Making Teacher Change Visible: Developing an Action Research Protocol for Elementary Mathematics Instruction

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Abstract

Professional development is a well-established component of teacher change, and action research can make that change visible. In this study, quantitative and qualitative data were collected from 237 elementary teachers and intervention specialists from 33 federally-designated Appalachian counties of Southeastern Ohio who participated in the year-long Better Mathematics through Literacy (BMTL) professional development experience. Using an ongoing, recursive, and emergent approach, the researchers identify changes in teachers' pedagogical approaches related to teaching early childhood mathematics. Three predominant themes emerged: Through the BMTL experience, the early childhood teacher-participants became more integrated, more contextual, and more constructivist in their mathematics instruction.

Introduction

Over the past decades, mathematics educators and our educational partners have engaged in an on-going conversation about the critical importance of teaching and learning mathematics with understanding, especially within the early grades of school (National Council of Teachers of Mathematics [NCTM], 2001; National Research Council [NRC], 2001). From a student perspective, these formal learning experiences set the tone and expectations in the mind of young children for what it means to know and to do

mathematics. Standards documents from professional organizations, specialized reports from national-level commissions and advisory panels, and experts in our field have challenged mathematics educatorsand educational leaders to critically examine how teachers and students come to view, to know, and to understand the mathematics they are expected to learn and to teach (NCTM 2007; National Mathematics Advisory Panel [NMAP] 2008).

These advocates of reform in the approach to mathematics education at all grade levels consistently advocate for using problem-based, constructivist approaches to mathematics encouraging the formulation of ideas and concepts through discovery and inquiry and the use of classroom discourse and reasoning to communicate mathematical thinking and sense-making. Yet, daily, within the tens of thousands of early childhood and elementary classrooms throughout the United States, a large majority of teachers do not have conceptual understandings of the mathematics they teach to effectively support and structure the pedagogical strategies advocated within these reform documents (Ball, Hill, & Bass, 2005; Ma, 1999). Further, many inservice teachers working with young children feel they lack the pedagogical skills to successfully implement mathematics instruction that falls outside the predominant tell-show-do framework. Thus, many teachers challenged with establishing a well-connected and conceptual foundation for learning mathematics in the minds of young children that is predicated on purposeful problem-solving, reasoning, integrating mathematical ideas, and communication often default to a teacher-centered approach that relies heavily on the memorization of isolated facts, the repeated implementation of canned algorithms that have no inherent meaning, and mathematics

classrooms that function within a framework of sanctioned silence (Boaler, 2008; Van de Walle&Lovin, 2008).

To implement the vision of meaningful mathematics in the first years of schooling within a small section of Appalachia, the Better Mathematics through Literacy (BMTL) project has been designed as a one-year professional development experience for inservice early childhood teachers and intervention specialists. The main goals of the project are to strengthen teachers' conceptual mathematical content knowledge and to examine holistic approaches to mathematics through engaging, learner-centered activities, structured classroom discourse, the infusion of the NCTM Process Standards (2001), and the literary devices of writing, reading, and communicating (Burns, 1995; Kenney, 2005; O'Connell, 2005; Storeygard, 2009). The designers of this professional development experience anticipated that BMTL would be a conduit for teacher change and used the teacher-participants' engagement in the action research process to track this change. The purpose of this paper is to investigate how the action research component of BMTL structured and supported the teacher-participants' reflection about their mathematics instruction and how this manifest itself in their teaching of elementarymathematics.

Teacher Change, Professional Development, and Action Research

The literature surrounding the process of teacher change indicates that it is anything but linear and self-contained. Change might be "prompted, promoted, or supported by discussions with other teachers... a workshop experience, frustration resulting from an often-tried activity that no longer works, an article in a practitioner or research journal, or a new grade level or population of students" (Richardson &Placier 2001, p. 908). Teaching behaviors can be redirected by setting goals that lead to new

behaviors. Setting explicit goals to effect change can impact teacher decision-making that is enmeshed in a way that honors the numerous interdependent interactions that constitute the highly complex environments of schools (Carlson, Dinmeyer, &Johnson, 2006). The most effective professional development for teachers typically occurs through active and engaged participation in communities of practice where individual members can shape what they are learning and what they can do with it (Gilrane, Roberts, & Russell, 2008).

Strategies for teacher change also include the use of structures that support job-embedded inquiry and professional interaction. These approaches recognize that teacher learning should (a) be centered around the critical activities of teaching and learning, (b) investigate practice through questioning, analysis, and criticism, and (c) be built on substantial discussions that foster analysis and communication (e.g. Darling-Hammond, 1999; Putnam, &Borko,2000; Boyle, Lampianou, & Boyle, 2005).Each of these approaches is a response to the situated, social, and context specific nature of teacher change which can be scaffolded and supported through the action research process. Allowing these interactions to occur over time, particularly in a context supported by professional development, such as BMTL, enables teachers to practice and reflect on their teaching as it occurs within the context of their individual classrooms.

In his original work on reflection, John Dewey (1933) noted that much of teachers' work is uncertain and requires deep and foundational reflective practices. Further, he also suggested that the process of reflection begins when a teacher experiences a difficult or unexpected problem in the classroom (Dewey, 1933). Action research, as defined and implemented within the BMTL experience, engages teachers in this kind of reflective thinking that is necessary to identify and address problems in the classroom and ways to

improve teaching and learning. In this process, having identified an area where student learning could be improved, the teacher steps back to analyze the situation (Windschitl, 2002). When done systematically, this approach may lead to new solutions and greater professional expertise (Eraut, 2000; Wang & Odell, 2002).

Reflection is an integral component of action research and has been characterized differently by a wide variety of authors, yet most are essentially similar. For example, Marcos, Sanchez, and Tillema(2008) describe reflection in four steps: identifying a problem, making a plan for change, experimentation, and reviewing the plan. Korthagen and Vasalos (2005) conceptualize reflection in similar although slightly different way. They view reflection as starting with an action, looking back on the action, becoming aware of essential aspects, creating alternative methods of action, and engaging in a trial. A key similarity in both of the processes described above is the recursive nature of the reflective process. At their core, these two views of reflective thinking have elements of planning, acting, and reviewing what has happened. One difference between the two is that the first model began with a problem, and the second model began with an action.

Action research can take many different forms in that it occurs through the purposeful, personal, and reflective examination of teaching practice within individual classrooms. Yet, in its purest intent, action research provides teachers with opportunities to demonstrate what Schon (1983) calls “reflection-in-action” and “reflection-on-action” and what Darling-Hammond (2005) identifies as the cycle of teacher thinking that occurs during “enactment” and “reflection.” Action research also contains elements of what Cochran-Smith and Lytle (1999) call “knowledge-of-practice,” which they define as knowledge accrued from the systematic and purposeful reflection on teaching. The type of

thinking associated with teacher inquiry is employed after the act of teaching and requires teachers to be reflective, analytical, and to engage with thinking processes that are more deliberate, concerned with method, and associated with a systematic process (Korthagen&Vasalos, 2005). It is within the articulation of this enactment and reflection that action research can help make teacher change becomemore visible.

The Structure of Better Mathematics through Literacy

Better Mathematics through Literacy (BMTL) was conceived and designed in a collaborative effort of university faculty in mathematics education, reading education, and early childhood education along with administrative and support staff from a university center for the study and development of literacy and language. Funding for the project was made available through a yearly competitive proposal review process sponsored by the Ohio Board of Regents Improving Teacher Quality Grants. In five consecutive years of implementation, the BMTL project has been awarded over $700,000 to provide high-quality professional development, mathematics manipulatives, selections from children's literature, and professional resources in student-centered mathematics instruction. With an average of 47 teachers per yearly cohort,237inservice elementary teachers and intervention specialists representing thirty-three Appalachian Ohio counties and forty-five individual school districts have completed the professional development project

The BMTL professional development experience consists of three stages. These include an intense, week-long Summer Institute, three follow-up sessions during the academic year, and a conference-style Action Research Final Symposium where the teacher-participants present the structure and findings of their own action research projects.

During eachweek-long Summer Institute,the BMTL cohorts are immersed and engaged within a mathematics learning community to explore student-centered mathematics instruction through two different perspectives. As students, the teacher-participants receive a first-hand experienceof rich, open-ended mathematical tasks that span the elementary mathematics concepts of counting, number sense, operations, and algebraic thinking. These activities create a classroom atmosphere conducive to meaningful learning and naturalistic inquiry and are supported by children's literature that develop and expand mathematics concepts. As teachers, the workshop facilitators assist the teacher-participants in deconstructing the critical elements of the mathematical tasks and student-centered pedagogical strategies used in facilitating the tasks as well as the questioning strategies and interpersonal communication which are specifically designed to solicit the teacher-participants' mathematical thinking. Inevitably, the juxtaposition of the student-centered approach to mathematics instruction in BMTL and the teacher-directed approach occurring in most teacher-participants' classrooms creates a high level of cognitive dissonance for the teacher-participants. This unease, coupled with the expectation to enact and reflect upon their own implementation of similar tasks and strategies, sets the stage for action research during the school year.

In stage two, three follow-up sessions occur in September, December, and February of the academic year.Cohort groups meet simultaneously through distance learning technology as the researchers and teacher-participants explore additional, developmentally-appropriate mathematics concepts in probability, geometry and spatial sense, and measurement, respectively.These structured activities and discussions followed a similar format to the days of the Summer Institute, but specific conversations were

designed for teacher-participants to share the struggles and successessurrounding the implementation of student-centered mathematics in their classrooms as well as their reflection, questioning, and analysis surrounding their action research. A day-by-day summary of the mathematics concepts, the mathematics manipulatives, and children's literature used within the BMTL professional development program is given in Table 1. (See Appendix)

Stage Three of the BMTL professional development program, the Action Research Final Symposium was conceived as a public display and celebration of the teacher-participants' experience within the year-long professional development. Held in late April of each academic year, a conference-style format allowed each participant ten to fifteen minutes to present the focus of his or her action research project, any student work or data that supported the findings and conclusions, and the teacher-participant's summary of the impact of the BMTL experience on their teaching and learning of mathematics during the school year. Each presentation session was digitally recorded, and each participant was required to submit a written reflective summary of his or her action research experience and findings to the BMTL team.

Role of Action Research Protocol in Making Teacher Change Visible

Having examined the interconnectivity of professional development, action research, and teacher change, this section addresses the BMTL Action Research Protocol, an instrumentwhich served as a key vehicle for making teacher change visible within the year-long professional development. Now in its fifth year of implementation, BMTLhas incorporated an action research component since the outset. Rather than severing all ties with the teacher-participants following the one-week Summer Institute, the BMTL team set the expectation of moving the participants

into action. That is, we wanted the elementary teacher and intervention specialists to implement and experiment with the student-centered approach to elementary mathematics and to document and reflect upon their experiences as the school year progressed.

In the first year, the action research project was admittedly problematic as it became evident to the project team that the teacher-participants were not clear on the expectations for the action research project or even what constituted action research. Based on their vociferous feedback, they were overwhelmed by what we were asking them to do, and most had a conception of "research" as an action far removed from their day-to-day life in elementary classrooms. The research team, seeing action research as a crucial opportunity for teachers to critically engage in the reflective examination their mathematics teaching in elementary schools but recognizing the teachers' confusion and frustration over how to conduct such research, developed an Action Research Protocol (ARP) for use in all future iterations of the BMTL experience.

The ARP was a way of taking what was, to the teacher-participants,an overwhelming and seemingly insurmountable task and making it more systematic, manageable, and reflective. The ARP broke down the project into meaningful and accessible chunks that the teacher-participants were able to utilize in examining and reflecting upon their mathematics instruction. This instrument which appears as Table 2 (see appendix) gave a month-by-month guide to the participants in the form of guiding questions and open-ended personal reflection prompts throughout the school year. The participants were asked to draft their written responses to the ARP questions based on their experience and their interactions with students and to collect student work samples and other relevant data that would support their evolving thinking, tentative conclusions, and reflective responses. As the school year progressed, participants were

asked to submit their written protocol responses to the research team at each Follow-up Session, and a wedge of time at each Follow-up Session was also dedicated to group discussion and idea sharing centered on the successes and struggles of the action research project. The systematic and supportive structure of the ARP provided the researchers with data useful for tracing teachers' changes in pedagogical approaches to teaching elementary mathematics. The instrument also provided a framework for teacher-participants build success in the focus and development of their classroom-based research.

Discussion and Findings

From the 237 elementary teachers and intervention specialists who completed all three stages of the BMTL professional development experience in the past five years, the researchers purposefully selected a subset of twelve teacher-participants from across all cohorts for in-depth analysis. Based on demographic and categorical data provided at registration, the subset represented an equivalent blend of grade-level teaching assignments and included two intervention specialists who work primarily with small groups of students within a resource room. This purposeful subset also ensured a representative sample in years of teaching experience, a balance in bachelors and masters degree holders, district-level mathematics curriculum, and geographic location within Appalachian Ohio. Gender was not used as selection criteria as only six of all BMTL participants have been male; the researchers felt that including a male in the sample may risk participant confidentiality.

From this purposeful sample of twelve, the average BMTL participant is a forty-one-year-old female with an average of thirteen years teaching experience in elementary settings. Most taught in self-contained classrooms of twenty to twenty-five students and used traditional, or teacher-directed, mathematics curricula. Ten of the twelve participants are Appalachian

natives teaching in school districts within twenty miles of the cities and towns in which they were raised.

Through their recursive, qualitative examination of the sample teachers' responses to the ARP and the transcriptions of their Action Research Projects, the two researchers were able to identify how the teacher-participants within the sample internalized the professional development from the Summer Institute, and further, how the action research was structured and implemented within their individual classrooms. All teachers within the purposeful sample articulated detailed evidence of student work and personal, reflective narratives of how their daily mathematics instructional time became less textbook-driven as a result of their new, investigative approach to mathematics. As evidenced by sample data in Table 3, three predominant themes of teacher change emerged through the data sets. The researchers assert that through the BMTL Professional Development program and through the deliberate self assessment and reflection structured by the Action Research Protocol, the elementary teachers and intervention specialists became more integrated, more contextual, and more constructivist toward mathematics instruction.

The three major findings are summarized in this section, and Table 3 highlights a brief sample of teacher voices that exemplify the findings. As readers view Table 3, they will see quotes from the teacher-participants' Action Research Protocols demonstrating afirst-person perspective of the growth trajectory progressing from September to December to February and to the Final Symposium in late April where teachers presented their action research projects. Though it should be emphasized that each of the three themes in the findings was found in all twelve of the purposeful sample for this study, Table 3highlights onlyone teacher for each of the three findings for the sake of brevity. It was the

decision of the authors to use Table 3 to exemplify the reflective thinking and seeds of positive change identified in the larger data corpus. (see appendix)

Teacher Pedagogical Change 1: BMTL Teacher-Participants became *More Integrated* in their Approach to Mathematics Instruction

Throughout the academic year, the researchers notedthat the participants began to view their mathematics instruction in a more integrated fashion. The Action Research Protocol (ARP) was the primary tool participants used to reflect on and assess their own teaching practices as well as their students' responses to new strategies they were implementing. Participant reflections in the ARP clearly indicated that as the teachers set the expectation that their students use writing, speaking, and communicating to articulate their developing mathematical thinking, students were ultimately able to make better understand mathematical concepts. Recurring examples in teacher responses to the ARP showed that students were making sense of the mathematics they were learning rather than memorizing a set of steps to carry out a procedure. As a result of BMTL, the participants were also introduced to children's literature and trade books that are centered on mathematical themes that can provide connective threads between their literacy and mathematics instruction.Sample evidence of this finding appears in Table 3, which features Allison, a third grade teacher. Along with the purposeful sample of 12 teachers, she was able to identify the powerful impact of using children's literature, writing, and communication to enhance her teaching of mathematics. As teachers reflected on their implementation of BMTL strategies through the ARP, they clearly noted the important role that integrating reading, writing, and verbal communication played in increased

mathematical understanding. What could also be observed through participant responses to the ARP is that as they noted students' increased ability to make sense of mathematical concepts, they were more inclined to continue the integrated approach, sometimes using children's literature in tandem with manipulatives and regularly providing students with opportunities to talk about how they were processing the mathematics.

Teacher Pedagogical Change 2: BMTL Teacher-Participants became *More Contextual* in their Approach to Mathematics Instruction

A second emergent theme identified by the researchers articulated a more contextual approach to the mathematics that, in years past, they had taught through more traditional means. Using strategies from BMTL, teachers shifted their teacher-centereddemonstrations of procedures to instruction that involved more complex mathematical tasks and situations that became the basis for authentic problem solving connecting with students' daily lives. As a result of BMTL, rather than presenting mathematical concepts in isolation and stripped of any relevant context, teachers found increased engagement and interest from students by placing mathematical experiences within the context of their students' day-to-day experiences. Concepts central to building mathematical understanding were no longer artificially separated into chapters or workbook pages or artificially fragmented segments of the school day, but instead connected with students' prior knowledge. Strategically selected titles fromchildren's literature were used as a conduit to understanding as students actively and excitedly used a wide range of solution strategies to make sense of addition and subtraction in a context.Sample evidence of this finding appears in Table 3, which features Kelly, a second grade teacher, and her successin bringing mathematics to life by removing it from the

confines of a textbook. Reflections through the ARP repeatedly demonstrated teachers' awareness of the benefit of linking mathematical concepts to real world contexts to which students could relate. This dovetailed naturally with the first finding that participants, upon implementing BMTL strategies, became more integrated in their approach to teaching mathematics. The value of hands-on activities and connecting mathematics with larger units of study, rather than teaching math in isolation or through a series of isolated worksheets, was a recurring theme in the participants' ARPs. Teachers noted that as they connected math with examples from real life and other subjects and employed more hands-on learning strategies, students were able to see how the pieces fit together and thus have a more holistic, meaningful experience with mathematics.

Teacher Pedagogical Change 3: BMTL Teacher-Participants became *More Constructivist* in the Approach to Mathematics Instruction

Finally, as a result of having a first-hand learning experience in which mathematics concepts were presented in a student-centered manner within the BMTL Summer Institute participants were more willing to allow students to discover mathematical concepts and relationships in ways that made sense to the students. As the ARP asked teachers to think about what strategies they were using and how those strategies impacted student learning, they routintely reflected back on how as they provided opportunities for students to make mathematical observations and generalizations rather than constantly telling them what to do and how to think, student learning improved. Mathematics became an investigative and evolving construct in the minds of the students rather than a set of discrete facts and algorithms they were to memorize. Teachers regularly shared that their students were not only growing in their competence and confidence with mathematics, but also that they

were showing signs of increased engagement along the way. Sample evidence of this appears in Table 3, which features Sarah, a kindergarten teacher and her reflection on how students can actively construct mathematical understanding as a result of their increased engagement.

Conclusion

The national conversation surrounding early childhood mathematics centers on how to strengthen classroom teachers' mathematical content knowledge and how to implement pedagogical changes that mirror the integrated, contextual, and constructivist approach supported by reform documents. Our research team feels that opportunities such as the Better Mathematics through Literacy professional development project, and in particular the Action Research Protocol, can provide meaningful learning opportunities to early childhood teachers and intervention specialists. The deliberate, practical, and reflective nature of action research provided the BMTL teacher-participants with a framework for examining their teaching and their students' learning and as a result changes their teaching to be more integrated, contextual, student-centered, and constructivist. While we feel that opportunities in early childhood development are plentiful, we want to emphasize that what makes BMTL different and profoundly impactful is the way that it establishes, through the Action Research Protocol, a clear expectation that teachers take what they are learning and put it to use in the classroom. Ultimately, the point of imbedding action research in this meaningful professional development experience is to guide teachers in a reflective examination of their pedagogical practices and, where necessary, lead to changes in mathematics instruction that mirror calls for national reform in mathematics.

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Appendix

Table 1:

Structure of Better Mathematics through Literacy

BMTL Session	Mathematics Focus	Literacy Focus	Mathematics Manipulatives	Children's Literature Selections
Stage One: Summer Institute				
Day One	Rich Mathematical Tasks Student-Centered mathematics Building a Math Community	Using expository writing as a tool for Inquiry Reading Difficulties in Math	Color Tiles	*Math Curse* *Mrs. Spizter's Garden* *Hurray for Diffendoofer Day*
Day Two	Counting, Number Sense, Bridges from Counting to Addition NCTM Process Standards	Counting Books Syllable Classification Before, During, and After Readings Classroom Publishing and Book Making	Base Ten Blocks Dominoes Ten Frames Twenty Frames Digit Cards	*Ten Black Dots* *12 Ways to Get 11* *Rooster's Off to See the World* *One Duck Stuck* *The Grapes of Math* *One is a Snail, Ten is a Crab* *Each Orange Has 8 Slices*
Day Three	Deconstructing the Four Basic Operations Using Context for Problem Solving Learning Theories in Mathematics Education Formative Assessment in Mathematics	Using Non-math texts as a context for mathematical activity Using the Writing Process for Refining Mathematical Tasks Consonants and Iconicity Short Vowels and Iconicity	Counters	*Mouse Count* *The Monster Who Did My Math* *Not Norman, A Goldfish Story* *512 Ants on Sullivan Street* *The Doorbell Rang* *One Hundred Hungry Ants* *Commotion in the Ocean* *Amanda Bean's Amazing Dream*
Day Four	Fraction Concepts	Phonemes Morphemes	Fraction Circles Fraction Squares Fraction Overlays Cuisenaire Rods Tangrams Geoboards Pattern Blocks	*Five Creatures* *Apple Fractions* *Fraction Fun* *How Many Snails* *Pizza Counting* *Fraction Action*
Day Five	Patterns Developing Algebraic Thinking	Patterns in Poetry Creating stories from graphs	Attribute Blocks Snap Cubes	*Tiger Math* *Math for All Seasons* *Rabbits, Rabbits, Everywhere* *Where the Sidewalk Ends*

Stage Two: Follow-Up Sessions

September	Listing Outcomes Data Analysis Early Probability Concepts Likely / Unlikely	Integrated Teaching Units and Theme Days Best Bets for Spelling	Spinners Number Cubes Two-color counters	*Probably Pistachio* *Fortunately* *Go Away! Big Green Monster*
December	Geometry and Spatial Sense Sorting and Classifying Symmetry	Handwriting and Spatial Sense Connections from Manuscript to Cursive	MIRAs 3D Solids Sorting Circles Tangrams Pattern Blocks	*Snowflake Bentley* *The Greedy Triangle* *Grandfather Tang's Story*
February	Measurement Standard and Non-Standard Units of Measure Frames of Reference for Measurement	Prefixes and Suffixes Measurement Poems Class Books	Judy Clocks Measuring Cups Measuring Spoons The Master Ruler Stopwatches Sand Timers Protractors	*Great Estimations* *How Big Is a Foot?* *Measuring Penny* *Inch by Inch* *Is a Blue Whale the Biggest Thing There Is?*

Table 2

Action Research Protocol

Better Mathematics Through Literacy (BMTL) Action Research Project

Monthly Planning Document for 2009-2010

August: Think about what you've learned in the intensive July workshop. Figure out what BMTL strategies (ways of teaching) you will integrate into your curriculum in 2009-2010

September: Be deliberate about what BMTL strategies (ways of teaching) you are using by keeping a journal. Besides being mindful to align your ways of teaching with Standards, be deliberate in examining the effect of your teaching (with BMTL) on student learning. The effect on student learning needs to be a continued and deliberate focus. The following questions may help structure your thinking in this regard:

1. How am I teaching? (i.e. What strategies am I using?)
2. What effect is the way I am teaching having on student learning?
3. How do I know that the way I am teaching is working (or not working) to improve student learning?
4. What sources of evidence will support the fact that the way I am teaching is having a positive effect on student learning? (Possible sources of evidence: student work, observations recorded in a journal, various forms of assessment, video tape or interview with students)

September 26th: Bring answers to the above questions (preferably word processed). We will spend some time debriefing on what's happening in your classrooms and how BMTL strategies (ways of teaching) are impacting student learning. *Bring two copies of your written answers—one for yourself and one for us to keep.*

October-November: Consider our discussion from the first follow-up session (September 26th)—what you heard from others about what is and isn't working. Utilize feedback from others and continue to be deliberate about how the way you are teaching relates to what and how your students are learning. Because we will be moving through an actual school year you will be utilizing more strategies or ways of teaching (and repeating some strategies) as the year goes on. Keep track of what strategies (ways of teaching) you are adding and how the strategies you are repeating over time impact student learning. Besides the original four questions (above) the following questions should help structure your thinking and move toward the Action Research Project:

1. What ways of teaching (strategies) have I used over a prolonged period of time?
2. What difference do I see in my students' learning now that they have more practice with these strategies and ways of thinking and learning?
3. What evidence do I have to support my conclusions in #2? (Here again, samples of student work, observations recorded in a journal, formal and informal assessments, video tapes of students working, and interviews with students would be excellent sources of evidence).

December 5th: Bring your answers to the above questions and some examples of student work that will show some of what's going on in your classroom as a result of BMTL. We will take time to share and generate feedback. *Bring two copies of your written answers—one for yourself and one for us to keep.*

January-February: Continue the process of being deliberate about your teaching and your students' learning as you employ strategies (ways of teaching) from BMTL. Because each follow-up session will present new information (September = Geometry; December = Probability; February = Measurement), you should especially be mindful of strategies you are adding. For strategies you are continuing throughout the school year (for instance, if your students are keeping a math journal), your observations and supporting evidence of the effect on student learning over time are valuable. So besides the prior seven questions, you may want

to ask the following:

1. Have I seen my students become more confident, comfortable, and capable with math because of the way I am teaching? Explain with some specific details which combine observation and supporting evidence.
2. Now that I'm 6 months into the school year and within three months of the Final Symposium for BMTL, what would I like to focus on in more depth? (i.e. What do I want to be the focus of my Action Research Project?)

February 20th: Bring answers to the above questions (optional) and the four questions listed below (required). *Bring two copies of your written answers—one for yourself and one for us to keep*. This is our last follow-up before the Final Symposium so you'll need to have a clear sense of direction on the specific aspect of BMTL and its effect on student learning that will be the topic of your Action Research Project. What we are looking for are the following:

- A clearly defined topic (a particular strategy or way of teaching) employed as a result of BMTL
- Conclusions about how the strategy/way of teaching affected student learning
- Evidence that supports your conclusions

The following questions will give shape to your Action Research Project:

1. What strategy (way of teaching) did I employ, and how was I deliberate in exploring the effects of this strategy or way of teaching on student learning? *You don't have to cover every strategy; focus on a particular strategy (way of teaching) or manageable combination of strategies.*
2. What was the effect of this strategy or way of teaching on student learning?
3. How do I know that this strategy or way of teaching impacted student learning in a given way? What evidence do I have to support my conclusions?
4. How can I share this research with others? (trifold, PowerPoint, essay of strategies and findings, video of students working, interviews with students, samples of student work, etc.)

March-April: Keep utilizing BMTL strategies (ways of teaching) and being deliberate about analyzing their effect on student learning. Formalize your Action Research Project for the Final Symposium, making sure to address the four questions from the February 20th follow-up session and the following:
How will what you learned this year through BMTL affect your future teaching?

- Continuing: What do you envision continuing?
- Improving: What changes do you plan to make to improve you implementation of BMTL strategies (ways of teaching) next school year?
- Expanding: What do you plan on expanding?

April 24th: Final Symposium. The two groups will meet together, and we will have some outside guests to include area teachers, principals, and representatives from the Ohio Department of Education and the Ohio Board of Regents.

The following guidelines will help you to anticipate the Final Symposium:

- Each presenter will have 10 minutes.
- We will videotape the presentations.

One Final Consideration: Attached is "Permission to Use Photos/Videos" for you to have the parents/guardians of your students sign in the event that you would like to incorporate pictures in your Action Research Project. If you have your own form that covers the same (or more generic) content that you've already secured for the year, that's fine too. *If you use this letter, make sure to personalize it with your school information in the signature portion of the letter mid page.*

Evidence of Major Findings

BMTL Sample Teacher-Participant& Grade Level	Action Research Responses September	Action Research Responses December	Action Research Response February	Action Research Final Presentation Transcript
*Finding One: BMTL Teacher-participants became **more integrated** in their approach to mathematics instruction*				
Allison Grade 3	"We no longer teach the math by chapters... we now have 90 minute blocks for math. We had been so engrossed with our Reading First priorities that math had been neglected." (Fall, response 1)	"We are continually reviewing and discussing various standards at the same time. We are also connecting the standards in math together in numerous ways throughout the school year." (Winter, response 2)	"During the summer when I was taking BMTL, I saw the importance of using literature with students because it would stick in their minds and help them to remember concepts... Little did I know how many [books with mathematical ties] I had or would find in bookstores now that I had seen the relevance of this process." (Spring, response 2)	"I feel that all of these improvements have made a difference with our students in math this year. They seem to understand the concepts and the skills much better than in recent years. With the third grade teachers team-teaching with the assistance of the intervention teacher, it has made a GIGANTIC difference in our children's lives." (Final Action Research Symposium Transcript)
*Finding Two: BMTL Teacher-participants became **more contextual** in their approach to mathematics instruction*				
Kelly Grade 2	"I have noticed that the first week of using math journals, most of the students just drew pictures based on what they read. Now many are starting to write what we are doing. I had no ideas that placing their math problems in a context would make word problems so much easier! We talk about what we did in math and I put words on the board if they ask." (Fall, response 1)	"I introduced the idea of multiplication during the patterns we were doing recently and many were so enthralled with it that they continued to do patterns on their own with paper, cubes, and parquetry blocks. The mood in the room was infectious as the students explored with the tiling tasks." (Winter, response 3)	"I continued with the small group conversations, manipulatives and putting the math in the context of larger units that we were studying, and working together. I think this will be beneficial in measurement and exploration. I never thought that measurement would fit well with our social studies unit on continents. But, I'm hoping that the more hands-on activities with measurement and practical applications, the students will see the benefit of this genre of mathematics." (Spring, response 2)	"I have been teaching for over twenty years, and this year was my first focused effort to create integrated units that involve multiple subjects throughout the day. The problem solving that the students have done this year is a strong piece of evidence that has shown me that even second-graders can see the big picture, and they want to see how all of the pieces fit together." (Final Action Research Symposium Transcript)

*Finding Three: BMTL Teacher-participants became **more constructivist** in their approach to mathematics instruction*				
Sarah Grade K	"By holding the bar higher this early in kindergarten, I am observing that the students are working at a higher level than I thought possible. The students have been able to cut apples into halves and fourths and been able to recognize and to cut out examples of two-dimensional shapes. This includes the special education IEP kids who are excelling and going beyond just the basics." (Fall, response 3)	"I noticed that with the books we make, the students are actively engaged and seem to be retaining more of the information and concepts than students in the past. I never really thought it would work, but the less I tell them about how to complete a task, the more they collaborate and figure it out on their own!" (Winter, response 2)	"I have seen my higher level students soar beyond what I thought possible from a six year old child. So far, these students have been able to comprehend and apply concepts of probability, fractions, and even multiplication as repeated addition. I have seen a large portion of my special education students grasp differentiated forms of these same concepts." (Spring, response 2)	"I believe that word of mouth in a small school district like mine is very valuable. I have discussed the strategies with many staff members at all grade levels, encouraging them to take this course to improve their mathematics thinking about the way we teach math concepts to our students. This approach to mathematics is beginning to catch on in all of our building grade levels." (Final Action Research Symposium Transcript)