have quite a few goals.”

Lesson study teams took ownership of the lesson they designed and described the lesson as a shared product. They felt that it was their group’s responsibility to learn from the lesson implementation and make their lesson even better. If parts of the lesson did not work perfectly or turned out differently than anticipated, rather than being critical of the teacher who implemented the lesson, the group saw it as a shared experience. Plural pronouns like “our” and “we” were used to discuss improvements that could be made for future implementations of the lesson. One fourth grade teacher described her team’s reaction after observing the research lesson in another team member’s classroom this way: “We thought that the part that the kids would have the most trouble with was the Imagine part. And they actually took less time than we had thought, and they really enjoyed it. So everything we had thought beforehand, we really changed our opinion when we got to see the kids. We had underestimated their ability. It was really positive
for the kids. They were really excited.” She went on to say, “We created an excellent lesson that I think the kids really understood.”

Similarly, a third grade teacher commented that, “Going back to the rooms and seeing [the lesson] delivered, well this is our product. . . . we were able to look back at it and say you know what, let’s change this part because maybe it will work better in a different way. So that, to me, was a powerful part of this project.”

All the teachers involved in the research lesson planning and implementation felt that this was a great learning experience for them. In the preliminary 2007 evaluation report for the project the external evaluator noted, “Sometimes the teachers were frustrated as they, like their students, tried out a strategy, rejected it, modified it, and tried again. Rather than relying on problems laid out for them in texts . . . the trial and error approach, and particularly the input from the team, made them look at concepts with an analytic eye. . . . There are so many curricular variables teachers may encounter, the ability to analyze and plan will have an impact on their teaching.” One teacher interviewed emphasized, “I am learning from you, you can learn from me. This is like an ongoing process.”

In addition to the benefits of learning from their research lesson implementation, teachers seemed to appreciate the opportunity to observe other teachers teaching. Several of the teachers interviewed noted that this was the first time in their careers that they had had an opportunity to visit other teachers’ classrooms. One fourth grade teacher stated, “I really liked that day when I was able to go and observe other schools and other teachers teaching. . . . I had never been to those schools before and it was interesting to see how the schools were run and get a different perspective of the system.”
A third grade teacher reiterated this sentiment in during a focus group interview, saying, “Just having the opportunity to go and observe how a colleague’s doing the same thing you do but with a different approach, was just a great opportunity for me. I also like the fact that we had a chance to go back and reflect on things that worked and didn’t work. That was also very helpful for me. Then I could see myself doing it in the future” (Focus Group Transcripts, 2007). Another teacher stated, “I’ve never had the opportunity to do that with other professionals. I can’t think of anything that was not good” (Focus Group Transcripts, 2007).

Throughout the lesson study phase of the MALL project, teachers were able to develop strong relationships with other teachers in their group. The teams worked in a truly collaborative manner to create a lesson they could be proud of. The trust and support developed through the planning phase helped to foster a supportive environment for reflective discussions during the post-lesson debriefing. When asked what the most valuable part of this project was for her, one teacher facilitator in the group commented, “I think that by working with a core of teachers we were able to put all of our gifts together and make a great lesson plan. We were able to establish great relationships among each other; we respected each other. I think it built our confidence as well. I think as teachers we close our door, we teach and we do our thing. It is so intimidating for someone to come in and observe. It is hard to take the constructive criticism on a lesson or whatever they are seeing. But I think this just built a great rapport among teachers and helped me see that there are other teachers out there within MPS with many, many talents and are willing to work at this type of lesson.” She continued, “I think the
relationships that are built with trust, constructive criticism, open ideas, creating a safe environment has been really valuable. I think that has been the best part.”

Another facilitator commented that the most valuable part of the project for her was “Working with a group of educators committed to supporting the needs of ELL students in MPS. The collaboration and collegiality [fostered by the lesson study experiences] have been tremendously motivating and beneficial in helping me be reflective about my own practice” (Facilitator Reflections, 2007).

All of the teachers interviewed seemed to value the contributions of their team members and stated that they had learned much from each other. One third grade teacher commented, “It was a great experience working with teachers from other schools, listening to different stories, being present when delivering lessons to different students at different schools from different neighborhoods and different cultures. So, just to have the chance to work with different people, [and] build upon what you have been doing for years in terms of teaching, I see this as a big chance for me to improve on my teaching practices with ELLs in terms of math.” Another teacher reflected, “We struggled with the time commitment, but it was worth it. I feel like through this process I have met so many people that I feel really comfortable with. I feel like I have made friends and [have] people I can call on.”

In my interview with the project director, she talked about the professional relationships developing among project participants. She said the best part of the project for her was, “To watch that being built in a very sincere, ongoing, a very real way . . . It’s not just that we are all here for this project and then OK, goodbye. We have all been through things like that. But just watching how much they really network. They
appreciate each other’s perspectives and what they are learning genuinely from each other. They have developed these personal affiliations. They like each other. So, this bonding is very powerful to watch.”

This type of relationship building is explicitly developed within the project. From the very beginning, groups of teachers are encouraged to work together to solve problems and are given time to share and discuss their ideas. During the kick-off phase to the lesson study portion of the project, teachers read and discussed the article, *A Deeper Look at Lesson Study* (Lewis, Perry, & Hurd, 2004). In our conversation after the lesson study kick-off event, the project director commented to me, “Today, when I was reading that article again . . . and the teacher who pointed out that having these conversations and establishing these networks contributes to the consistency in what’s being delivered or structured for the students within the school. The one who said, ‘What’s the good of teaching the students to think like a scientist if the next teacher devalues it?’ You just see how important the personal connections are. So, I talk with you, I know what you are trying to do and I appreciate your perspective. I am going to be more willing, or more open to thinking . . . that’s someone who I respect, so even though I do not think that way necessarily, I would like to make sure that all your efforts are not in vain.”

She continued, “It is great to sit back and observe these things come out. Those are not necessarily in the goals and objectives of the project, they are not written in there, but you see them just as a natural part.” In her view, collegiality and collaborative relationships are critical to any successful professional development program. As she stated in our interview, “Having experienced that myself as a teacher, I really appreciated it became a part of how I plan whatever professional development experiences.”
As the project moved forward, attention was being paid to include multiple perspectives and expertise in each lesson study group. During the summer 2007 program, schools were encouraged to send teams of teachers which included ESL teachers and fine arts teachers. A few of these teachers did join their grade level teachers for the lesson study cycle in 2007, though further recruitment efforts are necessary to increase the numbers of these groups in future cohorts.

Viviana, a fourth grade facilitator, worked in a group that had a visual art teacher, mathematics specialist, and four fourth grade teachers. A fourth grade teacher herself, Viviana commented on the make-up of her team, “I think the most valuable part of working with a new core of teachers in lesson study is really accepting their talents. Right now, currently, this is the first time that there are fine arts and ESL teachers invited, and to see a fine arts perspective in our group is like, wow, I never through of it that way! So, not only to have the fine arts come in and deliver their expertise, but to have someone sitting in your group has been really valuable.”

In addition to integrating the fine arts and ESL specialists into the teams, discussions have started among the facilitators and the project director about the role that school administrators might play in the project. During the 2006 cycle, two building principals attended research lessons and debriefing conversations that took place in their schools. During the 2007 cycle one assistant principal completed the entire program, including the summer workshops and the complete lesson study cycle, with a team of teachers from his school. That type of support and perspective in the process was extremely valuable to the group. While that type of time commitment may not be
reasonable in all cases, it seems clear that the support of a school-level administrator is essential if this project is to have the type of impact we might hope for at the school level.

Step Eight: Perform

*perform* – to fashion, to shape, to mold

The eighth and final step of the 4MAT model is *Perform*. In this step learners are able to share what they learned with others (McCarthy, St. Germain, & Lippitt, 2002). “Here the students display their understanding, how relevant the content is to them, its connection to larger ideas, how it fits into their world” (McCarthy and McCarthy, 2006, p. 68). In the eighth step of the 4MAT model, learners share what they do with others (McCarthy, 1987).

As the MALL project continues to develop, one of the next steps for the project is to continue to share its work with a larger audience. That growth includes building a leadership team to work with new and larger groups of teachers, sharing this model with pre-service teachers at City Arts College, and sharing this project’s story through professional conferences, papers, and even this dissertation. In this section I analyze how the MALL project participants are sharing what they have learned from this work, how leaders plan to move forward, and how the project leaders are attempting to build a leadership structure that will support this progress.

Leadership Development

In order to continue to expand the MALL project, a leadership cadre must be developed through this program that can sustain the needs of that expansion. All of the current project facilitators have participated in the project as teachers first. The project
aims to continue this model of leadership development, and has started to work with the Midville Public Schools to develop a plan to support the professional growth of the teacher participants in this project.

One of the stated goals of the project is to prepare a cadre of teachers with the knowledge and confidence necessary to provide leadership related to professional development and classroom support for other teachers in their implementation of standards-based mathematics curricula with English language learners (Final Report, 2008). The project aims to accomplish this goal to support the development of the teachers in the project, but also to build an infrastructure that can sustain the program in the future. In our interview, the project director described her perspective on leadership by stating, “For any project it makes more sense to say, ‘Let’s talk about this together.’ Being the sole leader is just too much, and it does not make any sense.”

The MALL program has provided teachers with the opportunity for professional growth, first as program participants and later as developing leaders. Project facilitators help deliver the professional development workshops and lead the lesson study teams. Several participants attribute their ability to assume leadership positions in their schools to what they have learned in this program. One facilitator is now working as a resident principal, another has become a reading specialist, and several others are now pursuing National Board teacher certification (Facilitator Reflections, 2007). These teachers cite support for leadership development received through this project in terms of books, videos, communications, and particularly collaboration. The project director, Dr. Johnson was repeatedly mentioned as a model for and of effective leadership (Project Evaluator Notes, 2007).
In my conversation with Dr. Johnson, she described the growth she has seen in one of the project’s veteran facilitators, Viviana. “I think Viviana is a prime example . . . watching her want to know more about how to deliver instruction more effectively, I think goes way beyond just wanting to be the one who gives orders. It’s that ‘I want to be the person who knows more so that I can be the kind of example that will motivate other teachers to want to deepen their knowledge both in terms of pedagogy and content.’”

In my interview with Viviana, she described her personal growth as a leader. She stated, “Looking into the future as a leader, I look at getting math endorsed and hopefully moving on to a bigger leadership role as a citywide math specialist or facilitator. I believe that [participation in] this [project] has sparked an interest and has inspired me to continue and move on to bigger things.”

While some project facilitators have assumed leadership positions within the project with ease, others have been pushed out of their comfort zone to assume these responsibilities. One facilitator stated, “This is my first leadership role, to be honest with you, it has been quite an experience. I did not think I could do it. When [the project director] first told me that she wanted me to become a facilitator, it was a hard decision for me, but I am doing the best I can, and learning as I go.” Another new facilitator stated, “I definitely don’t feel that I am an expert, but it has given me a tool to share with my colleagues in an informal way.”

Teacher facilitators noted that these leadership positions helped them to share their knowledge and understandings with other professionals. One teacher had just been invited to become a new facilitator with the project. In our interview he explained, “I
know the project is long and I know it requires a lot of your time and a lot of patience and a lot of effort, but I want to be part of telling teachers, ‘You know what, it’s worth it.’ Even though I have only been doing it for a couple of months, I have seen so many good things about it, so I just want to be a part of it and say, ‘You know what, you can do it.’”

Many of the facilitators saw these leadership positions as opportunities to grow professionally and continue to expand their learning, and as an opportunity to help other teachers to do so as well. A new facilitator described her experience by stating, “I think this project has made me more comfortable with the idea of taking a leadership position in math. I feel like it is not one of my strengths, maybe if I go to more PD maybe it would become a strength.” Another facilitator described her work as a facilitator, “I feel at times because it is a new role for me I had to reflect on what I could do better and attempted to make corrections for the next meeting. It was a personal growth process” (Facilitator Reflections, 2007).

Teacher facilitators noted the advantages of continuing in the project as a facilitator. Doing so meant that they would have the opportunity to take part in some of the professional development themselves. One new facilitator explained, “I do not mind sitting through these workshops all over again because I feel like every time I might pick up something different. The more you hear something, maybe, the more you might be able to do it on your own someday.” Another new facilitator stated, “I think there’s more to learn from this experience. I think I’d like to see what it’s like on the other side too.”

All of the facilitators I spoke with felt supported in their positions as teacher leaders within the MALL project. Each new facilitator was paired with a more
experienced facilitator for each of the lesson study teams. Facilitators also had regular conference calls with the entire team of facilitators and the project director where they could get answers to questions and check in with each other regularly. Teacher leaders also had access to mathematics specialists and the project director when they needed help. One facilitator summarized, “I received support through conversations with other facilitators. If I had concerns or questions I was able to get feedback through e-mail correspondence. I felt that the conference calls were also a great support” (Facilitator Reflections, 2007).

Spreading the Word

In addition to building a leadership base to support the project as it continues, the project leadership team has begun to consider how it can share its work with a larger audience of people. The State Board of Higher Education, the funders for this grant, have encouraged this focus. In a meeting in May 2007 with the various projects funded by these grants, the state highlighted the need to systematically apply learning from these projects to partner universities’ pre-service teacher preparation programs. The board wanted grantees to consider how these projects can help to inform work that is being done throughout the state, and the entire educational field.

In considering this request, Dr. Johnson returned to City Arts College and considered how this project is impacting her work at the college level with her teacher candidates. During the fall term of 2007, Dr. Johnson put these considerations into practice with her Mathematics Methods course, a master’s level course for students seeking teacher certification. One evening, Dr. Johnson invited four facilitators from the
project to her class to share their experience with the class and introduce her students to
the lesson study model. Students were then grouped with each of these teachers to
collaboratively plan a lesson, which the MALL project facilitator would teach in their
own classroom while the CAC students observed. In essence, the teacher candidates
participated in their own small lesson study with a more experienced teacher.

CAC students were also expected to attend and observe one of the research
lessons presented by one of the lesson study groups in the current MALL cycle. While
they had not participated in the planning of the lesson, these observations would give the
students the opportunity to see the lesson study model in action and also see a complete
mathematics lesson that integrated the arts and strategies for supporting English
Language Learners.

By introducing this project to students at CAC and having them work directly
with project participants, these college students were given an opportunity to work
closely with current teachers, and also to see a unique professional development model
first-hand. From conversations with these students and their host teachers, this was a
valuable experience for both groups. In an interview, one MALL teacher stated, “I feel
like when I came out with my bachelor’s I didn’t feel like I was really prepared for
becoming a first year teacher. I never studied any curriculum in depth, and then all of a
sudden you have to be like a master teacher and understand all of these concepts.” This
type of integration of pre- and in-service teacher learning can help to bridge that gap and
demonstrates that professional growth is an ongoing process.

In additional efforts to share the work of this project with a larger audience,
partnership participants have begun to make presentations at conferences and on Midville
Public Schools professional development days to disseminate information about the program elements and to advocate for more wide-scale use of the program’s approaches. These presentations have included the use of videotapes of research lesson presentations, debriefing/reflection sessions, and other professional development activities.

Next Steps for the Program

Each year the project has worked with new and larger groups of teachers. The hope is for that trend to continue into future years. However, as the project grows so too do the logistical challenges of this intensive model. The Midville Public School district has asked the project to consider scaling up significantly to accommodate a greater percentage of the teachers in MPS schools working with ELL students in these targeted grades. While the needs of the district are indeed large, careful consideration has been given to strategically considering the growth of this project.

In several cases there are now school buildings that have three or more teachers on staff who have gone through the entire MALL program, including lesson study. Thought has been given to trying to make this model work in more individual schools. The project director described her vision of how this project might grow, “It should start in the schools and you have this group, and the groups start growing so they get too big. And then they have to make two groups, and they just start multiplying within a school until we have a school where we have teachers talking about instruction and talking about student learning and their own understanding of the subjects is just a part of the culture of the school. . . . [Then] we can really be sitting on a base where teachers are observing each other and planning together.”
In one focus group, a teacher participant envisioned a more school-based model. She stated, “It’s nice that we all got together and worked in different schools, but I would like to see teachers from the same school, just doing it in each other’s room . . . so every year you could be teaching these lessons. That would be nice. I would like to see my staff doing it. I think it would be very beneficial.”

In the summer of 2007, a team of fifth grade teachers from the same school participated in the project alongside the school’s assistant principal. This team of teachers has articulated numerous possibilities for the project’s integration into the school’s culture. The project director described her conversation with the assistant principal by stating, “I could just see the wheels spinning, about the possibilities that [our model] could be a mark of the school. Imagine if we could say something like that . . . and have a model school where we could talk about this program model with the lesson study piece. It could be a nice showcase for the state, for our project.”

As the project looks toward the future, the project director has noted her desire to see other people taking on the leadership of this project. She describes, “I really want to see it happening, being led by other people. . . . I have to pass the torch. Nothing should die just because one person cannot continue doing this. . . . At some point I want to just stop and say to the facilitators, ‘Now you can do this.’ If every one of us can talk and tell the story, our capacity to relate what this is about and the importance of it becomes more a part of how we explain this to anyone who wants to hear about it.”

During the spring of 2008 there are plans to continue thinking about how this project may grow and how parts of this project may become more institutionalized within MPS. The project continues to evolve and develop. Consideration must be given to how
to plan for and manage this growth and development. In the data on leadership, the time and resources issue was consistently raised: if lessons learned from this process are to be shared throughout and across schools, administrative support is essential (Evaluators Notes, 2007). The leaders of the project need to continue to consider the demands the project makes on people’s time, allocation of resources, and also structural support within the school district to sustain this program into the future.

Summary

This case study aimed to answer four research questions:

1. In what ways has the MALL project helped teachers of English language learners make standards-based mathematics learning accessible for their students?
2. How has the MALL project helped to develop leadership in teacher participants?
3. In what ways have the stated goals for teachers of the MALL program been met?
4. In what ways does the MALL professional development project meet the needs of the large urban district to support teacher growth?

I believe that answers to each of these questions were found through this study.

This case provided numerous examples of the knowledge and strategies teacher participants gained from their involvement in this project (research question 1). Evidence is also provided that details how the MALL project met its goals of improving teacher practice, deepening content knowledge, facilitating teacher use of the strategies introduced during the professional development, developing curricular materials, and developing a cadre of teacher leaders (research question 3).

The Perform section of this case study detailed some of the ways that the project helped to develop leadership in teacher participants (research question 2) and met the
needs of the MPS district to support teacher growth (research question 4). These two questions are examined further in the discussion of this study in Chapter Five. Chapter Five also provides an analysis of whether the MALL project is an exemplary model for professional development, offers recommendations for future research, considers the leadership implications of this study, and shares leadership lessons for systemic change.
Chapter 5
DISCUSSION

Introduction

The purpose of this case study was to describe and analyze the Mathematics Access for Language Learners (MALL) professional development project. Data was collected from archival records, participant observations, and interviews with project participants, facilitators, and the project director. Data was then analyzed and presented in Chapter Four using Bernice McCarthy’s 4MAT model (McCarthy, 2000a, 2000b) as a framework. In this chapter I considered whether the MALL project is an exemplary model for professional development, shared implications for leadership from project participants, offered recommendations for future research, and shared my own learning from this study about the role of leadership in supporting systemic change.

The MALL Project: An Exemplary Model for Professional Development?

Hawley and Valli (1999) present a consensus model of effective professional development in which they highlight eight characteristics. I believe that at least six of these are embodied by the MALL professional development project. These features include the following:

- The MALL Project activities were designed in response to an analysis of the differences between goals for student learning and student performance in MPS.
- The MALL Project involved teachers in the identification of their learning needs.
- The MALL Project was organized around collaborative problem solving.
- The MALL Project provided continuous support for its participants.
The MALL Project incorporated evaluation of outcomes through multiple sources of information.

The MALL Project provided opportunities for participants to develop a theoretical understanding of the knowledge and skills to be learned.

This project was designed around the learning needs of ELL students. The lesson study component of the project had an unrelenting focus on student learning (Stigler & Hiebert, 1999). All efforts to improve and refine lessons were evaluated with respect to clearly specified learning goals and data collected on student learning during the lesson implementation. Refinements to the research lesson were justified with respect to student thinking and learning.

The entire project was organized around collaborative problem solving, both during the summer workshops and later during the work of the lesson study teams. Throughout the workshop and lesson study portions of this project, teachers were given opportunities to identify their learning needs and work collaboratively to meet those needs. Teachers were supported in developing productive collaborative relationships organized around solving meaningful problems related to their work as teachers of mathematics to English Language Learners (ELLs).

The length and intensity of the project allowed for continuous and ongoing support throughout an entire academic year. This was not a one-stop professional development model where teachers walked away from one session with all that they needed. Teachers participated in more than 120 hours of professional learning activities spread over the academic year. Throughout these sessions teachers had the support of
project facilitators to help them translate their learning into their own professional contexts.

One of the strengths of the MALL project was its expectations for participants around continual reflection and self-evaluation. The project took seriously the findings of external evaluation reports and the feedback it received from teachers. In each cycle of the project, new strategies were incorporated or the project evolved as project personnel responded to better meet the needs of the teachers that it served. The MALL project used the data it collected to anticipate future challenges and modify the project.

The project was organized around a sound theory of learning that allows ample opportunity for supported practice and development of new skills. The project also afforded the participants opportunities to practice and extend their learning from the project. Teachers were given an opportunity to develop a theoretical understanding of the knowledge and skills to be learned.

This professional development project allowed teachers opportunities to develop their skills in mathematics and as educators of ELL students. It provided teachers with opportunities to examine the arts and the role these can play in supporting student learning. The project introduced teachers to the 4MAT model of learning and the lesson study process. Moreover, this project allowed teacher participants to be a part of a professional community that learned together and worked to meet the needs of all students in the mathematics classroom.

The Hawley and Valli model (1999) also includes two additional features of effective professional development that I believe were not evident in this project in its current state:
• The MALL Project was not primarily school-based and was not integral to school operations.
• The MALL Project was not part of a comprehensive change process within MPS.

Hawley and Valli highlight the importance of job-embedded learning (1999). Smylie (1995) describes the optimal workplace as one where learning arises from and feeds back into work experiences, where learning is considered part of the work. The incorporation of lesson study helped to bring the professional learning in this project closer to the classroom practice of the teachers. However, this project was still an “outside” and in most ways an “ancillary” professional development project that was not necessarily integral to the operations of individual schools within MPS or to the MPS district. In many cases the teachers who participated in this project returned to schools where administrators and fellow staff members had little knowledge about the MALL project and therefore lacked an understanding about the work that was being done within this project. Consequently, program participants were “on their own”—there were limited supports in place to sustain the professional community that was built throughout the project or help the participants assume the role of “instructional leader” in mathematics or with ELL students at their local schools.

There was clearly a greater need for leadership (principal, lead teacher, coach) involvement in the MALL project at both the school and district level. As it was currently situated, the MALL project was not an integral part of a comprehensive change process. The Midville Public Schools (MPS) is a large and bureaucratic system that is slow to change. There are many different initiatives competing simultaneously for the attention of teachers and school administrators with little coordination among them.
Guskey (1995) cautions, “There is no easier way to sabotage change efforts than to take on too much at one time” (p. 119).

The Midville Science and Mathematics Initiative (MSMI) is the currently sanctioned district initiative for mathematics and science. Approximately two-thirds of the schools in the district participate in this initiative, which is focused around supporting the use of standards-based mathematics curricula. While the MALL project is aligned with some of the goals of the MSMI, the project operates, for the most part, independently of MPS. Further, the MSMI goals are not specifically focused on increasing mathematics achievement of English Language Learners.

Hawley and Valli (1999) list some indicators of district-level support for comprehensive change efforts, including adequate funding, technical assistance, sustained central office follow-through, avoidance of quick fixes, and providing teachers with adequate time to learn, plan, and implement new practices. The MPS central office involvement in the MALL project was limited to technical support such as providing facilities, processing the payroll for teacher participants (from grant funds), and sending communication to schools during the project’s recruitment phase. No district funding was allocated to this project. The Department of Science and Mathematics for MPS employs more than fifty mathematics facilitators, specialists, and coaches. None of these mathematics leaders has ever attended or participated in even one session of MALL professional development, except for me. My own involvement as a project facilitator is voluntary, and is outside of my normal job responsibilities.

Wagner, Kegan, Lahey, Lemons, Ganier, Helsing, Howell, and Rasmussen (2006) offer an approach to thinking systematically about the goals and challenges of change in
schools and districts that they call the 4 C’s – competency, conditions, culture, and context. As I looked back at the MALL project from a leadership perspective, I considered how this project addresses each of these C’s.

I believe that the MALL project had a strong focus on building teacher competencies. The professional development offered in this project focused on building a repertoire of skills and knowledge that influences student learning (Wagner, et al., 2006). Within the project, conditions were also developed that support change leadership. The arrangements of time, space, and money within the project supported the type of professional learning that the project hoped to attain.

Wagner, et al. define culture as “the shared values, beliefs, assumptions, expectations, and behaviors related to students and learning, teachers and teaching, instructional leadership, and the quality of relationships within and beyond a school” (2006, p. 102). The collaborative nature of the professional development helped to support the development of shared values, beliefs, and behaviors and strong professional relationships within the project. However, in the schools where teacher participants worked, there may not have been a culture that supported the transfer of their learning from the project. Local leadership needed to be more involved in understanding the project and consider how to support the development of this type of culture among their staff.

The greatest challenges for the MALL project were in the area of context. The context of the larger organizational system of MPS is a challenging system to work with and in. While the project addressed the changing needs of learners in the district with regard to English Language Learners, the project could not, in its present state, respond
completely to that need. While the district put pressure on the project to ramp up and work with larger audiences of teachers, the district offered no commitment to supporting that growth or even understanding the complexity of such a request. At the time of this study, the MALL project was one of only two professional development efforts focused on meeting the content area needs of teachers of ELL students. The other project was in the second year of a two-year research study, served fewer than thirty teachers in the district, and operated independently of the MALL project, MSMI and the MPS district.

District and project leaders need to consider how this project meets the needs of the district and fits into the vision of change for the system. If the MALL project is to become part of a comprehensive change process in MPS, the district office needs to understand the symbiotic relationship between the goals of this project and the larger MSMI goals, recognize the emerging “best practices” in mathematics instruction for ELLs from the MALL project, and then assume a larger role in supporting the work of the project. District resources should be allocated to support and sustain the unique work of the MALL Project initiatives, beyond the grant funding.

External partnerships and grant funding can be a good impetus for new ideas and provide extra resources, but ultimately the school district must commit to supporting the project if it is to become a part of the culture of the district and if the changes are to be sustained. In addition to funding, personnel in the district’s Department of Science and Mathematics should be more aware of and more involved in this project. A stronger partnership between MPS and CAC should be developed and include more than just one or two key individuals. This district support can help the MALL project to grow, reach a larger audience of teachers, better integrate the work of this project with the professional
development efforts of the larger district initiatives, and disseminate the emerging best practices.

Implications for Leadership

I believe that a deeper understanding of this specific professional development project can help district leaders and professional developers understand the components of quality professional development programs. Ball and Cohen (1999) argue for building a collection of examples of practice-based professional development. They state, “Having such instances would make it possible to engage the ideas in ways that are grounded in practice of professional development, concretizing the discussion. Those cases should be studied and distributed widely . . . . The materials should be vivid enough to be compelling, concrete enough to provide resources for others efforts, and open enough to avoid being converted into lists of abstract principles and ‘shoulds’” (Ball & Cohen, 1999, p. 29).

I believe that the story of the MALL program holds many valuable leadership lessons for professional developers and school and district leaders. In considering the implications of this study, I present these recommendations in the words of the teachers and project leaders that I interviewed. In each of my interviews with the teachers and leaders of this project, I asked them for their ideas on what school or district leadership would need to keep in mind if they were to try to replicate a professional development project like the MALL program in their own context. What follows are the specific recommendations that were voiced in these interviews and I present them here because I believe they have captured these ideas more articulately that I can. Their comments are
organized into three categories—taking an interest and listening to teachers, allocating resources, and building a community that supports risk taking and innovation.

Take Interest, Listen to the Teachers

“First, of all, see bilingual education as a plus. Don’t look at it as, ‘Oh no, we have to deal with this so let’s do whatever just to fill the requirements.’ And if you see it as a plus, well start building from it. There are so many things out there.”

“Administrators should support the project, encourage teachers to participate, and ideally model good participation through learning about the process and even participating themselves.”

“For a principal to drop in and observe it, they really have to have had some experiences with this to feel this is something that I need to, in some shape or form, carve time and money out to support this. It goes back to the connect step, you have to connect to some personal experiences to make you feel this is the way to go.”

“I think they need to show an interest. It seems like they just say they want you to do this and walk away. But they are not there helping with ideas or helping problem solve. It seems like they forget what it was like to be in a classroom, what it was like to have thirty kids.”

“But I think that not just our administrators in schools, but also top administrators from the district to sit in and say, ‘Wow this takes a lot longer than I thought.’ Because it is very easy to say take it all to the schools, but there is a lot of time involved . . . . So I think if they are there to experience it, to hear from us, they will better understand that it is not just a matter of ok, let’s take it out to everyone. I
would like to see them sitting there for at least one full session, so they also understand this lesson study approach and what we are trying to do.”

Allocate Resources

“I think administrators would need to work to provide the resources to allow this type of work to take place. Through time allocation, money for stipends, or both, administrators would need to take the lead in appropriate resource allocation.”

“Declare that they need to put the money back in to the arts, put the arts back into the curriculum.”

“Honestly, I think it is going to take money.”

“There would also have to be a lot of collaborative work to make it work.”

Build a Community that Supports Risk Taking and Innovation

“I think it falls a lot on our administrators. I think part of our professional development days, this would be a great way to begin the process of introducing this to teachers. . . . If every one to two teachers would do that, throughout the system, I think the whole system would be affected positively.”

“They should keep in mind that this is not something that will happen overnight. It is going to take a lot of work. And people are going to do it differently. There has to be room for individuality.”

“Specifically, through this project, I would say keep your minds open. Let students present their understanding in any way.”

“If you are trying to incorporate a program like this, involve the whole school. Not just one teacher, one grade level. Involve the whole school and build a culture. Because only following though with it year to year is the only way it will work. We
need a community of learning in teaching. If you are collaborating within your school, that is even better because you are working with them, creating with them.”

“Let teachers be creative, not just follow along the curriculum. Be open to let teachers find different ways, and hear them, support them.”

Recommendations for Future Research

This study provided an in-depth look at one professional development program over a specific period of time. While this program seemed to have a strong impact on many of the teachers interviewed, the long term effects for both teachers and students were not studied. Future studies might examine the effects of this program on teacher practice over a longer period of time.

As schools are pressured to make Adequate Yearly Progress under No Child Left Behind, gains in student achievement scores have become the primary goal and metric of many professional development endeavors. The National Staff Development (NSDC) standards state that staff development that improves the learning of all students should be data-driven and “use disaggregated student data to determine adult learning priorities, monitor progress, and help sustain continuous improvement” (NSDC, 2001). In addition to being data-driven, NSDC states that staff development should “use multiple sources of information to guide improvement and demonstrate its impact” (NSDC, 2001). The impact on student learning was beyond the scope of this research study, but an analysis of student achievement data may provide valuable information in understanding the impact of this professional development project.

There is currently a shortage of research studies on effective content area professional development for teachers of English Language Learner (ELL) students.
Future research should continue to analyze programs that have been effective in helping teachers to meet the needs of these students. The numbers of ELL students in American schools continues to grow and all teachers must begin to consider how to simultaneously meet the content and language development needs of students who are learning in a new language.

Leadership Lessons for Systemic Change

Antonio Machado wrote, “Traveler, there is no path, the path is created by walking.” The path of my own learning and development as a leader for change continues to be created as I walk it. As I traveled the path of this study I had the opportunity to reflect on and gain a deeper understanding of a project that has transformed my vision of leadership and professional development. I have learned valuable lessons about change leadership and the role that professional development can play in a systemic change effort. As I approach my future work, both within and beyond the MALL project, there are lessons I will take with me from this study.

When I began my study, I believed that this was a study largely about building competency. I sought to tell the story of a quality professional development program that worked to build the competencies of a very specific population of educators. However, as I analyzed the project, the themes that emerged were about more than just improving teachers’ understanding of mathematics and best practices in working with ELL students. The culture of learning that this project created through incorporating lesson study, the arts, and time to reflect and analyze all helped me to realize that change leadership is about much more than just competency building.
This study has confirmed for me that the 4 Cs (Wagner et al., 2006) provide a valuable framework for planning, and organizing for change as well as for leading and assessing change efforts. Through this process, I have gained a better understanding of the importance of using this framework in my work as a leader. I have learned that while competency building is important and leaders and professional developers need to have a clear vision of their goals for teachers, leaders must also take into consideration the complexity of change, and must take time to consider all four Cs in the Wagner et al. framework. Competency, conditions, culture and contexts are all interrelated and work together in important ways. Competency is just one component of a comprehensive change strategy. Teachers can develop their competency, but if they are returning to school environments where the culture, conditions, and context do not support that learning, then much of the learning is lost.

Conditions for learning must be created within a professional development program. Change is a complex process and takes time. One day workshops are not sufficient to create the kind of changes we really hope to make in teaching and learning. Providing appropriate time and space for professional learning means that resources must be allocated to allow for this. Hawley and Valli (1999) argue that professional development should be school-based and integral to school operations. Professional learning should be as context-embedded as possible and connect to the daily work of teachers. Professional development leaders must protect space for professional learning, and value teachers as professionals.

Change efforts also need to create a community of professional learning that supports risk taking and innovation. Culture is perhaps the most challenging of the Cs to
develop. During Doctoral Core, one of my take aways was to not forget the “who” in the change process and that change is not all about the “what.” This study has reinforced that learning. My belief that relationships are at the core of change and change efforts has been affirmed. We must make time to build a foundation for change through professional, collaborative relationships.

“Leaders see value in linking and connecting their colleagues. They demonstrate in their personal and professional conduct trustworthiness, openness, and affirmation. Leaders grow leadership relationships through being themselves people in whom others can feel trust, respect, and faith” (Donaldson, 2001, p. 47). Leaders for change must take time to focus on building a professional culture that will support competency development in areas that are relevant and meaningful for teachers.

Leadership should be collaborative and shared among many different people at the project, school, and district levels. Multiple voices can help to support reflective leadership,

Even if the weight of carrying people’s hopes and pains may fall mainly, for a time, on one person’s shoulders, leadership cannot be exercised alone. The lone-warrior model of leadership is heroic suicide. Each of us has blind spots that require the vision of others. Each of us has passions that need to be contained by others. Anyone can lose the capacity to get on the balcony, particularly when the pressures mount (Heifetz, 1994, p. 268).

When developing a culture that supports improvement in teaching and learning, leaders must also take time to reflect and analyze, then re-focus when necessary. The complexity of the change process requires leaders to acknowledge that they do not have
all of the answers. As they move through the process, leaders must work to develop their own competencies by seeking feedback and reflecting on their work as agents of change.

The fourth C in the model is context. This involves “understanding global, state, and community realities and re-visioning what all students need to know” (Wagner et al., 2006, p. 105). We need to understand contexts at the school, district, state, and federal level “to help inform and shape the work we do to transform the culture, conditions and competencies of our schools and districts. And we may, in turn, need to influence elements of the context in which we work” (Wagner, et al., 2006, p. 104).

This study highlighted for me that there are numerous challenges associated with working to create change in a large urban district. While there is a lot of room for improvement, and a general acknowledgement that change is necessary, the system is hard to move and has not adopted a relentless focus on making comprehensive changes. The district seems drawn to quick-fixes that at best can create superficial changes in teaching and learning. As I participate in district-level conversations about professional development, I find myself pushing against the pressure to endorse packaged, ready-to-go professional development. This project and this study have demonstrated for me the value of a more customized and targeted model of professional learning that takes into consideration competencies, culture, and conditions of change. Professional development needs to be a part of a comprehensive change process and leaders who work to support that change must consider the intricacies and complexities of that endeavor.

This is not to say that all meaningful professional development needs to happen on the district-wide scale. I have seen first-hand that bigger will not always mean better, particularly if the cost comes in losing the personal relationships that are at the core of
meaningful professional development. However, projects of any size must consider the context in which they are working and be aware of how their work fits into the larger change process. Project leaders should be deliberate and focused in who they work with. Focusing work in specific schools or groups of schools, and working with school leaders within those contexts is more likely to create the conditions, culture and contexts that will work together to support and sustain improvements in teaching competencies.

Professional development projects must reach out to administrators and school leaders. They must connect professional learning to context within the school building. Leaders must also consider district-level actions that can support the change process at higher levels and work to make changes in the larger context that can better support and sustain changes in teaching and learning throughout the system.

Wagner et al. state that “Systems thinking is about trying to keep the ‘whole’ in mind, even while working on the various parts” (2006, p. 97). Competencies, conditions, culture, and context are all interrelated elements that affect the tasks of improving learning, teaching, and leading. One of the greatest challenges for change leaders is to employ systems thinking to their work and understand the interrelationships among the various components of the change process (Wagner et al., 2006).

As I continue along my path as a change leader I understand that the district I work in has professional development needs that extend beyond the current capacity of the MALL project. As I continue to work with other district leaders to develop more professional development opportunities in mathematics for teachers of ELL students, I find that that the lessons I learned from studying the MALL project have a tremendous impact on how I approach this work. As I look at professional learning I realize that
while content and competency building need to be at the center of such learning, so too does creating a culture for learning where teachers are working together to take on these challenges. Teachers must feel supported in taking the risks needed to grow and develop as professional educators. Leaders must understand that creating change is about simultaneously developing the competencies, conditions, culture and context that will support and sustain systemic change.

Antonio Machado reminds us that the path is created by walking. The path of my career is still being created. I am not certain exactly where it will lead. However, I am sure that as I travel my path I will work to remember the valuable lessons I have learned from this study. As I create the path of my career I will keep these lessons close at hand. I will also consider myself fortunate to have the talented and thoughtful educators I have worked with in this project to remind me of what is possible and to offer their support as we travel this path together.
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Appendix A

Definition of Terms

**Basic Interpersonal Communication Skills (BICS)** – Part of a theory of language proficiency developed by Jim Cummins (1979, 1984), BICS is often referred to as “playground English” or “survival English.” It is the basic language ability required for face-to-face communication where interactions are embedded in a situational context. This language is highly contextualized and often accompanied by gestures. BICS is much more easily and quickly acquired than CALP, but is not sufficient to meet the cognitive and linguistic demands of an academic classroom (Cummins, 1984).

**Castañeda v. Pickard** – In 1981, in the most significant decision regarding the education of language-minority students since *Lau v. Nichols*, the 5th Circuit Court established a three-pronged test for evaluating programs serving English language learners. According to the Castañeda standard, schools must: base their program on educational theory recognized as sound or considered to be a legitimate experimental strategy, implement the program with resources and personnel necessary to put the theory into practice, and evaluate programs and make adjustments where necessary to ensure that adequate progress is being made [648 F. 2d 989 (5th Circuit, 1981)].

**City Arts College (CAC)** – University in Midville with special programs in the arts and communication. CAC secured grant funding for the MALL project from the State Board of Higher Education and currently coordinates the program.

**Cognitive/Academic Language Proficiency (CALP)** – Part of a theory of language proficiency developed by Jim Cummins (1979, 1984). CALP is the language ability required for
academic achievement in context-reduced environments. Examples of context-reduced environments include classroom lectures and textbook reading assignments.

**English Language Learners (ELL)** – Students whose primary or home language is one other than English and are in the process of learning the English language.

**English as a Second or New Language (ESL or ENL)** – An educational approach in which English Language Learners are instructed in the use of the English language. Their instruction is based on specific curriculum that typically involves little or no use of the native language and focuses on goals for language learning. Content-based ESL/ENL makes use of instructional materials, learning tasks, and classroom techniques from academic content areas as the vehicle for developing language, content, cognitive and study skills.

**Equal Education Opportunities Act of 1974** – This civil rights statute prohibits states which receive federal funding from denying equal educational opportunity to an individual on account of his or her race, color, sex, or national origin. The statute specifically prohibits states from denying equal educational opportunity to limited English proficient students by the failure of an educational agency to take appropriate action to overcome language barriers that impede equal participation by its students in its instructional programs. [20 U.S.C. §1203(f)]

**Lau v. Nichols** – Suit filed by Chinese parents in San Francisco in 1974 that led to a landmark Supreme Court ruling that identical education does not constitute equal education under the Civil Rights Act. School districts must take "affirmative steps" to overcome educational barriers faced by non-English speakers. [14 U.S. 563 (1974)].
Lesson Study – Lesson study is a teacher-led instructional improvement cycle modeled after the Japanese approach to instructional improvement. In lesson study, teachers work together to collaboratively plan a research lesson, conduct the lesson, with one team member teaching and others gathering evidence on student learning and development, discuss the evidence gathered during the lesson, and teach the revised lesson in another classroom and study and improve it again (Lewis, 2002).

Limited English Proficient (LEP) – A term used to represent those students who are assessed and found eligible to receive support services for learning English through a variety of approved programs provided in public schools.

Mathematics Access for Language Learners (MALL) – A professional development project designed to provide MPS teachers with the knowledge, strategies, tools and materials to help participating teachers make mathematics content accessible to their English Language Learner students.

Midville Public Schools (MPS) – A large Midwestern urban school district. Nearly 15% of MPS students are categorized as LEP. More than 80% of the district’s students come from low income families.

Title VI of the Civil Rights Act of 1964 – Prohibits discrimination on the basis of race, color, or national origin in programs and activities that receive federal financial assistance. The Title VI regulatory requirements have been interpreted to prohibit denial of equal access to education because of a language minority student's limited proficiency in English [42 USC § 2000d et seq. (1964)].

4MAT – The 4MAT System is an instructional design model created and developed by Bernice McCarthy (1987, 2000a, 2000b, 2003). This model is based on learning styles research, and provides an instructional model where students move from “experiencing to reflecting, to conceptualizing, to tinkering and problem solving, to integrating new learning with the self.” (McCarthy & McCarthy, 2006, p. 11).
Appendix B

Timeline of Dissertation Data Collection

(June 2007 – January 2008)

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Appendix C

Informed Consent – Participant

Thank you for agreeing to participate in this study that will take place from June 2007 to March 2008. This form outlines the purposes of the study and provides a description of your involvement and rights as a participant.

I consent to participate in a research project conducted by Alison M. Whittington, a doctoral student at National-Louis University located in Wheeling, Illinois.

I understand that this study is entitled Creating the Path Together: A Case Study of a Mathematics Professional Development Program for Teachers of English Language Learners. The purpose of this study is to describe and analyze a specific professional development project to determine: in what ways this professional development project has helped teachers of English language learners (ELLs) make standards-based mathematics learning accessible for their students; how this project has helped to develop leadership in teacher participants; in what ways the stated goals for the program have been met; and in what ways this professional development project meets the needs of the large urban district in which it is situated.

I understand that my participation will consist of one interview lasting 1 – 2 hours in length with a possible second, follow-up interview lasting 1 - 2 hours in length. I understand that I will receive a copy of my transcribed interview at which time I may clarify information.

I understand that my participation is voluntary and can be discontinued at any time without prejudice until the completion of the dissertation.

I understand that only the researcher, Alison M. Whittington, will have access to a secured file cabinet in which will be kept all transcripts, taped recordings, and field notes from the interview(s) in which I participated.

I understand that the results of this study may be published or otherwise reported to scientific bodies, but my identity will in no way be revealed.

I understand that in the event I have questions or require additional information I may contact the researcher: Alison M. Whittington, 2861 W. Palmer St., Chicago, Illinois 60647, USA, (773) 710-4611, Email address: alison@whit1010.org

If you have any concerns or questions before or during participation that you feel have not been addressed by me, you may contact my Primary Advisor and Dissertation Chair: Dr. Linda Tafel, National-Louis University, 1000 Capitol Drive, Wheeling, Illinois, 60090, (847) 947-5044; Email address: LTafel@nl.edu

Participant’s Signature _______________________ Date _______________

Researcher’s Signature _______________________ Date _______________
Appendix D

Interview Questions for Teacher Participants

1. How did you become interested in this project? What did you hope to gain from your participation?

2. What has been most valuable to you about this project?

3. How have your ideas about ways to incorporate ESL strategies into your math instruction changed as you’ve participated in this project?

4. As a result of your participation in this project, do you feel better prepared to adapt your mathematics instruction to meet the needs of your ELL students? Please explain.

5. In what ways has your involvement in this project helped you to develop a deeper understanding of mathematical concepts and learning standards?

6. As a result of this project, how has your thinking changed about the role the arts can play in mathematics and ESL instruction?

7. In what specific ways (if any) was the lesson study process useful to you?

8. Would you recommend this project to other teachers at your school? Why or why not?

9. Have you taken on more leadership responsibilities in your school or district since your involvement with this project? If so, please specify.

10. How is this project different from other professional development you have participated in?
Appendix E

Interview Questions for Project Facilitators

1. How did you come to participate in this project as a facilitator? What did you hope to gain from your participation?

2. What has been most valuable to you about this experience?

3. As a result of your participation in this project, do you feel better prepared to adapt your mathematics instruction to meet the needs of your ELL students? Please explain.

4. In what specific ways (if any) was the lesson study process useful to teacher participants?

5. In what ways, if any, do you think teachers will change their practice (lesson planning, delivery, reflection, etc.) as a result of participating in this project? On what do you base your view?

6. In what ways has your involvement in this project helped you to develop a deeper understanding of mathematical concepts and learning standards?

7. What kind of leadership and administrative support do you believe is necessary to make this model work at the school wide level?

8. Have you taken on more leadership responsibilities in your school or district since your involvement with this project? If so, please specify.

9. What, if anything, would you change about the way the project chooses, prepares, and supports facilitators?

10. How is this project different from other professional development you have participated in?
Appendix F

Interview Questions for Project Coordinator

1. How long have you been involved with this project? In what capacity?

2. How was this project conceived?

3. Why did you choose to include lesson study in the program model? In what specific ways (if any) was the lesson study process useful to teacher participants?

4. Were the arts always a part of the program model? Why did you decide to include the artists in the professional development?

5. What do you feel are the key ideas that teachers should walk away from this program with?

6. In what ways, if any, do you think teachers will change their practice (lesson planning, delivery, reflection, etc.) as a result of participating in this project? On what do you base your view?

7. What have you learned from this endeavor?

8. What has been most valuable to you about this experience?

9. What has been most challenging to you in directing this project?

10. What kind of leadership and administrative support do you believe is necessary to make this model work at the school wide level?

11. How replicable is this project? If someone were to try to replicate this project, what do you think are the most important things to consider?

12. What, if anything, would you change about the way the project chooses, prepares, and supports facilitators?
13. What do you think makes this project different, or stand out from other professional development?

14. What are the next steps for this project? What is your vision for this project over the next five years?
Appendix G

List of Archival Data Sources Reviewed

End of summer survey summary (June 2007, July 2007)
Facilitator written reflections (May 2007)
Focus group transcripts - Grade 3, 4, and 5 (Spring 2007)
Handouts and powerpoint from NCTM conference presentation (October 2006)
Interim evaluation report (June 2006)
Letter to principals (Summer 2007)
Notes from meeting with board of higher education (May 2007)
Observation notes from external evaluator (Spring 2007)
Participant binder (Summer 2007)
Preliminary FY07 external evaluation notes (May 2007)
Program application (Spring 2007)
Project budgets (2006-2008)
Project narrative (Fall 2004, Fall 2006, Fall 2007)
Project renewal acceptance letter (September 2007)
Research lesson plans (Spring 2006 - Fall 2007)
Teacher attendance data (June 2004-December 2007)
Teacher written reflections (Spring 2007)
Three-year evaluation report (January 2008)
STEP 1: Connect to Life Experiences (5 minutes)

Purpose: To present learners with the problem, using a context to which they can relate.

Activity: The facilitator will introduce the following problem situation, modeling with Dunkin Donut cups of the four sizes and showing 4 creams as she describes how she takes her coffee.

I usually buy a small (S) Dunkin Donut coffee, and I ask them to add 4 creams. That’s the taste I like. But, I don’t buy a S everyday. Sometimes I buy a medium (M) when I feel a little sleepy. Sometimes I buy a large (L) when I know I’m going to have a long day. And, when it’s a re-structured day, I buy an extra-large (XL).

The problem is that whenever I change the size of the coffee from a small, I can’t get the same taste I get with the small coffee. It always tastes different. I never seem to know how many creams to tell them to add to get that same taste. Can you help me out?

Evaluation: Learners’ level of interest in finding a solution to the problem

High: Most of the learners nodding, smiling, or showing other signs that this is a problem to which they can relate.

Medium: About half the learners nodding, smiling, or showing other signs of interest

Low: No visible indication of interest

STEP 2: Attend (10 minutes)

Purpose: To have learners attend to the English language vocabulary and structures that will be important for understanding the problem to be solved.
Activities: The facilitator will review the first part of the problem situation, projecting the problem and posting the words cup, small, medium, large, extra-large written on sentence strips next to the cups, which will already be taped on a poster. She will also point out that we often use abbreviations or short cuts to indicate the words, and so introduce the c, S, M, L, and XL. Learners will be engaged in discussions about reasons why these abbreviations would make sense. The facilitator will also show other examples (balls, water bottles) of small, medium, large, and extra-large, assessing for the learners’ ability to use the words.

The written words for coffee and cream will also be introduced and posted next to examples on the word wall poster.

Evaluation: Learners’ use of the terms to name or describe objects

Entering: Learner can repeat the new vocabulary words.

Beginning: Learner can point to objects that can be described with the vocabulary words.

Developing: Learner can give examples of objects that can be described with the vocabulary words.

Expanding: Learner can explain or discuss the vocabulary words.

Bridging: Learner can tell a story that involves use of the new vocabulary words.

Step 3: Imagine (10 minutes)

Purpose: To reinforce learners’ understanding of the terms, same and different by using nonverbal art representations of the new language structures or vocabulary.

Activities: The facilitator will move to the second part of the problem to introduce the terms same and different.
Music: Same and Different
The facilitator tells the class that she is going to demonstrate two rhythm patterns. Students should listen carefully to each pattern and identify whether the patterns sound the same or different.

Example 1 –
The facilitator says “Listen carefully. Here is the first pattern. Then, she claps four times slowly:

Ta Ta Ta Ta

The facilitator pauses briefly, then says, “listen carefully. Here is the second pattern” she repeats the

Ta Ta Ta Ta

She then asks the class if the two patterns the same or different? Why do you say that?

Example 2 –
The facilitator says, “Now listen carefully to two more patterns. Here is the first pattern. Then, she claps any kind of rhythm she chooses, such as eight fast claps:

Ti-ti Ti-ti Ti-ti Ti-ti

The facilitator pauses briefly, then says, “listen carefully. Here is the second pattern.” She claps a different pattern:

Ti-ti Ti-ti Ti-ti Ta
She then asks the class if the two patterns are the same or different? If they reply different, she asks: “How were they different?” If they do not hear the difference, repeat the two patterns.

Variations:
The facilitator claps a pattern and then asks the class to respond by clapping the same pattern

The facilitator claps a pattern and then asks an individual student to respond by clapping a different pattern.

Mix claps, snaps, and other body percussion, such as tapping your feet, stomping, patting your arms or thighs. All can be used to produce rhythms for the purpose of reinforcing the concept of same and different as expressed through sound.

**Evaluation:** Learners’ use of the terms to name or describe objects

- **Entering:** Learner can repeat the new vocabulary words.
- **Beginning:** Learner can point to objects that can be described with the vocabulary words.
- **Developing:** Learner can give examples of objects that can be described with the vocabulary words.
- **Expanding:** Learner can use an art form to model the vocabulary words.
- **Bridging:** Learner can tell a story that involves use of the new vocabulary words.

**STEP 4: Inform (20 minutes)**

**Purpose:** To introduce proportional reasoning.

**Activities:** The facilitator will focus on the question being asked in the problem. Each table will be given the four different cups. The following chart will be projected. The facilitator will introduce the chart as a **data table** and post that word on the word wall poster.
<table>
<thead>
<tr>
<th>SIZE OF CUP</th>
<th>NUMBER OF CREAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>4</td>
</tr>
<tr>
<td>M</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td></td>
</tr>
<tr>
<td>XL</td>
<td></td>
</tr>
</tbody>
</table>

The following questions will be posed:

*Facilitator:* What do we know?

*Hoped-for response:* We know that we get 4 creams for the small cup of coffee.

*Facilitator:* What do we want for all the other size cups?

*Hoped-for response:* We want the same taste.

*Facilitator:* Can we figure out how many creams we would need from the information we have on the data table?

*Hoped-for response:* No

*Facilitator:* Why not?

*Hoped-for response:* We need more information

(pass out sets of cups)

*Facilitator:* Can we find some information to help us figure out how many creams?

*Hoped-for response:* The number of ounces is written on the cups.

Facilitator should stop to introduce the term ‘ounces’ by posting it on the word wall poster and showing what one ounce looks like, 8 ounces, 32 ounces, etc. and talking about them in terms of the capacity they can hold.

Facilitator should also introduce the abbreviation for ounces.

*Facilitator:* So, is there a better way to fill out our data table?

*Hoped-for response:* Let’s use the number of ounces.
Introduce size and capacity as vocabulary words and post on word wall.

Facilitator can then draw a data table such as the following and ask students to draw the data table:

<table>
<thead>
<tr>
<th>CAPACITY OF CUP (oz)</th>
<th>NUMBER OF CREAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>S—10</td>
<td>4</td>
</tr>
<tr>
<td>M—14</td>
<td></td>
</tr>
<tr>
<td>L—20</td>
<td></td>
</tr>
<tr>
<td>XL—24</td>
<td></td>
</tr>
</tbody>
</table>

The facilitator can then introduce the different ways to show the relationship between the capacity of the cups and the number of creams.

10 oz cup to 4 creams
10 to 4
10:4
10/4

The term ‘ratio’ can then be introduced, with an explanation of the meaning in terms of a comparison between two different quantities. The word can be posted on the word wall poster.

The facilitator can then ask if the learners notice anything about the sizes of the cups that might help them.

*Hoped-for response:* The large cup is two times as large as the small cup.

The facilitator can then introduce the term **double**, posting the word on the word wall poster and showing different pictures to illustrate it.

The facilitator can then ask how we could get the same taste of coffee when the size of the cup is doubled.

*Hoped-for response:* Double the number of creams. We would need 8 creams for the large coffee.
The facilitator can then write:
10 to 4 is the same as 20 to 8.
10:4 = 20:8

The data table can then be filled in with the new information.

<table>
<thead>
<tr>
<th>CAPACITY OF CUP (oz)</th>
<th>NUMBER OF CREAMS</th>
<th>WORD FORM</th>
<th>COLON</th>
<th>FRACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>S—10</td>
<td>4</td>
<td>10 oz cup to 4 creams</td>
<td>10:4</td>
<td>10/4</td>
</tr>
<tr>
<td>M—14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L—20</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XL—24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The term ‘proportion’ can now be introduced. Learners can be told that when we compare two ratios that are the same, we say that they are in proportion to each other. When we compare ratios we are using a special kind of thinking called ‘proportional reasoning.’

Learners can then be asked to look for the relationship between the 10 and 4. Once that’s determined, is that the same relationship between the 20 and 8? It can be asked that since the relationship between both pairs of numbers is that the size of the cup is 2.5 times greater than the number of creams, can we expect the taste of the coffee to be the same? The terms proportional, proportions can be emphasized.

**Evaluation:** Learners’ use of proportional reasoning to determine the number of creams necessary for the large cup and their ability to symbolically represent proportions.

   **Full accomplishment** of the task
   Good understanding of proportions as same relationship between two or more pairs of numbers
   Use of at least three different ways to convey proportional relationships between pairs of numbers

   **Substantial accomplishment** of the task
Reasonable understanding of proportions as same relationship between two pairs of numbers
Use of at least two different ways to convey proportional relationships between pairs of numbers

**Partial accomplishment** of the task
Partial but limited understanding of proportions as same relationship between two pairs of numbers
Incomplete or misdirected use of ways to convey proportional relationships between two pairs of numbers

**Little accomplishment** of the task
Little understanding of proportions as same relationship between two pairs of number
Ways to convey proportional relationships is almost or completely inaccurate

**STEP 5: Practice (10 minutes)**

*Purpose:* To provide learners with additional opportunities to use proportional reasoning to solve for the other two coffee cup sizes.

*Activities:* The facilitator will point out that there is still more to be determined to get the same taste for the M and XL cups.

Knowing the capacity of the cup was 2.5 times the number of creams for both the S and L cups, can learners determine the number of creams that should be used for the M and the XL cups, keeping in mind that we want the same taste.

Learners will be asked to complete the data table, working in teams to present their solutions on newsprint. Teams will be asked to orally justify their solutions.

*Evaluation:* Learners’ use of proportional reasoning to determine the number of creams necessary for the large cup and their ability to symbolically represent proportions.

**Full accomplishment** of the task
Good understanding of proportions as same relationship between two or more pairs of numbers, as demonstrated in team explanations
Use of at least three different ways to convey proportional relationships between pairs of numbers
**Substantial accomplishment** of the task
Reasonable understanding of proportions as same relationship between two pairs of numbers, as demonstrated in team explanations
Use of at least two different ways to convey proportional relationships between pairs of numbers
**Partial accomplishment** of the task
Partial but limited understanding of proportions as same relationship between two pairs of numbers, as demonstrated in team explanations
Incomplete or misdirected use of ways to convey proportional relationships between two pairs of numbers
**Little accomplishment** of the task
Little understanding of proportions as same relationship between two pairs of number, as demonstrated in team explanations
Ways to convey proportional relationships is almost or completely inaccurate

**STEP 6: Extend (10 minutes)**

**Purpose:** To provide learners with additional opportunities to reinforce their understanding of the proportional relationship between the size of the cup and the number of creams.

**Activities:** The facilitator will show a ball that is even larger than the XL ball used previously, and will ask the learners what they would call that size ball. (Hoped for response: XXL, Jumbo)
Then the facilitator will present the following problem for learners to work on individually. Each learner will be asked to write a narrative and use pictures to explain their solutions in their blue books.
Show transparency of the following:

If Dunkin Donuts were to make an XXL or Jumbo cup, how many ounces do you think it would hold? How many creams would be needed to get the same taste as the original S cup with 4 creams?

**Evaluation:** Learners’ use of proportional reasoning to determine the size and the number of creams necessary for the XXL cup and their ability to communicate their rationale for their solution.

- **Full accomplishment** of the task
  Good understanding of proportions as same relationship between two or more pairs of numbers, as demonstrated in picture and written explanation

- **Substantial accomplishment** of the task
  Reasonable understanding of proportions as same relationship between two pairs of numbers, as demonstrated in picture and written explanation

- **Partial accomplishment** of the task
  Partial but limited understanding of proportions as same relationship between two pairs of numbers, as demonstrated in their team solution and nonverbal representation

- **Little accomplishment** of the task
  Little understanding of proportions as same relationship between two pairs of number, as demonstrated in their team solution and nonverbal representation

**STEP 7: Refine (10 minutes)**

**Purpose:** To provide learners with additional opportunities to reinforce their understanding of the proportional relationship between the size of the cup and the number of creams.

**Activities:** The facilitator will ask learners to work in teams of three or four to compare their solutions. They are to arrive at one solution as a team and come up with a visual they could use to market the new XXL cup. They should also come up with a jingle or
commercial for the new cup size, including the number of ounces and the number of creams for that “perfect” taste.

**Evaluation:** Learners’ use of proportional reasoning to determine the size and the number of creams necessary for the XXL cup and their ability to communicate their rationale for their solution.

- **Full accomplishment** of the task
  - Good understanding of proportions as same relationship between two or more pairs of numbers, as demonstrated in their team solution and nonverbal representation

- **Substantial accomplishment** of the task
  - Reasonable understanding of proportions as same relationship between two pairs of numbers, as demonstrated in their team solution and nonverbal representation

- **Partial accomplishment** of the task
  - Partial but limited understanding of proportions as same relationship between two pairs of numbers, as demonstrated in their team solution and nonverbal representation

- **Little accomplishment** of the task
  - Little understanding of proportions as same relationship between two pairs of number, as demonstrated in their team solution and nonverbal representation

**STEP 8: Perform (10 minutes)**

**Purpose:** To provide learners with opportunities to share their thinking and understanding of use of proportional reasoning with others.

**Activities:** Teams will post their pictorial representations and perform their commercial or jingle.

**Evaluation:** Learners’ use of proportional reasoning to determine the size and the number of creams necessary for the XXL cup and their ability to communicate their rationale for their solution.
**Full accomplishment** of the task
Good understanding of proportions as same relationship between two or more pairs of numbers, as demonstrated in their team solution and nonverbal representation

**Substantial accomplishment** of the task
Reasonable understanding of proportions as same relationship between two pairs of numbers, as demonstrated in their team solution and nonverbal representation

**Partial accomplishment** of the task
Partial but limited understanding of proportions as same relationship between two pairs of numbers, as demonstrated in their team solution and nonverbal representation

**Little accomplishment** of the task
Little understanding of proportions as same relationship between two pairs of number, as demonstrated in their team solution and nonverbal representation