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Determining impact: using formative evaluation in a professional development program for teachers of mathematics and science

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DETERMINING IMPACT: USING FORMATIVE EVALUATION IN A PROFESSIONAL DEVELOPMENT PROGRAM FOR TEACHERS OF MATHEMATICS AND SCIENCE

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Abstract

The purpose of this study was to evaluate a professional development (PD) program for middle and high school teachers of mathematics and science which is funded by a $5 million National Science Foundation grant. The evaluation was internal and formative in nature and took place in two separate phases. The focus of the evaluation was not only on program improvement but also to extend the body of existing knowledge in the area of teacher professional development. Both the needs of project stakeholders and the findings of previous research in the areas of professional development and program evaluation were drawn on to help inform the framework and direction of the study. The objectives of phase one were to ascertain participants' perceptions of program activities, identify program activities reported as having direct impact on classroom practice, and collect recommendations for program changes. Data were collected from the 2010 mathematics cohort through survey, a focus group, interviews, and content analysis of documents. Findings suggested the following activities influenced the professional beliefs of teachers and impacted their classroom practice: viewing familiar mathematics content in alternative ways, exposure to pedagogical strategies including the principles of learning and deliberate practice in conjunction with planning for implementation, observing peers present topics from the school curriculum, and individualized assignments with support provided in various forms. Numerous recommendations for program changes were made to the program director based on the analysis of participant feedback. The objective of phase two of the evaluation was to determine the strength of Desimone's (2009) five features of effective PD in the program and their influence on teacher knowledge and practice, as reported by participating teachers. Fifty science and math teachers out of sixty-

three current and past program cohort participants responded to an invitation to complete an online survey. A path analysis was conducted from the survey results and a formal causal model was estimated. Active learning, content focus, coherence and consequent enhanced knowledge and skills and changes in teacher practice were reported at moderate to high levels. Coherence and enhanced knowledge and skills appear have the strong interconnectedness with change in teacher practice.

1 Introduction

Student achievement in mathematics within K-12 education has received an abundance of attention by the federal government in recent years. The United States is increasingly in competition with other countries around the world in mathematics as well as other disciplines such as science, technology, and engineering, collectively referred to as the STEM fields. Currently, there exists an impetus to promote the STEM disciplines in order to increase our competitiveness internationally for the future.

With the passage of the No Child Left Behind (NCLB) Law, high-stakes standardized tests have become the ruler by which we measure our status and progress as a nation regarding student achievement. In this current age of accountability, federal, state and local authorities which govern education are seeking out ways to increase test scores, thereby raising the number of students who are categorized as proficient in not only STEM related fields, but all core subject areas. Teachers have been identified as pivotal in determining the level of achievement realized by the students in the classroom. Professional development for teachers has been recognized as a means to provide teachers with the requisites to make changes to their practice and the potential to improve student achievement (Ball & Cohen, 1999; Cohen & Hill, 2000). Substantial funds have been invested in programs aimed at increasing the knowledge base and pedagogy of teachers, especially in the STEM fields. One example of such investment is the nearly $1.2 billion spent on the "Math-Science Partnerships" funded by the National Science Foundation (NSF) and U.S. Department of Education between 2002 and 2007 in which pre-service and in-service teachers were provided with mathematics and science learning experiences (Hill, 2011). An abundance of studies have been carried out in conjunction

with these partnerships in an effort to better understand the processes associated with teacher professional development. The Reestablishment of the America Competes Act in 2010 provides the continuation of funding for such programs and activities in support of STEM education.

Over the past decade, some consensus has been reached on both a causal model for teacher professional development and features associated with the effectiveness of such activities. Nevertheless, there is still a great deal left to learn about the development of teachers professionally and its impact on the work they do in the classroom. Understanding how teachers improve their practice is imperative in growing the number of quality teachers in our schools, accomplishing the current goals of school reform efforts, and increasing student achievement.

The purpose of this study is to evaluate The Louisiana Math and Science Teacher Institute (LaMSTI), a professional development program funded by a $5 million NSF grant for middle and high school teachers of mathematics and science. The evaluation focuses not only on program improvement but also aims to add to the body of existing knowledge in the area of professional development for teachers. Both the needs of the stakeholders involved in the project and the findings of previous research in the areas of professional development and program evaluation were drawn on to help inform the framework and direction of the evaluation. The findings of this evaluation aided program stakeholders by providing formative feedback and recommendations for improvement. In addition, the evaluation results confirmed findings from previous studies of the key role specific features of professional development play in the effectiveness of such activities.

2 Literature Review

Professional Development

According to Desimone (2009) there are a variety of contexts for teacher learning including formal, informal, independent, and group-oriented. Proposed amendments to Section 9101 (34) of the Elementary and Secondary Education Act as reauthorized by the NCLB Law of 2001 define the term professional development as "a comprehensive, sustained, and intensive approach to improving teachers' and principals' effectiveness in raising student achievement". Today, there are many PD opportunities offered to teachers through their schools, districts, local universities, and departments of education, which are typically of a structured nature and aim to achieve explicit outcomes. The scholarly literature contains valuable information which can be beneficial to professional development providers in designing such efforts to optimize effectiveness and productivity.

A consensus on the effects of teacher professional development has developed and consists of teachers experiencing effective professional development followed by an increase in teacher knowledge and skills and/or changing their attitudes and beliefs. Teachers then use such changes to improve the content of or approach to their instruction, and student learning is fostered (Desimone, 2009). This process is illustrated in Figure 1 below. Although the process

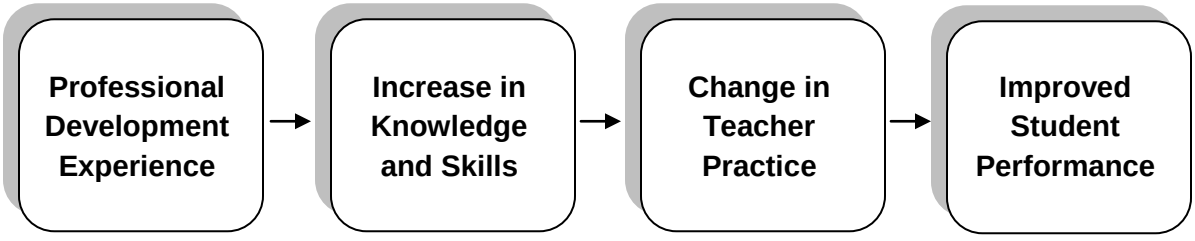


Figure 1. Causal Model for Teacher Professional Development

of professional development leading to student achievement is not always stated in the same number of steps or stages, a similar rationale seems to be followed generally. Yoon, Duncan, Lee, Scarloss, and Shapley (2007) describe professional development affecting student achievement through three steps. "First, professional development enhances teacher knowledge and skills. Second, better knowledge and skills improve classroom teaching. Third, improved teaching raises student achievement" (p. 4). The authors go on to say that if one link is weak or missing, an improvement in student achievement cannot be expected. For instance, if a teacher fails to apply new ideas, information or knowledge from professional development to their classroom instruction, students will not profit from the teacher's professional development. Borko (2004) cites numerous studies (Fennema et al., 1996; Franke et al., 2001; Knapp & Peterson, 1995) which indicate that the learning process for teachers can be lengthy and inexact and that some teachers change more than others during participation in the same professional development. Borko also states that some elements of teachers' knowledge and practice are more readily altered than others.

A recent study by Quint (2011) was designed to test the effects of PD illustrated above in the causal model. Her findings suggest that professional development can increase teacher knowledge which can improve instruction and ultimately lead to greater student achievement. However, she indicates that in this study a considerable amount of change in teacher knowledge and practice was needed to detect even a modest amount of change in student outcomes. This raises the question about the adequacy of existing as well as specially designed instruments to detect the full effects of PD on classroom practice and student learning.

Oftentimes standardized tests are used to gauge whether or not student knowledge, skills, and understandings have increased. It is reasonable to question whether or not such assessments can accurately measure all the benefits teachers and their students reap by teacher involvement in such training opportunities. Of course, if the goal of PD is solely to raise student test scores (which in many cases in this age of accountability may be the primary motivation), then using high stakes testing as a measure of the effectiveness of PD is appropriate.

Program Evaluation Methodology

Evaluation research is typically response to a group or individual's informational needs motivated by the desire to improve social conditions or policies (Henry & Mark, 2003). There are a variety of perspectives on how best to evaluate educational programs. Experimental and quasi-experimental designs are considered the most rigorous, but are often not possible in actual field settings (Gaytan & McEwen, 2010). Most educational programs are executed in the field where complex conditions exist, including a wide range of possible moderating and mediating variables. Independent variables can rarely be manipulated by researchers in evaluation settings in education and a single, discrete treatment is not generally identifiable. Methods chosen to evaluate such programs must be suitable not only to the evaluation questions being asked, but also to field conditions (Chatterji, 2005). While randomized controlled experiments are the preferred choice by the U.S. Department of Education Institute of Education Sciences' What Works Clearinghouse (WWC) for educational research studies, such expectations are not often a viable option in program evaluation (Yoon et al., 2007). Although the federal government has dedicated significant funds to PD through the Elementary

and Secondary Education Act and hundreds of studies have addressed the topic of teacher learning and PD, there is little rigorous evidence available on the impact of PD on teacher and student outcomes (Garet et al., 2010). In a recent study sponsored by the Institute of Education Sciences (IES), of the more than 1300 studies identified as potentially addressing the effect of professional development on student achievement in three content areas including mathematics, only nine met the WWC evidence standards. All nine of the studies focused on PD effects on elementary school student achievement (Yoon et al., 2007).

Although loose controls reduce the validity of causal inferences in research settings in which interventions are implemented, highly controlled experiments limit generalizability due to unrealistic, laboratory-like conditions because they are not reflective of actual field conditions (Chatterji, 2005). Chatterji describes combining the use of more than one research method as a characteristic of a pragmatic and productive evaluation design which deepens the understanding of relationships and causality. A mixed methods approach to the evaluation of educational programs can be useful in terms of triangulation (also known as corroboration), which aids in establishing construct validity evidence. Furthermore, combining methods can be helpful in obtaining a fuller picture of the construct and of the program itself (Greene and Caracelli, 1997 as cited by Chatterji, 2005).

Chatterji (2005, 2007) makes the case for Extended-Term Mixed-Method (ETMM) evaluation designs and offers five guiding principles. 1) A long time-line, in which data gathering could serve numerous functions even early on including needs assessment, contextual studies, and the determination of whether the program is being implemented as intended. 2) The evaluation should be guided by a program's theory and by the identification of factors that

could influence outcomes. 3) Such a long-term evaluation approach should include both formative and summative evaluation phases with at least one feedback loop to stakeholders. 4) Intensely, focused causal questions in appropriately timed field experiments where treatments and interaction variables are clearly defined. 5) The effective combination of quantitative and qualitative research to draw more comprehensive conclusions.

Chatterji (2007) notes the recommendation for the use of more long-term phased "impact evaluation" designs for research on drug treatments by the National Institutes of Health (NIH), which offers guidelines for a three phase design. The first two phases are more exploratory in nature, aiming to determine the best delivery methods and safe dosage levels and whether the treatment is being implemented optimally. Only then is the confirmatory phase entered where the actual randomized controlled trial (RCT) is executed. RCTs in complex, field settings get compromised to different degrees and are not adequate in isolation for making causal inferences on programs.

If the medical science community is recognizing the need for a phased design in which the actual RCT is delayed until after an exploratory phase of implementation is completed, then certainly educational researchers should be willing to follow suit in studying professional development programs.

> Although it is tempting in randomized field trials to focus only on the ultimate outcome of student achievement, including measures of proximal outcomes and other potential moderators and mediators can have significant payoff. Measurement of mediating variables is especially critical in making use of study results to draw conclusions about the theory of teacher change and the theory of instruction on which the PD intervention is based (Wayne, Yoon, Zhu, Cronen, & Garet, 2008, p. 475).

If only student achievement is measured in a study of PD and no impact is found, then without teacher outcomes measures, it is not possible to determine the point where or why the causal

model failed. It might be that the PD was effective in increasing teacher knowledge or in making changes to instruction, but it simply did not result in increased student performance levels. In order to optimize results, key elements of the PD model must be identified in advance so that measures can be designed to quantify them (Wayne, et al., 2008).

Timing of Outcome Measures

Professional development effects may be delayed because time is needed to implement the changes that emerge from the PD activities. For this reason, time is needed before meaningful data can be gathered regarding indirect impact on student achievement (Kreider & Bouffard, 2006 as cited by Gaytan & McEwen, 2010). This claim of postponed effects of PD on student achievement was substantiated recently in a study by Silverstein, Dubner, Jon, Glied, and Loike (2009). The study involved measuring participants' student pass rates on high stakes science exams before and after a PD intervention, consisting of a research experience program in which teachers engaged in hands-on science. Differences in pass rates on the exam were not significant in the first two years after participant entry into the PD program; however, a significant difference was detected in the third and fourth years. A teacher taking years to translate professional development experiences into new educational practices adds to the rationale of a phased design approach to educational program evaluation.

Wayne et al. (2008) point out the importance of timing in terms of the PD experience. The attainment of impact on student achievement is dependent upon the negotiation of a number of contributing links, which take time to develop. The authors cite an observational study by Harris and Sass (2007) which suggests that content-focused PD experienced by middle

school mathematics teachers will not have impact on student achievement during the year of participation, but may have an impact in the year following participation in the PD.

Garet, et al. (2010) reports interim results from an impact study sponsored by the IES where the central research questions focused on the impact of a PD program on teacher knowledge, teachers' instructional practices, and on student achievement. The PD dealt with rational number topics and focused on two aspects of teacher's content knowledge, the common knowledge of mathematics (CK) and specialized knowledge of mathematics for teaching (SK). CK includes the computational or procedural skills, conceptual understanding, and problem solving skills which students should ideally have after completing the seventh grade. SK includes the ability to identify common errors in student work, knowing the key mathematical understandings within a topic, and the ability to select constructive representations and explanations for a given topic. After one year of PD, only one of three measures of instructional practice showed significant positive impact. Specifically, the frequency with which teachers engaged in activities intended to elicit student thinking. There was no statistically significant impact on teacher knowledge or student achievement.

Exemplars of Professional Development Evaluation

Evaluation is a tool which can be used to ensure that each link in the causal chain leading to student achievement is firmly established. Program providers often have their own perceptions regarding the effectiveness of their program. These are typically formed through anecdotal evidence, but without a systematic collection of data, these perceptions cannot be confirmed. Program providers may remain unaware of weaknesses in their program design

preventing improvements from being made in these areas. Evaluation can reveal areas for program improvement especially when the program is ongoing.

Gaytan and McEwen (2010) proposed a model (as seen in Figure 2 below) for evaluation of professional development. (This was applied to PD aiming to improve the integration of instructional technology into teaching practices). The authors recommend five levels which must be followed in order without skipping a level. Each level should have a rubric that includes indicators of quality. In addition, they suggest that planning must reverse the order of the five levels and work backwards from the desired student learning outcomes. The model may be applied to teacher professional development in any discipline by inserting applicable indicators of quality at each level. Below is an adapted and more generalized model of the one proposed by Gaytan and McEwen (2010) and leaves out the indicators:

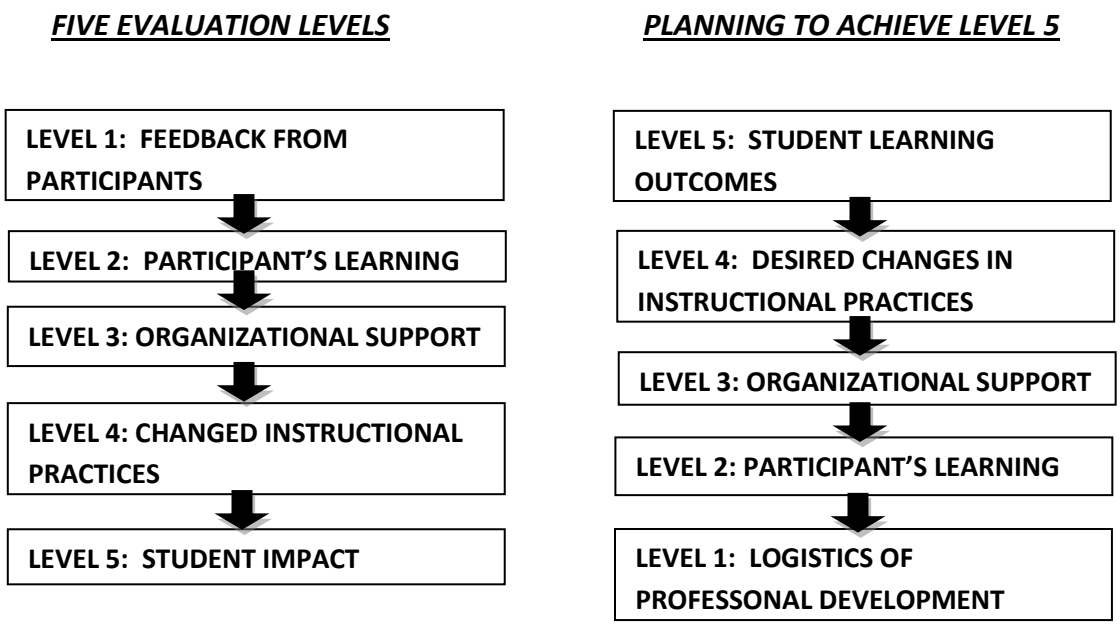


Figure 2. Evaluation Model for Professional Development for Teachers

Penuel, Fishman, Yamaguchi, and Gallagher (2007) call for measures at each of four levels for the study of PD program implementation. The first level is the professional-

development-provider level followed by the gathering of data about the design of the activities, including the extent to which they incorporate the kinds of features that past studies have identified as effective. The next level involves an objective measure of program implementation at the teacher level tied to a model of implementation fidelity. Lastly, Penuel et al. calls for observation data or automated records that document implementation and complement self-report data obtained through surveys.

He, Rohr, Miller, Levin, and Mercier (2010) discuss the study of a program that had been in existence for numerous years but had never been methodically evaluated. This study focused on the development and use of a logic model for evaluation of a program that aimed to promote continuous improvement. In developing the model, its pictorial nature required evaluators, planners, and providers to think systematically about the overall design of the program and make connections among theories, activities, and outcomes. This process allowed the identification of strengths and weaknesses of the program design and allowed stakeholders to find the best interpretation for the evaluation data. The findings of the study largely confirmed widely held beliefs about the effectiveness of the program but promoted greater staff awareness of the relationship among program goals, its day-to-day operations, and national standards. Additionally, goals based on the different perspectives of the students were developed (He et al., 2010).

A Consensus on Features of Effective Professional Development

The NCLB Law set forth five criteria for PD to be considered high quality: 1) Sustained, intensive, and content focused; 2) aligned with standards and assessments; 3) improves/increases teacher knowledge (TK) in subject area; 4) advance of teacher

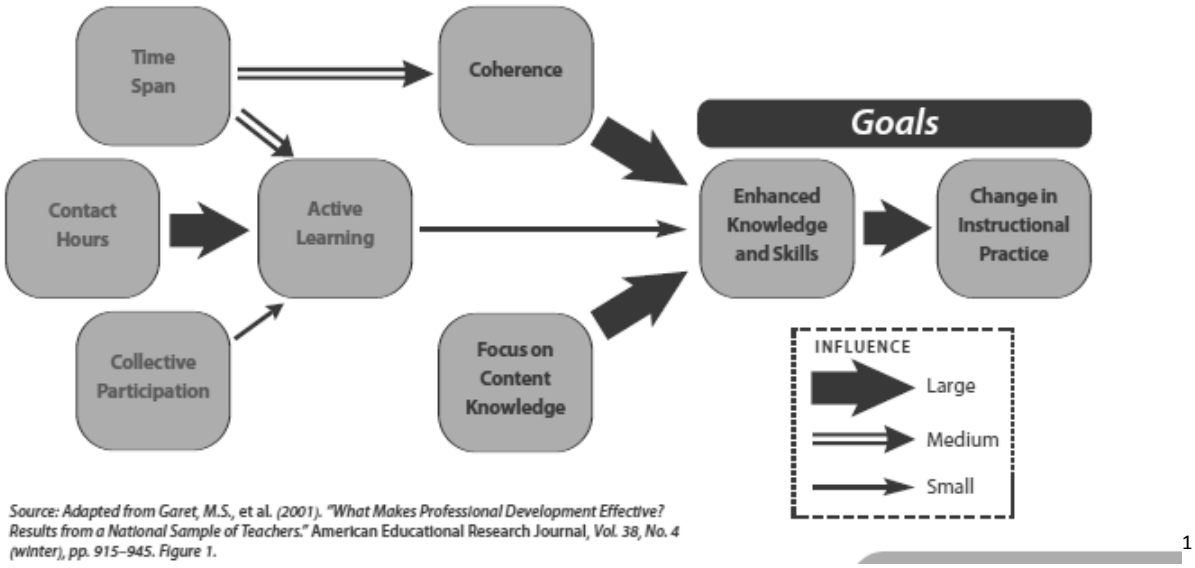
understanding of effective instructional strategies (scientifically based); 5) regularly evaluated for effects on teacher effectiveness and student achievement (Yoon et al., 2007). These criteria largely overlap with the features of effective PD described by Desimone (2009). Her study of the literature yielded a consensus on several characteristics of PD related to increases in teacher knowledge and skills and improvement in teacher practice. Based on this, she suggests the following five features of effective professional development:

1. Content focus. The subject matter content and how students learn that content should be a core part of PD for teachers.
2. Active learning. As opposed to passive learning (e.g., lectures), teachers undergoing PD should be involved in the learning process. This can include activities such as observing expert teachers, being observed and engaging in discussion and feedback, collaborating with other teachers on a specific task, producing written work on a difficult idea or problem, etc (Desimone, 2009).
3. Coherence. The PD should be consistent with the work teachers do in the classroom, with the teacher's knowledge and beliefs, and with school, district, and state standards, curriculum frameworks and assessments. Activities should be consistent across the PD experience, forming of an integrated program of teacher learning. (Garet, Porter, Desimone, Birman, & Yoon, 2001).
4. Duration. PD should be of sufficient length. Current research suggests the tipping point may be over a semester and at least 20 hours of contact time (Desimone, 2009).

5. Collective participation. PD should include opportunities for interaction and discussion among participants. This may be prompted through participation of teachers from the same school, department, discipline, or grade (Desimone, 2009; Garet et al., 2001).

Desimone (2009) states that these fundamental features of PD are essential for the effectiveness of professional development and therefore good targets for evaluation. She suggests their inclusion in impact studies as a "next step to understanding the relative importance of the features for improving student achievement in different contexts" (p. 183).

To emphasize the degree to which such PD features have been accepted as keys to effectiveness, one needs only look to a publication disseminated by The American Educational Research Association (AERA) in 2005. This document puts forward a model for PD (see Figure 3 below) that incorporates all five of the features discussed above. All influence changes in knowledge, skills, and instructional practice (Holland & AERA, 2005).



[1]

Figure 3. Aspects of Teacher Professional Development and Their Relationship to Better Instruction

[1] Copyright 2005 AERA. Used by permission.

This model was adapted from a study by Garet et al. (2001) that utilized data collected from a national evaluation of the Eisenhower Professional Development Program. This was a federal program that primarily supported professional development for math and science teachers by providing funding for a range of PD activities that varied widely by activity type, sponsor, and duration. The authors created a path model through the examination of the relationships between features of professional development and self-reported change in teacher knowledge and skills and classroom teaching practices. The number of contact hours is shown as having the greatest influence on the amount of active learning which takes place during professional development. Coherence and content focus are most associated with teacher enhanced knowledge and skills which in turn significantly impacts change in instructional practice (Garet et al., 2001).

Even when quality PD is delivered, it does not guarantee that a change in teacher practice will result. A clearer understanding of the factors which influence the transfer of learning which takes place in PD is necessary. Ingvarson, Beavis, Bishop, Peck, and Elsworthet (2004) point out the wide range of factors which influence classroom practice. Among these are teacher, student, school, and system level factors. Such factors must surely have an impact on the degree to which teachers transfer their knowledge and skills gained during professional development to their classroom practice. These factors and their relationships to outcomes of teacher PD need further exploration.

In Summary

Although the causal model for teacher professional development is largely accepted, it is evident that as a representation of the PD process, it is still crude. In particular, when PD

succeeds or fails, how specific is the model in helping us to pin down the reasons and account for how the factors that contributed (or interfered) brought about their effects. How and to what degree do factors such as teacher motivation, self-efficacy, school environment, and personal dispositions influence success or failure? To answer these questions, teacher professional development must be evaluated in multiple phases over an extended period of time, preferably using a mixed methods approach. Studying student outcome measures alone does not provide enough information. PD providers supplied with measures at various stages in the causal model can make informed decisions about accomplishments and necessary changes to their programs. These considerations helped inform the framework and direction of this evaluation study.

3 Program and Evaluation Overview

Program Overview

Program Description. The Louisiana Math and Science Teacher Institute (LaMSTI) is a teacher professional development project funded by a $5 million grant from NSF. A partnership including Louisiana State University (LSU) as the lead institution, two local school districts as core partners, the Louisiana Department of Education, and thirteen additional school districts which lie within 45 miles of the university as supporting partners. One of LaMSTI's major goals is to offer a special track of the Master's of Natural Sciences (MNS), a professional degree program of the College of Sciences. The program is designed for practicing middle and secondary STEM teachers. The academic program is composed of 30 semester-hours of graduate course work including a master's thesis. The program is completed over a period of 26 months requiring six weeks of coursework during each of three consecutive summers with frequent contact maintained during the two intervening academic years. Coursework is based on a challenging and unique, content-focused curriculum that develops teacher leaders in science and mathematics. Participants select a concentration of either mathematics or science. Admission to the program is competitive. The NSF grant provides a $20,000 stipend for each participating teacher, while the university provides tuition. NSF funding also supports the university faculty who design and deliver the special courses for the program. Ninety-six teachers in all will be supported by the grant. They attend in four cohorts of 24 each – 12 math and 12 science. The cohort structure promotes collegiality and the development of a genuine professional community.

Program History. The prototype of LaMSTI was launched in the summer of 2007, with the immediate motivation arising from a collaboration between a local school district and the university. The goal was to increase the number of highly qualified teachers at a local inner city school. The prototype was expanded the following year after seed funding was obtained from the Louisiana Board of Regents.

Stakeholders. Prominent stakeholders in LaMSTI include the program's principal investigator, a professor in the Department of Mathematics, and several co-investigators. In addition, Department of Psychology faculty members are carrying out a research component of the project. These researchers seek findings that will inform the design of academic programs by producing knowledge about professional development using the methodology of cognitive science. The program's instructors, the participants, and the districts, schools, colleagues, and students of the participants also have a stake in the success or failure of LaMSTI, as does the public at large.

Other Evaluations of the Program. Formative and summative evaluations are provided by an independent contractor. The external evaluator with the Psychology research team cooperates to support the development of fundamental knowledge concerning teacher change. The statewide data collection system will be used to track student achievement and teacher effectiveness in mathematics and science as a demonstrable result of inputs from grant activities. In addition, pre-post comparisons of teacher indicators of satisfaction, levels of preparedness, and confidence in teaching will be analyzed.

Resources. Resources consumed in the implementation of LaMSTI include time, human capital, and various materials, all of which are obtained with funding supplied by the NSF grant.

Numerous instructors are needed to carry out the multitude of activities related to the program courses. An operations manager handles various paperwork, data collection, scheduling, etc. Paper, binders, books, computers, printers, internet access, computer software, photocopiers, and the use of classroom space are all considerations with regards to resources for program execution.

Evaluation Overview

This study involved the evaluation of LaMSTI in two distinct phases, each having its own specific purpose. The evaluation is formative in nature and is meant to supplement the work done by the external evaluation team.

Locating the Researcher in the Study. Because I am a participant in LaMSTI as a member of the 2010 mathematics cohort, this evaluation is an internal one. I have developed close relationships with the participants as well as with the instructors of the program which will enable me to offer a different perspective from that of the external evaluator. In addition, my knowledge of the day-to-day activities within the program is much more extensive than that which can be obtained through a few days of observation from an outsider.

Evaluation Approach. The evaluation does not strictly adhere to any single evaluation approach but instead utilizes features of several approaches woven together to form a stronger overall model. I have borrowed from the CIPP decision-oriented model the concept of program stages and the different needs that arise at each stage. Stufflebeam's ideas of *process* and *product* stages are employed to frame this formative evaluation as program activities and outcomes are examined (Fitzpatrick, 2010). I have made efforts to link scholarly literature to attributes of the program under evaluation. Especially because program planners cite

educational research to rationalize choices made in structuring the program. The director had significant input on data collection strategies and participated in the shaping of the components of the survey instrument in order to make findings more useful to him. This depth of involvement by a key stakeholder and my participation in the program speaks to attributes associated with the participant-oriented approach (Fitzpatrick, 2010).

4 Evaluation: Part I

Purpose of the Evaluation

The focus of this part of the evaluation is on the cohort of 13 participants in the mathematics portion of LaMSTI who entered the program in the summer of 2010. I am myself a member of this cohort. The intent of this evaluation was to assess outcomes of specific program activities for the purpose of formative feedback. Results were to inform program planners and instructors, aiding them in adapting future courses and activities for our cohort's upcoming summer and for the new cohort of students to began the program in the summer of 2011. Constructive changes to the program as it progresses could prove crucial in the attainment of program goals and success for the program in general. For this reason, focusing on whether the activities/courses are addressing participant needs and making progress toward achieving program goals would be valuable as would identifying links between particular actions and outcomes.

Program Framework for Summer One

Members of the 2010 mathematics cohort attended classes five days a week for six consecutive weeks during the summer. The time totaled about 40 hours per week. During this first summer of attendance, participants were registered for three courses and a total of nine graduate credits. According to the syllabus, one hour per day was blocked for Math 4999 Selected Readings in Mathematics (internally designated as Research Seminar I) where participants were to report on, discuss, and criticize research reports from STEM education literature. Math 6302 internally named "Algebra and Geometry Concepts and Standards" was designated as receiving five and a half non-consecutive hours of time in which participants were

involved in activities such as: lecture and discussion relating the LSU's College Algebra course (Math 1021) to middle and high school algebra; work in the computer lab where participants gained familiarity with content and delivery methods used with college freshman mathematics courses; lessons and guidance with Mathematica to acquire basic skills with this software; and extended, open-ended projects which explore significant mathematical problems. Finally, Psychology 7938 Teaching and Leading had a two hour allotment each day devoted to lecture, discussion and small group problem solving centered on the examination of evidence-based skills that underlie expert teaching practice and how to apply these in the classroom. Goal implementation was another aspect of this course.

Research Basis for Framework

Program planners cite educational research to support choices made in program design. For example, Ball, Lubenski, and Mewborn's (2001) demonstrate that a deep understanding of the structure, content, and goals of the curriculum is needed by mathematics teachers. Other competencies which the program coursework is designed to develop include a large repertoire of fully analyzed mathematical examples that may be incorporated in lessons and tests (Baumert et al., 2010) and the ability to conceptualize and assess the mathematical knowledge of others and select appropriate actions in response (Ma, 1999).

Evaluation Questions

A preliminary set of evaluation questions were initially developed through consultation with the program director. The narrowing of this question set to the three questions listed in the table below was a result of the examination of each question against certain criteria. The

following considerations were taken into account in prioritizing the questions and finally reducing the number of questions in the set.

- Is it realistic to answer the question given the available resources?
- Does the question focus on key dimensions of continued interest?
- Would the answer to this question provide important information and have impact on the program?
- Would an answer to the question provide information not readily available now?

Table 1. Evaluation Questions and Data Collection Strategies

Evaluation Questions	Data Collection Strategy	Stakeholder to Provide Data
1. What are participants' perceptions of the program activities?	Survey, Documents, Interviews	All Participants
2. Which program activities did participants experience which had direct transfer into the classroom?	Survey, Interviews	All Participants
3. How would participants change the program if they had the opportunity to and why?	Survey, Documents, Focus Group	All Participants

This portion of the evaluation reflects a mixed methods approach and includes both a cross-sectional design as well as a case study. An overview of the sequence of data collection and instruments utilized during the survey are provided in Table 2 on the following page. A complete list of the program activities participants took part in during the summer can be found in the appendix in Table 14.

Table 2. Sequence of Data Collection and Instrument Descriptions

Survey *(Phase One)*
This survey represents both quantitative and qualitative aspects of the evaluation design and did not use a pre-existing instrument but rather one designed for the study. It was administered electronically to all program participants in the 2010 cohort and took approximately 15 minutes to complete. A combination of Likert scale items and open-ended questions were utilized. The Likert scale component of the survey focused on the extent to which specific program activities (1) had influence on participants' beliefs or views on their teaching practice, the curriculum or mathematics content; (2) had direct impact on participants' teaching practice; and (3) participants' reactions to program activities. The opened-ended question component addressed topics related to (1) program changes participants would like to make; and (2) specific examples of how program activities impacted their classroom practice.
Documents *(Phase Two)*
Next, documents in a variety of forms were collected. *Accounts* the program director collected over the summer from participants regarding satisfaction with program activities was one source of data. After week one of the program, participants were asked to write briefly about their experiences of each program activity. After week two, participants were asked to write about what was working well for them and what was not as well as if the program was connecting with their professional life. Suggestions for change were welcome also. Although collected and briefly inspected by the program director during the summer, no further analysis was done on these documents in any formal manner. A variety of documents from program participants including lesson plans, lecture notes, assessments, logs, and activities were to be collected and used as evidence that participants' experiences in program activities had direct transfer into their classrooms. Ultimately, this did not occur due to lack of participant cooperation.
Interviews *(Phase Three)*
The final phase consisted of three interviews with selected participants lasting about 15-20 minutes. Interview questions were designed to get a better understanding of information collected during phase one and two. Interviews were held in person or over the phone depending on availability of participants.

Data Collection Procedures

The data collection process began with the administration of an electronic survey. All 13 participants from the 2010 mathematics cohort received an email which contained basic instructions and a link to the survey. An online survey software tool was used to create the instrument, and a complete copy of the survey can be found in the appendix. Reminder emails were sent out by both the program director and me, and a total of 10 members of the cohort responded to the survey including myself. The first three questions on the survey were Likert scale items and related to a list of program activities generated by me and approved by the program director. The focus of these questions was on the extent to which specific program activities (1) had influence on participants' beliefs or views on their teaching practices, the curriculum, or mathematics content; (2) had direct impact on participants' teaching practice; and (3) evoked positive or negative reactions by participants. This information was ultimately converted into quantitative data during the analysis process. The last three questions on the survey were open-ended and used to collect qualitative data. These questions were designed to gather specific examples of direct impact on participants' teaching practices as well as suggestions for improving the program.

Next, existing documents were collected from the program director, which were accounts that participants wrote during last summer regarding satisfaction with program activities after weeks one and two of the six-week summer session. After week one, participants were asked to write about their views of the program activities which had been experienced up to that point. At the conclusion of week two, they were asked to write about what was going well, what was not going well, what changes were needed, if LaMSTI was

connecting to their professional life, and how the program could make the connection better.

An attempt was made to collect documentation from program participants including lesson plans, lecture notes, assessments, activities, etc. which would provide evidence that participants' experiences in program activities had direct transfer into their classrooms. I did not encounter much success in the collection of such documents. These documents were to be brought to a Saturday class meeting which had low attendance, but only one participant brought documents to submit. Unexpectedly, a portion of this class meeting was dedicated to a focus group style discussion among participants led by the program director regarding what participants would like to see in the upcoming summer as part of program activities. Notes were recorded during this session and were included for the analysis portion of the evaluation.

Lastly, a sample of three participants was selected based on convenience and interviews were conducted using a combination of phone and in-person interviews. A copy of the interview protocol used is located in the appendix. Participants were asked to elaborate on specific examples of program activities directly impacting their teaching practice. In addition, probing was done to uncover why participants thought particular program activities ranked high or low for the Likert scale items on the survey.

Evaluation Results

Question 1: What are participants' perceptions of the program activities?

The scaled items of the survey reflected participants' reactions to program activities as well as the extent to which each influenced their beliefs or views on their teaching practice, the curriculum, or mathematics content. The information collected on these questions was transformed into numerical data and entered into SPSS. A complete list of results from this

analysis, including the mean value and standard deviation of each program activity on each of these questions is reported in Tables 3 and 4 on the following two pages. Two activities (Statistics and Calculus) do not appear in Table 4 due to a design flaw in the survey for this question which caused some participants to rate the activity when they had not actually participated in it.

In conjunction with the quantitative data from the survey, qualitative data were examined also. The participants' written accounts after week one and two of the summer

Table 3. Participant Perceptions of Influence by Program Activities on Beliefs and Views

Question #1: Select the extent to which each program activity influenced your beliefs or views on your teaching practice, the curriculum, or mathematics content.

Program Activity	Mean	SD
Teaching and Learning	2.70	0.4583
Morning Lectures	2.50	0.5000
Statistics Lectures	2.50	0.8660
Networks Seminar	2.30	0.6403
College Readiness Workshop	2.22	0.9162
Mathematics Standards	2.22	0.4157
MathXL Computer Lab Assignments	2.20	1.0770
10-Minute Talk Peer Presentations	2.20	0.7483
Thesis Seminar	1.80	0.6000
Calculus Lectures	1.50	0.5000
Geaux Teach Mentoring	1.50	1.0247
Lessons on Mathematica	1.00	0.7746
Mentoring	0.90	0.8307
Optimization Lectures	0.89	0.8749
Mathematics and Music	0.80	0.7483

**Note: Range of possible mean values is 3 to 0, with 3 representing a 'great extent' and 0 representing 'not at all'.

Table 4. Participant Reactions to Program Activities

Question #3: Thinking back to your experiences over last summer in the program, select which best describes your reaction to each program activity.

Program Activity	Mean	SD
10-Minute Talk Peer Presentations	3.60	0.4899
Math XL Computer Lab Assignments	3.50	0.6708
Morning Lectures	3.40	0.4899
Teaching and Learning	3.40	0.6633
Networks Seminar	3.20	0.7483
Thesis Seminar	3.00	0.6325
College Readiness Workshop	3.00	0.7746
Geaux Teach Mentoring	2.70	1.1000
Mathematics Standards	2.63	0.6960
Mathematics and Music	2.25	0.6614
Lessons on Mathematica	2.10	0.9433
Optimization Lectures	1.80	1.1662
Mentoring	1.60	1.1136

**Note: Range of possible mean values is 0 to 4, with 4 representing strong positive and 0 representing strong negative.

were inspected for common themes with regards to the program in general as well as views on specific program activities. It is important to note that not all program activities included in the survey had been initiated at the point these were written. The following are brief summaries of what participants collectively reported. Direct quotes from participants are provided in Table 5.

Morning Lectures with the Program Director. Participants enjoyed their experiences in the morning lectures with the program director because they found it useful, challenging and appreciated the sharing among the group members. There was a clear consensus among participants that the alternative ways of looking at common mathematical concepts not only broadened and deepened their mathematical understanding but was directly relevant to the

classroom. Participants expressed satisfaction in knowing the 'why' behind common mathematical procedures. The only con spoken of was the desire to have complete lectures with clear conclusions before moving on to other topics. By the end of week two participants noted that this issue had been addressed.

Table 5. Direct Quotes from Participants on Program Activities

Morning Lectures with the Program Director
I like the connection being made between the algebraic and geometric way to model problems.
I liked the alternative way to look at expressions with the tree diagram.
MathXL Computer Lab Assignments
(It) gives everyone a chance to work at an individual pace to study and learn.
I really want to improve my knowledge of the subject and feel this is a great tool.
10 Minute Talk Peer Presentations
I would do the 10 minute lecture; then give everyone 5 to 10 minutes to write down their thoughts for the person. Give the handout to the person and cut the discussion part.
Have the 10-minute lecture, and following it, just have WRITTEN feedback. The oral feedback is not necessary at all.
Lessons on Mathematica
Has been interesting, but will the programming be useful to me? Probably not.
Thesis Seminar
I feel that this has been somewhat vague. I would like more clear components which need to be included. At this point, I would also like some free time during which we can research possible topics.
Teaching and Learning with the Psychology Professors
The Psych class is discussing learning principles, problem solving, and techniques of effective teaching all of which are directly translatable to the classroom.
I can see how this will be useful, enjoying the information. It's just a lot of info for two hours. Hard to listen to a 2 hour lecture after lunch.
Optimization Lectures
I find this somewhat confusing. I am not sure how I would be able to use this in my teaching.
This is really good information to know, but I do not see myself showing kids how to program on AIMMS.

MathXL Computer Lab Assignments. Participants valued the individualized nature of the computer lab assignments along with the experience of working in the program itself. Those that needed some remediation on the topics in Math 1021 and 1022 were thankful that they had the opportunity to work through such problems. Those who had already mastered these topics upon entering the program were happy to move on to other topics such as calculus or statistics. A common request by some participants was to have more time during the day to work on their computer lab assignments.

10-Minute Talk Peer Presentations. These presentations were well received by participants as they liked seeing how other teachers present certain topics. After each teacher gave his/her presentation, other participants asked questions and/or gave feedback to the presenter in front of the group. It was strongly suggested by numerous participants that feedback on these presentations be written and not given orally in front of all the other participants. The written feedback could then be collected and given to the presenter to read at a later time. Many participants did not feel it was appropriate to judge a colleague's performance in front of an audience.

Lessons on Mathematica. Although many reported finding these lectures interesting, the overriding sentiment was that they could not duplicate the procedures presented and did not see it transferring into the classroom with the level of knowledge they possessed about the software. The activities were time consuming and required a high degree of understanding of the software. If one number or symbol was input incorrectly, an error would result.

Thesis Seminar. Although participants, in general, found the seminar useful and or interesting, their comments also reflect confusion on what is required and on topic selection for

their theses. They requested more time to work individually and research topics as well as having exposure to more journal articles and thesis examples.

Teaching and Learning with the Psychology Professors. Participants consistently praised the quality of the topics presented in these lectures and their applicability to the classroom, but nearly every person expressed discontent with the format of this session. The collective view was that it was too long without a break and too much information to digest in a single sitting. Almost everyone recommended a change in the lecture style presentation and suggested more collaboration, discussion, and activities be incorporated.

Optimization Lectures. Several participants enjoyed this activity but felt that it did not relate very well to what they do in the classroom. A variety of skill levels existed in terms of technology and mathematics among the group causing numerous participants to feel confused, taxed, and overwhelmed by the activity.

These summaries alone provide valuable information regarding participants' perceptions of the various activities, but they also provide some insight into the rankings of some of the activities in the tables above. Because the documents used in this data analysis were from so early on in the summer, data was also collected in the interviews with participants regarding why particular program activities ranked high or low in scaled survey items (Questions #1 and #3). The opinions of participants at week one and two of the summer were not contradicted by the additional information obtained during the interviews, and in many cases, the opinions were reiterated. Upon inspection of Tables 3 and 4, it is clear that the same program activities are ranked in the top half or in the bottom half of the tables for both questions. The interviewees suggested that the higher ranking activities were those that were

most applicable to the classroom, were well thought out, and contained valuable information for them professionally. Teaching and Learning with the Psychology Professors, Networks Seminar, Morning Lectures with the Program Director and the program activities related to MathXL earned positive reactions and were perceived as having influenced participants' views or beliefs associated with their professional lives.

Question 2: Which program activities did participants experience which had direct transfer into the classroom?

The methods used to collect data to address this evaluation question included both survey questions and interviews with participants. Table 6 on the following page provides a summary of the results from a scaled item (Question #2) of the survey which addresses how participants perceived the impact program activities had on their teaching practice during the year. Again, responses were converted to numerical values and mean values and standard deviations were computed using SPSS.

There is a fairly definite break in the mean values which occurs near the middle of the table. This shows that the activities in the upper portion of the list were viewed by participants as being more applicable to the middle and high school classroom than those in the lower half. The findings of this quantitative data were mirrored by the qualitative data gathered in the interviews and an open-ended item on the survey (Question #5) which requested participants to provide specific examples of how their teaching practice was directly impacted by LaMSTI. All examples provided by participants except for one were linked to the activities which occurred in the top half of Table 6.

Table 6. Participant Perceptions of Direct Impact of Program Activities on Teaching Practice

Question #2: Select the extent to which each program activity had direct impact on your teaching practice (lesson planning, implementation, assessment, etc.) during this school year.

Program Activity	Mean	SD
Teaching and Learning with the Psychology Professors	2.50	0.5000
Morning Lectures with the Program Director	2.10	0.5385
College Readiness Workshop	2.00	1.2472
10-Minute Talk Peer Presentations	1.80	0.7483
Mathematics Standards	1.78	0.7857
MathXL Computer Lab Assignments	1.70	1.1000
Networks Seminar	1.60	1.0198
Statistics Lectures	1.50	0.5000
Thesis Seminar	0.90	0.7000
Mentoring with the Director of Field Experiences	0.80	0.7483
Optimization Lectures	0.78	0.7857
Geaux Teach Mentoring	0.70	0.7810
Calculus Lectures	0.50	0.5000
Lessons on Mathematica	0.30	0.6403
Mathematics and Music	0.30	0.4583

**Range of possible mean values is 3 to 0.

Teaching and Learning with the Psychology Professors was the activity which participants referenced most as having a direct impact on their teaching. Participants discussed the use of the principles of learning, deliberate practice, and implementation of the plans made on their goal worksheets during the school year. Near the end of the summer session, participants were given time to reflect and set goals for themselves that they felt would improve their practice. They developed a detailed plan for achieving these goals including what steps would be taken and how they would measure their progress. Participants agreed that this played a key role in this program activity influencing their teaching. One participant changed the design of their assessments in order to incorporate a learning principle related to

retention. She included a few problems from previously covered material on each successive test so that her students were exposed to the content many times over the course of the year. She noticed that mid-term exam grades were higher than in years past due to this change. Another teacher started to use skeleton notes with her presentations to students to cut down on how much information students were required to store in their working memory at a given time. This was a principle of learning discussed during the lectures given by the psychology professors. One participant stated, "The sessions with (the psychology professors) helped me focus more on the teaching practices that best help students remember content, and I have seen those that participate in class remember more, longer." A third participant implemented her goal worksheet plans which involved creating a friendlier environment for her students which suffer emotional issues stemming from their home lives. This was accomplished through greeting students at the door daily by name, finding activities which students enjoyed, etc.

MathXL was mentioned numerous times due to the fact that so many of the teachers in the program used it with their classes during the year. MathXL was the main software used in the College Readiness Workshop as well as in the Computer Lab Assignments. One participant who used MathXL described the challenges originally faced when implementing the new program. At first, it was not well received by her principal or by the parents. Access to technology at home was a problem for some students. Once these initial hurdles were crossed and the benefits of using MathXL were realized, all parties involved including the students became supportive. In the end, the value of the immediate feedback students received while working in MathXL and the multiple aids which students had instantaneous access to were acknowledged. Another participant stated, "The training enabled me to share my knowledge

with the other teachers at our school who would be using the program. I also held parent meetings informing parents about the program and how it would be implemented at the various grade levels."

Morning Lectures with the Program Director also represented a significant portion of the examples of direct impact. Although some specific problems solved during this program activity were incorporated into the classroom, such as the stadium oil spill problem, most of the instances provided by participants dealt with more general applications. A participant explained how these morning lectures/discussions had broadened her view on developing conceptual understanding of mathematical ideas. This year she focused on teaching concepts before or alongside algorithms. Other teachers stated how they presented mathematical concepts in a variety a ways to their students and how questioning techniques were used to involve students in the exploration of mathematical ideas rather than simply providing all of the information to them through a lecture. One participant had the following to say:

> (The morning lectures) were thought-provoking…as I not only worked with others to solve problems, but I created/adapted activities for my classroom as well. I emulated (the program director's) questioning techniques, where the students do the talking and I listen and add in when necessary.

Participants were challenged and excited about looking at familiar mathematical skills and ideas from a new perspective using alternative approaches. Not only was content-knowledge gained, but renewed enthusiasm about mathematics and its teaching was created.

More detailed descriptions of these program activities perceived to impact classroom practice can be found in Table 15 in the appendix. Several other program activities were referenced in participants' examples but to a lesser degree than those discussed above. Among these were the 10-Minute Peer Presentations. Evidence provided of direct impact of this

activity on teaching included the use of the following ideas or strategies by participants: "function machines are like washing machines"[2], split-page notes, Tom's technique for involving students in the lesson, and the use of board space to refer back to relevant concepts. The use of the Common Core State Standards in updating curriculum maps and when planning lessons was mentioned by a few respondents, and the reference to logarithms in the Mathematics and Music lectures was integrated into one teacher's lesson when covering exponential and logarithmic functions.

It is clear that participants found some program activities more applicable to their professional practices than others. The abundance of specific examples produced by participants substantiates that their teaching practices were affected by their experiences in the program.

Question 3: How would participants change the program if they had the opportunity to and why?

In order to answer this question, qualitative data was collected utilizing three different strategies: (1) an open-ended item (Question #4) on the survey, (2) participants' written accounts after weeks one and two of the summer program collected by the program director, and (3) notes from the focus group. An analysis was performed on the data collected, and themes were identified which recurred among participants and in many cases across data sources. The data being collected at three different times over the course of a ten month period adds to the dependability of the findings. The list below summarizes the main ideas which surfaced during the analysis process.

[2] This was an analogy made by a participant when presenting algebraic functions. Function machines are often used to help describe the process of inputs to outputs.

- More time dedicated to independent thesis work was requested, as was additional information regarding the requirements for the thesis.
- Collaboration among participants including science cohort members was identified as a desired component of the program. Participants wanted the opportunity to share lesson ideas and activities for use in the classroom. Examples of the nature of such exchanges included those related to STEM, real-life, technology, and hands-on learning.
- Maximizing coherence between program activities and what teachers do in the classroom was another appeal by participants. Time to plan for such implementation of program related content into lessons was recognized also.
- A reduction of the number of activities related to mentoring was a request as well. Participants expressed that program activities in this area were excessive and felt that their time could have been utilized better. One participant stated, "I believe it would be advantageous to eliminate some of the mentoring seminar/discussions because it was overkill and not effective." The information about mentoring presented in the Networks Seminar was adequate and was positively received by participants. (It should be noted that these activities provided information on mentoring and were not mentoring activities themselves. This recommendation by participants should not be misconstrued as a suggestion that mentoring itself has no merit.)

A major source of anxiety for participants was the thesis requirement of the program. Although a significant amount of time was dedicated to various aspects of the thesis, confusion remained about the exact components that would be required as well as the execution process involved. The following comments were taken from a participant's response to the opened-

ended question on the survey regarding changes they would like to make to the program. "I feel that I am lost on HOW to do a thesis. I feel if we had more practice on doing literature reviews and required assignments, I would have been more confident in the requirements."

Participants recognized the wealth of experience and knowledge held by their fellow colleagues in the group and wanted to have the time and opportunity to access this resource. These teachers know their own professional needs and deficiencies better than anyone else and believe that many 'gaps' in their own mathematical or pedagogical knowledge can be filled in by others in the group. Throughout this evaluation process, participants have expressed appreciation for the content delivered by instructors. They valued peer collaboration, and would have liked even more.

Maintaining strong connections between program activities and classroom teaching practices will increase program impact. Coherence is a feature of professional development which has been identified as critical to increasing teacher knowledge and improving their practice (Desimone, 2009; Penuel et al., 2007). Allowing time for teachers to plan for the integration of new information into their practice has also been referenced in the literature as an effective strategy for transferring what is learned during professional development into the classroom (Penuel et al., 2007).

Discussion and Recommendations

Participants come to LaMSTI because they what to gain more knowledge in their content area, mathematics. They are receptive to quality activities which they believe can help them to become more effective teachers. These teachers appreciate well-organized experiences, but at the same time like the flexibility the program has to offer. The program

design compensated for differences in participants' content knowledge of mathematics, and changes were made when necessary during the summer to meet the needs of all members of the cohort.

Participants developed relationships with their colleagues in the program and felt a sense of community. One participant stated, "The relationships that were fostered have been helpful, supportive, and positive. Life-long friendships have been created!" These relationships were formed through cooperative tasks associated with program activities, sharing teaching experiences with one another, seeking advice on instructional practices, etc. They looked to the program director, instructors, and to one another to build upon their existing knowledge, and this is truly what LaMSTI was designed to achieve.

This evaluation identified those program activities that participants viewed as being most positive and most influential. It also revealed the program activities that teachers perceived as having direct impact on classroom practice. Teaching and Learning with the Psychology Professors, Morning Lectures with the Program Director, Networks Seminar, Mathematics Standards Seminar, and program activities associated with MathXL were reported to have the most impact on participants and were the most positively received. The assumption of the program is that improved student achievement is dependent upon positive changes in teacher knowledge, behavior and instructional practices. LaMSTI was successful in bringing about such changes.

Recommendations and considerations for future activities to improve upon the success of LaMSTI include the following:

- Provide a clear and comprehensive explanation of what is expected with regard to the thesis and increase time allocated for participants to work on their theses individually.
- Foster collaboration between the math and science cohorts and encourage cross-curricular lessons and sharing of exemplary resources and activities.
- Maximize coherence between program activities and participants' teaching practices and allocate time dedicated to plan for the incorporation of material from program activities into the classroom.
- Reduce the number of activities devoted to theoretical aspects of mentoring.

5 Evaluation: Part II

Purpose of the Evaluation

The second phase of the evaluation looked more broadly at the impact upon enhanced knowledge and skills and changes in practice in both the science and mathematics cohorts. It also sought to determine the degree to which LaMSTI displayed known characteristics of effective PD and the relationships among these characteristics and teacher outcomes.

Evaluation Questions

In this portion of the study, we employed measures of the factors that appear in the causal model reviewed in Chapter 2, as well as measures of the features of effective PD identified by Desimone (2009). Table 7 displays the evaluation questions and data collection strategies.

Table 7. Evaluation Questions and Data Collection Strategies

Evaluation Questions	Data Collection Strategy	Stakeholder to Provide Data
1. To what extent do program participants report: a) the presence of the following features of effective professional development in program activities: content focus, coherence, and active learning? b) the following teacher outcomes as a result of their experiences in the program: enhanced knowledge and skills and change in teaching practice?	Survey	All Participants
2. How and to what degree: a) are the five features of effective professional development related to each other and to teacher enhanced knowledge and skills and change in teacher practice? b) are gains in teacher knowledge and skills associated with teachers making changes to their classroom practice?	Survey	All Participants

Data Collection Procedures

Participants. All 48 current LaMSTI participants were invited to participate in the study as well as those who have already completed the program for a total of 63 possible

respondents. This includes five different cohorts, with the first group starting the program in 2007 and the most recent entering the program in the summer of 2011. The program director sent emails containing a link to the electronic survey to all participants. Although participation was encouraged, it was purely on a voluntary basis. Three of the initial emails sent out regarding the survey were returned undeliverable. This may have been due to the fact that some participants changed schools and contact information was out of date. In all, 50 participants completed the survey—52% from mathematics cohorts and 48% from science. About 69% of respondents currently teach at the high school level, 27% at the middle school level, and 4% teach at both levels.

Measures. The survey used was designed specifically for this project but was modeled after an instrument used in a study by Garet et al. in 2001.[3] The 2001 study measured three structural features (duration, collective participation, and form) and three core features (content focus, active learning, and coherence) of PD, along with two teacher outcomes (knowledge and skills and change in teacher practice). The five features of effective PD identified by Desimone (2009) comprise two of the structural features and all three core features. The one structural feature (form) not included by Desimone was also not a variable in our study because all participants were engaged in the same type of activity. The five features, duration, collective participation, content focus, coherence, and active learning were measured along with two teacher outcomes –enhanced knowledge and skills and change in teacher practice.

[3] Our study differs from Garet's in significant respects. Our sample was not random and was much smaller in size. An objective of the LaMSTI program is to develop a professional learning community within and possibly between cohorts. Garet's study took data from a variety of PD opportunities funded by the Eisenhower Program around the nation.

According to Garet et al. (2001), duration has a positive influence on both coherence and active learning. Longer activities tend to provide more opportunities for teachers to participate in active learning and to promote consistency with the work that teachers do. Also, PD of longer duration is more likely to have a content focus. In the Garet et al. (2001) study and many others, duration was measured by contact hours and time span. In a cohort model, duration does not vary within cohorts, but does change for the entire cohort as it advances through the program. Participants of the present study were asked to identify their cohort to determine how many years they had been in the program.

To determine the level of collective participation, teachers were asked whether other teachers were participating from their school, whether other teachers were participating from their district, and whether other teachers who taught the same content as they did were participating in the program. A response of 'no' received a 0, and a 'yes' response received a 1. The answers for these three questions were averaged to achieve a single score for collective participation. In general, collective participation is believed to promote active learning, which in turn has an effect on gains in teacher knowledge and skills (Holland & AERA, 2005).

According to Garet et al.'s (2001) model, the structural features (which we have just discussed) influence the core features—content focus, active learning, and coherence. These core features in turn contribute to teacher enhanced knowledge and skills, exerting a positive influence on teacher practice. Coherence and content focus are the two core features which have been shown to have the most positive influence on both enhanced knowledge and skills and change in teacher practice, with coherence being the most influential (Garet et al., 2001).

In our study, the core features were measured using created scales. Scales were also constructed to capture the teacher-reported outcomes. A copy of the survey and all subscales employed in this study can be found in the appendix. Each of the scales contained between five and eight items which were averaged to obtain overall values for each of the five features and the two teacher outcome variables. A factor analysis was conducted on each scale, and a calculation of Cronbach's Alpha was used to determine the reliability of each. A summary of these results is reported in Table 8 below.

Table 8. Results of Factor Analysis and Reliability Ratings

Scales	**No. of Questions**	**No. of Factors**	**Cronbach's Alpha**
Content Focus (CF)	5	1	.72
Active Learning (AL)	5	1	.77
Coherence (C)	8	1	.92
Enhanced Knowledge and Skills (EKS)	5	1	.87
Change in Teacher Practice (CTP)	5	1	.88

Data Analysis Procedures. Before any analyses were initiated, the data was imported into SPSS and checked for data quality. There were a few pieces of data missing. Each case was considered independently and resolved without any extreme compromise of quality. A check for outliers was done using Cook's D. Assumptions of errors being normality distributed, linearity between the independent and dependent variables, and homoscedasticity of the variance of the residuals were examined by the use of scatterplots and adequately satisfied. The assumptions regarding correct model specification were met also.

A formal causal model was estimated to assess the effects of the five features of effective PD on teacher outcomes. A path analysis was conducted using regression analyses in SPSS along with hand calculations of reproduced correlations to determine model fit.

Alternative causal interpretations cannot be ruled out, but the strength and direction of relationships among variables can be identified.

Evaluation Results

Question 1: To what extent do program participants report:

a) the presence of the following features of effective professional development in program activities: content focus, coherence, and active learning?

b) the following teacher outcomes as a result of their experiences in the program: enhanced knowledge and skills and change in teaching practice?

Descriptive statistics were generated using SPSS to answer the first set of research questions. The results were indicative of the extent to which participants reported the presence of the core features of PD in program activities and desired teacher-outcomes. The Likert scales used for coherence and enhanced knowledge and skills were 5-point scales with values ranging from 0 to 4. (See the appendix for the meaning of the extremes.) Content focus, active learning, and change in teaching practice were all measured on 4-point Likert scales with values ranging from 0 to 3. The means and standard deviations for each of these variables are displayed in Table 9. The group mean reported for each construct is the average response of all teachers on all survey items within that construct.

Table 9. Descriptive Statistics for Effective Features of PD and Teacher Outcomes

Variable	Scale	Group Mean	Standard Deviation
Content Focus	0 to 3	2.37	.52
Active Learning	0 to 3	2.39	.56
Coherence	0 to 4	2.93	.79
Enhanced Knowledge and Skills	0 to 4	2.80	.83
Change in Teacher Practice	0 to 3	1.94	.67

Content focus and active learning were close in both their mean and standard deviation values as were coherence and enhanced knowledge and skills. The results indicate that overall participants felt the program activities were focused on content and produced occasions for them to engage actively in the learning process. The core feature, coherence, was also clearly present in program experiences. The teacher-outcomes of enhanced knowledge and skills and change in practice were also reported by participants as being achieved to a moderate degree, although results for change in teacher practice were lower. The results demonstrate that the PD experiences provided by LaMSTI possess features of effective PD and that teacher outcomes are reported as being realized. However, opportunity exists for improvement in these areas.

Question 2: How and to what degree:

a) are the five features of effective professional development related to each other and to enhanced teacher knowledge and skills and change in teacher practice?
b) are gains in teacher knowledge and skills associated with teachers making changes to their classroom practice?

The second set of research questions was answered through the process of path analysis. The goal was to identify how and to what degree the five features were related to one another and to enhanced knowledge and skills and changes in practice. In addition, we also sought to determine the influence of enhanced knowledge and skills on change in teacher practice. A path diagram was created for the initial model; see Figure 4, below. The arrows in the diagram depict the degree of influence between the model variables. Model construction followed precedents established in previous publications (Garet et al., 2001; Holland & AERA, 2005).

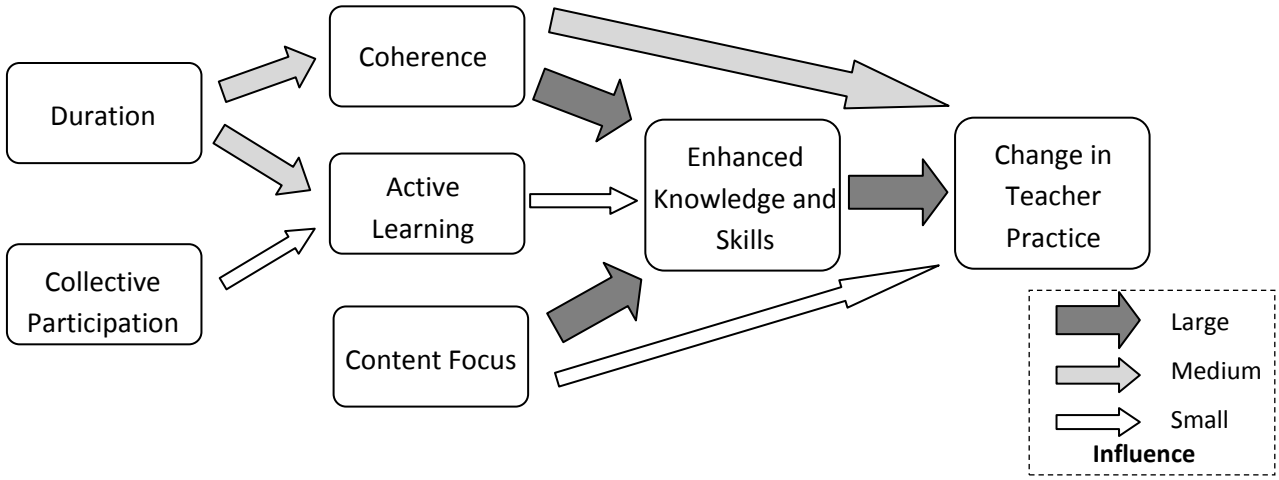


Figure 4. Path Diagram for Initial Model (Change in Teacher Practice)

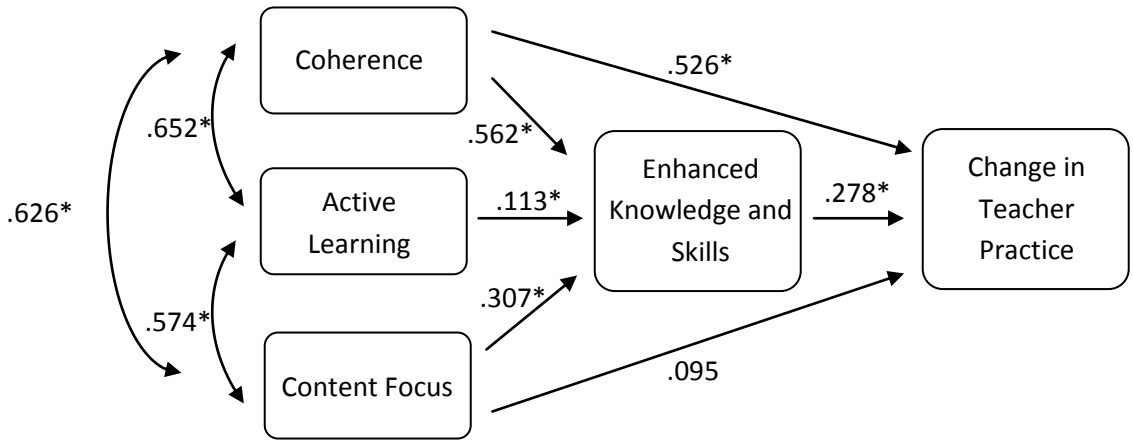
After the initial model was established, a correlation matrix was created to confirm the significance of relationships between model variables. As shown in Table 10 below, duration

Table 10. Correlations for Features of Effective PD and Teacher Outcomes

	Duration	Collective Participation	Content Focus	Active Learning	Coherence	Enhanced Knowledge and Skills	Change in Teacher Practice
Duration	1.00	.160	.128	.112	.011	.095	-.035
Collective Participation		1.00	.251	.062	.032	.176	.005
Content Focus			1.00	.574**	.636**	.719**	.618**
Active Learning				1.00	.652**	.653**	.621**
Coherence					1.00	.833**	.813**
Enhanced Knowledge and Skills						1.00	.780**
Change in Teacher Practice							1.00

** Correlation is significant at the .01 level.
* Correlation is significant at the .05 level.

and collective participation were not significantly correlated with any of the variables in the model. Due to the lack of a significant relationship between these two structural features and the core features included in the model, the path diagram was modified, dropping duration and collective participation. The revised model is shown in Figure 5 below with path coefficients which were determined by performing a succession of regression analyses in SPSS. All paths were shown to be significant at the .05 level.



*Indicates Significant Coefficients

Figure 5. Path Diagram for Revised Model (Change in Teacher Practice)

In order to assess the model fit, hand calculations were performed to obtain the reproduced correlations which were then compared with the observed correlations. The reproduced correlations were determined by identifying all legitimate paths between the variables in the model in a process referred to as path tracing (see Table 11). This process results in a correlation coefficient for each path, which is equal to the product of all coefficients in the path. These calculations are illustrated in Table 12. The following three rules to determine legitimate paths were used in this process:

(1) No path may pass through the same variable more than once,

(2) No path may go backward on an arrow after going forward on another arrow (although it is acceptable to go forward on an arrow after first going backward), and

(3) No path may include more than one double-headed curved arrow.

Table 11. Path Decompositions for the Revised Model (Shown in Figure 5)

Reproduced Correlation	**Path Decomposition**
12	= 12
13	= 13
14	= 14 + 12 24 + 13 34
15	= 15 + 14 45 + 12 24 45 + 13 34 45 + 13 35
23	= 23
24	= 24 + 21 14 + 23 34
25	= 24 45 + 21 14 45 + 23 34 45 + 21 15 + 23 35
34	= 34 + 32 24 + 31 14
35	= 35 + 34 45 + 32 24 45 + 31 14 45 + 31 15
45	= 45 + 41 15 + 43 35 + 42 21 15 + 42 23 35 + 41 13 35 + 43 31 15

Table 12. Calculations of Reproduced Correlations for the Revised Model (Shown in Figure 5)

Reproduced Correlation	**Path Decomposition**
12	= (.652) = **.652**
13	= (.636) = **.636**
14	= (.562) + (.652)(.113) + (.636)(.307) = **.831**
15	= (.526) + (.562)(.278) + (.652)(.113)(.278) + (.636)(.307)(.278) + (.636)(.095) = **.817**
23	= (.574) = **.574**
24	= (.113) + (.652)(.562) + (.574)(.307) = **.656**
25	= (.113)(.278) + (.652)(.562)(.278) + (.574)(.307)(.278) + (.652)(.526) + (.574)(.095) = **.580**
34	= (.307) + (.574)(.113) + (.636)(.562) = **.729**
35	= (.095) + (.307)(.278) + (.574)(.113)(.278) + (.636)(.562)(.278) + (.636)(.526) = **.632**
45	= (278) + (.562)(.526) + (.307)(.095) + (.113)(.652)(.526) + (.113)(.574)(.095) + (.562)(.636)(.095) + (.307)(.636)(.526) = **.785**

The reproduced correlations were evaluated against the observed correlations using the difference criterion of .05. As seen in Table 13, all of the reproduced correlations have no differences greater than .05 which indicates that the model is consistent with the empirical data and revisions are not warranted.

Table 13. Observed and Reproduced Correlations for the Revised Model (Figure 5)

	C - z_1	AL - z_2	CF - z_3	EKS - z_4	CTP - z_5
Observed Correlations					
C - z_1	1.00				
AL - z_2	.652	1.00			
CF - z_3	.636	.574	1.00		
EKS - z_4	.833	.653	.719	1.00	
CTP - z_5	.813	.621	.618	.780	1.00
Reproduced Correlations (Revised Model)					
C - z_1	1.00				
AL - z_2	.652	1.00			
CF - z_3	.636	.574	1.00		
EKS - z_4	.831	.656	.729	1.00	
CTP - z_5	.817	.580	.632	.785	1.00

*Difference between reproduced and observed correlations is greater than 0.05.

The path coefficients are displayed in Figure 5 and represent the results of the path analysis. The results indicate that all three core features are moderately correlated with each other and have a positive influence on enhanced knowledge and skills, with coherence being the most influential (.562) followed by content focus (.307). Coherence (.526) and enhanced knowledge and skills (.278), as reported by participants, are shown to have strong interconnectedness with change in teacher practice.

Discussion and Recommendations

These results confirm several findings from previous studies and offer additional insights. For example, results of previous studies suggest that sustained and concentrated PD is more likely to produce teacher reports of influence on outcomes than is a shorter PD experience (Garet et al., 2001). The present study suggests that a threshold exists past which duration of PD no longer has increased influence. At the time the survey was administered, participants in this study with the least amount of PD exposure had over 220 hours during a six week period with one follow up meeting taking place about two months after the initial PD experience concluded. I propose that after a certain period of time, increased impact of duration may not be detected, but other factors may continue to make a difference.

Collective participation has largely been characterized as participation of teachers from the same district, school and/or department (Garet et al., 2001). Collective participation was not a significant factor in this study, possibly because nearly all teachers shared their PD experience with others who taught the same discipline as they did. Whether other teachers from their school or district were participants in the program did not seem to make much of a difference. According to the survey, 50% of teachers reported that other teachers from their school were participating in the program. In an extended PD experience which involves cohorts such as this one, perhaps a measure of the extent to which participants perceive the development of professional community would be more appropriate.

In previous research (Garet et al., 2001), enhanced knowledge and skills (EKS) was found to be the variable with the most impact on change in teacher practice (CTP), but the findings of this study differ as evidenced by a lower coefficient between EKS and CTP (.278). In this study,

coherence (.526) is shown to be most influential on CTP. According to participants, it appears that the most significant feature of this PD experience overall as it relates to both EKS and CTP is the level of coherence between the program activities and the work that they do in the classroom. Content focus is also an important contributor to increasing knowledge and skills. Teachers' acquiring new knowledge and skills was not as crucial as their view on how consistent the experience was across program activities, with school, district, and state standards, and with their own knowledge, goals, and beliefs as teachers.

6 Conclusion

Some limitations existed within the context of this study. First, within the time frame and the resources available for this study, direct observation of changes in classroom practice was not feasible. Much of the data therefore came from teacher self-reports. Findings are based on the perceptions of teachers in the program and must be interpreted with this in mind. Second, in phase two of the evaluation the sample size was smaller than is typical for the type of analysis conducted.

The results of phase one of the evaluation were presented to both the program director and numerous instructors associated with the program. Changes have been made to the program in light of these findings. One example is the reduction in the number of mentoring activities during summer sessions. Another is the restructuring of the research seminar for new cohorts in order to provide additional information on the thesis requirement of the program. In general, the findings of this portion of the evaluation supplied program providers with formative feedback to be used in planning future activities for the program.

Phase two of the evaluation revealed that, according to participants, LaMSTI has attained moderate levels of the identified features of effective professional development. Of course, there is room for improvement. The findings of the path analysis raise some interesting questions that require further study. Is duration less of a factor for influencing the core features of the PD activities past a certain threshold? The research available on a threshold for duration in terms of PD effectiveness is inconclusive. Even more important, from the perspective of LaMSTI goals, is the question of whether the professional community created by the cohort model is comparable in influence to the kinds of collective participation that have

been studied elsewhere. The design of the LaMSTI project was based on the hypothesis that sense of community among participants is essential to the overall effectiveness of the program. To what extent and in what ways is this supported by observation? Better measures of the scope and strength of the professional learning community would be a good goal for similar studies in the future, especially when programs using a cohort model are under study.

A key finding in this study is the importance of coherence in influencing teacher outcomes including enhanced knowledge and skills as well as change in teacher practice. How consistent the teachers viewed the PD with their daily professional tasks and how consistent the experiences were across the program were the most influential factors. This idea of coherence requires additional investigation in future studies due to the significant role it seems to play. Can we say with more precision what it means? Can we measure it with greater accuracy?

A clearer understanding of the factors influencing the transfer of learning which takes place in PD is necessary. I suggest the exploration of factors at the teacher, student, school, and system levels and their relationships to outcomes of teacher PD.

Further study of the features of effective PD and their role in the causal model for teacher PD is needed. Gaining knowledge about the process by which teachers change their practice in a way that results in increased student performance is essential in providing effective PD experiences for teachers.

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Appendix

Table 14. Program Activities for the 2010 Mathematics Cohort Participants

Morning lectures with program director on algebra topics from 8:00 - 9:00 a.m.
MathXL computer lab assignments and took place predominantly from 9:00 - 11:00 a.m. in the computer lab and involved individualized assignments related to college algebra and trigonometry
10-Minute talk peer presentations on MathXL topics in college algebra and took place in the morning just before 9:00 a.m.
College Readiness Workshop taking place across campus and introduced participants to the web-based system My Math Lab for use in the middle and high school classrooms
Lessons on Mathematica led by the program director in the computer lab during the morning introducing participants to math software
Thesis Seminar discussions/activities led by program director from 11:00 a.m. - 12:00 p.m.
Teaching and Learning lectures/activities with professors from the Psychology Department which took place during the 12:30 - 2:30 p.m. time slot and covered topics on principles of learning, deliberate practice, achieving goals, and group problem solving techniques
Networks lectures/activities with psychology professor which took place during the 12:30 - 2:30 p.m. time slot and covered topics related to building and maintaining networks
Mentoring lectures/activities led by team from Geaux Teach which took place during the 12:30 - 2:30 p.m. time slot
Mentoring lectures/activities with Director of Field Experiences which took place during the 12:30 - 2:30 p.m. time slot
Mathematics standards lectures/activities which took place during the 12:30 - 2:30 p.m. time slot and focused on the new Common Core State Standards in mathematics
Optimization lectures and computer activities which took place in the afternoon from 2:30 - 5:00 p.m. using the software AIMMS
Mathematics and Music lessons/activities which took place from 2:30 - 5:00 p.m. and dealt with the relationship mathematics has to music
Statistics lectures which took place downstairs, mainly in the afternoon, and covered topics related to AP Statistics
Calculus discussions which took place upstairs, mainly in the afternoon, and covered topics related to Business Calculus

Table 15. Descriptions of Program Activities Perceived by Participants as having the Most Impact on their Classroom Practice

Morning Lectures with the Program Director

The "morning lecture" was scheduled between 8AM and 9AM. The intended format was for the professor to speak for 20 minutes and then turn a problem over to the class for a brief period of individual work followed by group discussion. The topics followed the Common Core State Standards, and included expressions and equations, functions, modeling and a little bit of geometry.

Teaching and Learning with the Psychology Professors

The Teaching and Learning course took place after lunch for two and a half hours on ten different days during the six week summer program for a total of 25 contact hours. The course focused on topics such as the principles of learning, engaging in deliberate practice, overcoming obstacles during goal implementation, group problem solving techniques. Relevance of the information delivered to education was emphasized. Near the end of the course, teachers selected goals to implement into their classrooms which would improve their teaching. They completed goal worksheets to plan for implementation. Follow-ups on goal progress was continued throughout the school year.

Program Activities related to MathXL

MathXL is an online product of Pearson Education which accompanies its textbooks in mathematics. After purchase, it can be accessed on the Web. It provides online homework, tutorials, and assessments in a modular, self-paced environment. LSU uses this system in its College Algebra and Trigonometry courses. The College Readiness Program at LSU trains high-school teachers to use MathXL in their classrooms. LaMSTI utilized this tool to advance its participants' content knowledge in mathematics by tailoring assignments to meet the needs of individuals in the program. The 10-Minute-Talk Peer Presentations given by participants were focused on topics from the assignments given in MathXL. Participants were to deliver to their peers content deemed as critical to understanding.

LAMSTI-MNS Participant Survey

Completion Time: Approximately 10 -15 minutes

1.) Select the extent to which each program activity influenced your beliefs or views on your teaching practice, the curriculum or mathematics content. A brief description has been supplied of each program activity as a reminder.

	To A Great Extent	To Some Extent	To A Small Extent	Not at all	N/A - Did Not Participate
Morning Lectures with [redacted] on Algebra Topics (These activities took place in the morning from 8:00 - 9:00 a.m.)	( )	( )	( )	( )	( )
Math XL Computer Lab Assignments (These activities took place predominantly from 9:00 - 11:00 a.m. in the computer lab.)	( )	( )	( )	( )	( )
10-Minute Talk Peer Presentations on Math XL Topics in College Algebra (These presentations took place in the morning and were done by LAMSTI and CART math participants throughout the summer.)	( )	( )	( )	( )	( )
LSU College Readiness Workshop with [redacted] (This workshop took place across campus and introduced participants to the web-based system MyMathLab for use in the middle and high school classrooms.)	( )	( )	( )	( )	( )
Lessons on Mathematica (These lessons were done by [redacted] in the computer lab during the morning introducing participants to math software.)	( )	( )	( )	( )	( )
Thesis Seminar Discussions/Activities (These were led by [redacted] from 11:00 - 12:00 p.m.)	( )	( )	( )	( )	( )
Teaching and Learning Lectures/Activities with [redacted] (These presentations were done during the 12:30 - 2:30 p.m. time slot and covered topics on principles of learning, deliberate practice, achieving goals, and group problem solving	( )	( )	( )	( )	( )

techniques.)					
Networks with [redacted] (These lectures took place during the 12:30 - 2:30 p.m. time slot and covered topics related to building and maintaining networks as well as mentoring.)	( )	( )	( )	( )	( )
Geaux Teach with [redacted] (These activities took place during the 12:30 - 2:30 p.m. time slot.)	( )	( )	( )	( )	( )
Mentoring with [redacted] (These activities took place during the 12:30 - 2:30 p.m. time slot and focused on mentoring.)	( )	( )	( )	( )	( )
Mathematics Standards with [redacted] (These activities took place during the 12:30 - 2:30 p.m. time slot and focused on the new Common Core State Standards in mathematics.)	( )	( )	( )	( )	( )
Optimization Lectures and Computer Activities with [redacted] (These activities took place in the afternoon from 2:30 - 5:00 p.m. using the software AIMMS.)	( )	( )	( )	( )	( )
Mathematics and Music with [redacted] (These activities took place from 2:30 - 5:00 p.m. and dealt with the relationship mathematics has to music.)	( )	( )	( )	( )	( )
Statistics Lectures with [redacted] (These took place downstairs in Prescott, mainly in the afternoon, and covered topics related to AP Statistics.)	( )	( )	( )	( )	( )
Calculus Discussions with [redacted] (These took place upstairs in Prescott, mainly in the afternoon, and covered topics related to calculus.)	( )	( )	( )	( )	( )

2.) Select the extent to which each program activity had direct impact on your teaching practice (lesson planning, implementation, assessment, etc.) during this school year.

	To A Great Extent	To Some Extent	To A Small Extent	Not at all	N/A - Did Not Participate
Morning Lectures with [redacted] on Algebra Topics	( )	( )	( )	( )	( )
Math XL Computer Lab Assignments	( )	( )	( )	( )	( )
10-Minute Talk Peer Presentations on Math XL Topics in College Algebra	( )	( )	( )	( )	( )
LSU College Readiness Workshop with [redacted]	( )	( )	( )	( )	( )
Lessons on Mathematica	( )	( )	( )	( )	( )
Thesis Seminar Discussions/Activities	( )	( )	( )	( )	( )
Teaching and Learning Lectures/Activities with [redacted]	( )	( )	( )	( )	( )
Networks with [redacted]	( )	( )	( )	( )	( )
Geaux Teach with [redacted]	( )	( )	( )	( )	( )
Mentoring with [redacted]	( )	( )	( )	( )	( )
Mathematics Standards with [redacted]	( )	( )	( )	( )	( )
Optimization Lectures and Computer Activities with [redacted]	( )	( )	( )	( )	( )
Mathematics and Music with [redacted]	( )	( )	( )	( )	( )
Statistics Lectures with [redacted]	( )	( )	( )	( )	( )
Calculus Discussions with [redacted]	( )	( )	( )	( )	( )

3.) Thinking back to your experiences over last summer in the LAMSTI program, select which best describes your reaction to each program activity.

	Strong Positive Reaction	Positive Reaction	Neutral	Negative Reaction	Strong Negative Reaction
Morning Lectures with [redacted] on Algebra Topics	( )	( )	( )	( )	( )
Math XL Computer Lab Assignments	( )	( )	( )	( )	( )
10-Minute Talk Peer Presentations on Math XL Topics in College Algebra	( )	( )	( )	( )	( )
LSU College Readiness Workshop with [redacted]	( )	( )	( )	( )	( )
Lessons on Mathematica	( )	( )	( )	( )	( )
Thesis Seminar Discussions/Activities	( )	( )	( )	( )	( )
Teaching and Learning Lectures/Activities with [redacted]	( )	( )	( )	( )	( )
Networks with [redacted]	( )	( )	( )	( )	( )
Geaux Teach with [redacted]	( )	( )	( )	( )	( )
Mentoring with [redacted]	( )	( )	( )	( )	( )
Mathematics Standards with [redacted]	( )	( )	( )	( )	( )
Optimization Lectures and Computer Activities with [redacted]	( )	( )	( )	( )	( )
Mathematics and Music with [redacted]	( )	( )	( )	( )	( )
Statistics Lectures with [redacted]	( )	( )	( )	( )	( )
Calculus Discussions with [redacted]	( )	( )	( )	( )	( )

4.) How would you change the program if you had the opportunity to and why?

5.) For activities which you reported as having direct impact on your teaching this year in question #2 above, please describe up to 3 specific examples below.

6.) About how many more examples could you describe for question #5 given the time?

Thank You!

Thank you for taking the time to complete this survey.

Interview Protocol

Provide information to interviewee on the activities which ranked highest in terms of Question 1 (influencing your beliefs or view on participants' teaching practice, the curriculum or content), Question 2 (direct impact on teaching) and Question 3 (reactions to program activities) on the survey which were as follows: Morning Lectures with [redacted] on Algebra, Teaching and Learning with [redacted], Math XL assignments and 10 Minute talks.

1. **Why do you think that these activities were ones participants had a positive reaction to and reported as having influence /direct impact on their teaching?**

Provide information on activities which ranked the lowest for Questions 1-3 which were as follows: Mentoring with [redacted], Optimization Lectures and Computer Activities, Lessons on Mathematica, Math and Music.

2. **Why do you think these activities ranked low with participants in these areas?**

3. **What would you like to do differently in your classroom related to instruction next year and why?**

4. **What kept you from making such changes this year?**

5. **Can you give me some additional details on the specific examples you listed in the survey about how the program had direct impact on your teaching this year?**

LAMSTI Program Survey

Page One

1) In which content area of the LAMSTI program are you participating?

( ) Mathematics

( ) Science

2) At what grade level do you currently teach?

( ) Middle School

( ) High School

( ) Both Middle and High School

3) In considering the LAMSTI program activities, indicate the degree of emphasis given to:

N=50	no emphasis	minor emphasis	moderate emphasis	major emphasis	Item Mean
a. deepening your content knowledge and skills.	0%	8%	10%	82%	2.74
b. improving your conceptual understandings of your content area.	2%	2%	18%	78%	2.72
c. deepening your knowledge of methods for teaching content to your students.	4%	10%	40%	46%	2.28
d. deepening your knowledge of resources (i.e. books, technology, equipment, manipulatives, people, etc.) available which could be useful to your classroom practice.	4%	18%	44%	34%	2.08
e. deepening your knowledge of the standards and/or curricula in your content area.	6%	18%	42%	34%	2.04

4) In considering the LAMSTI program activities, indicate the degree of emphasis:

N=50	no emphasis	minor emphasis	moderate emphasis	major emphasis	Item Mean
a. on meaningful discussion with other members of the program (i.e. participants, instructors, etc).	0%	2%	28%	70%	2.68
b. on participants giving presentations or watching presentations given by other teachers.	6%	14%	30%	50%	2.24
c. on producing written work on an idea or difficult problem in your content area.	0%	14%	28%	58%	2.44
d. on working with other participants in groups on a specific task.	2%	10%	28%	60%	2.46
e. on discussing the implementation of ideas of the professional development into your classroom.	4%	18%	38%	40%	2.14

5) Indicate the extent to which the LAMSTI program activities:

N=50	not at all	very little	some what	to a considerable extent	to a great extent	Item Mean
a. are consistent with your school's goals (i.e. standards, curriculum frameworks, and assessments).	2%	8%	12%	38%	40%	3.06
b. are consistent with your district's goals (i.e. standards, curriculum frameworks, and assessments).	2%	4%	14%	42%	38%	3.10
c. are consistent with the state's goals (i.e. standards, curriculum frameworks, and assessments).	0%	2%	18%	32%	48%	3.26
d. are consistent with your own goals, knowledge, and beliefs as a teacher.	0%	8%	10%	22%	60%	3.34
e. are consistent with the work you do in the classroom.	2%	6%	12%	42%	36%	3.06
f. were consistent across the program, meaning activities were part of an integrated program of teacher learning with activities related to each other.	0%	4%	24%	42%	28%	2.96
g. were discussed with administrators or other teachers at your school or district who did not participate in the program.	4%	18%	32%	30%	16%	2.36
h. were discussed outside of scheduled program meetings with LAMSTI participants that do not teach at your school.	6%	24%	24%	28%	18%	2.28

6) Are other teachers from your school participating in the LAMSTI program?

( ) Yes

( ) No

7) Are other teachers from your district participating in the LAMSTI program?

( ) Yes

( ) No

8) Are there other teachers who teach the same content as you participating in LAMSTI?

( ) Yes

( ) No

9) In which year did you enter the LAMSTI program?

( ) 2007

( ) 2008

( ) 2009

( ) 2010

( ) 2011

10) Indicate the extent to which the LAMSTI program activities enhanced your knowledge and skills in the following areas:

N=50	not at all	very little	some what	to a considerable extent	to a great extent	Item Mean
a. Curriculum (e.g., units, texts, standards)	4%	10%	28%	30%	28%	2.68
b. Instructional methods	4%	4%	28%	40%	24%	2.76
c. Approaches to assessment	6%	4%	38%	36%	14%	2.49
d. Use of resources (e.g., technology, printed material, equipment, manipulatives)	4%	8%	30%	30%	28%	2.70
e. Deepening knowledge of your content area	2%	2%	12%	24%	60%	3.38

11) Indicate the extent to which you have made changes in your teaching practice in each of the following areas as a result of the LAMSTI program activities:

N=50	no change	minor change	moderate change	major change	Item Mean
a. the content taught	10%	24%	50%	14%	1.69
b. the level of meaningful thinking required in content-related classroom activities	2%	14%	46%	36%	2.18
c. the instructional methods employed	4%	18%	44%	32%	2.06
d. the types or mix of assessments used to evaluate students	4%	18%	56%	20%	1.94
e. the way resources (e.g. technology, equipment, manipulatives) are used in instruction	10%	22%	42%	24%	1.82

Thank You!

Thank you for taking our survey. Your response is very important to us.

Application for Exemption from Institutional Oversight

Institutional Review Board
Dr. Robert Mathews, Chair
131 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.6792
irb@lsu.edu
lsu.edu/irb

Unless qualified as meeting the specific criteria for exemption from Institutional Review Board (IRB) oversight, ALL LSU research/ projects using living humans as subjects, or samples, or data obtained from humans, directly or indirectly, with or without their consent, must be approved or exempted in advance by the LSU IRB. This Form helps the PI determine if a project may be exempted, and is used to request an exemption.

– Applicant,Please fill out the application in its entirety and include the completed application as well as parts A-E, listed below, when submitting to the IRB. Once the application is completed, please submit two copies of the completed application to the IRB Office or to a member of the Human Subjects Screening Committee. Members of this committee can be found at

– A Complete Application Includes All of the Following:
(A) Two copies of this completed form and two copies of part B thru E.
(B) A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1&2)
(C) Copies of all instruments to be used.
*If this proposal is part of a grant proposal, include a copy of the proposal and all recruitment material.
(D) The consent form that you will use in the study (see part 3 for more information.)
(E) Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing or handling data, unless already on file with the IRB. Training link: ( )
(F) IRB Security of Data Agreement: ( )

1) Principal Investigator: Tiah B. Alphonso **Rank:** Doctoral Student

Dept: ETPP **Ph:** 225-241-4995 **E-mail:** talpho3@lsu.edu

2) Co Investigator(s): please include department, rank, phone and e-mail for each

S. Kim MacGregor, Associate Professor, ETPP, 225-578-2150, smacgre@lsu.edu

IRB# E5434 LSU Proposal #_____

(X) Complete Application

(Y) Human Subjects Training

3) Project Title: ELRC 7220 Program Evaluation: Math Teacher Professional Development

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 3-20-2014

4) Proposal? (yes or no) no **If Yes, LSU Proposal Number**

Also, if YES, either ◯ **This application completely matches the scope of work in the grant**

OR ◯ **More IRB Applications will be filed later**

5) Subject pool (e.g. Psychology students) Program director, program instructors, program participants

*Circle any **"vulnerable populations" to be used:** (children <18; the mentally impaired, pregnant women, the ages, other). Projects with incarcerated persons cannot be exempted.

6) PI Signature Tiah B. Alphonso **Date** 3/17/2011 (no per signatures)

**** I certify my responses are accurate and complete.** If the project scope or design is later changes, I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at LSU for three years after completion of the study. If I leave LSU before that time the consent forms should be preserved in the Departmental Office.

Screening Committee Action: Exempted X Not Exempted _____ Category/Paragraph _____

Reviewer S. Kim MacGregor **Signature** S. Kim MacGregor **Date** 3/21/11
Reg

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 I www.lsu.edu/irb
Exemption Expires: 3-20-2014

Consent Form

1. Study Title: Evaluation of a Master's Degree Program in Mathematics for Teachers

2. Performance Site: Louisiana State University and Agricultural and Mechanical College

3. Investigators: The following investigators are available for questions about this study:

   Tiah Alphonso 241-4995 (M-F, 1:00 p.m. - 5:00p.m.)

4. Purpose of the Study: The purpose of this evaluation project is to answer evaluation questions regarding the implementation of the program during the summer of 2010 and associated outcomes.

5. Subject Inclusion: Participants of the program's 2010 cohort.

6. Number of subjects: 13

7. Study Procedures: The study will be conducted in three phases. In the first phase, all program participants will spend approximately 10-15 minutes completing a computer-based survey including questions regarding their attitudes and opinions about activities experienced in the courses taken in the program during the summer of 2010. Next, documents such as lesson plans and logs will be collected to uncover any evidence of their experiences in the program transferring to their classroom practice. The final phase will consist of 15-20 minute interviews with participants. Interview questions will be determined by responses to the survey and analysis of documents.

8. Benefits: The data subjects contribute in the study will be analyzed and may yield valuable information which can be used to make improvements to the program.

9. Risks: The only study risk is the inadvertent release of information contributed. However, every effort will be made to maintain the confidentiality of your study records. Files will be kept in a secure location to which only the investigator has access.

10. Right to Refuse: Subjects may choose not to participate or to withdraw from the study at any time without penalty or loss of any benefit to which they might otherwise be entitled.

11. Privacy: Results of the study may be published, but no names or identifying information will be included in the publication. Subject identity will remain confidential unless disclosure is required by law.

12. Signatures:

    The study has been discussed with me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigators. If I have questions about subjects' rights or other concerns, I can contact Robert C. Mathews, Institutional Review Board,(225) 578-8692, irb@lsu.edu, www.lsu.edu/irb. I agree to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

Subject Signature:_____ Date:_____

Application for Exemption from Institutional Oversight

Institutional Review Board
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Unless qualified as meeting the specific criteria for exemption from Institutional Review Board (IRB) oversight, ALL LSU research/ projects using living humans as subjects, or samples, or data obtained from humans, directly or indirectly, with or without their consent, must be approved or exempted in advance by the LSU IRB. This Form helps the PI determine if a project may be exempted, and is used to request an exemption.

-- Applicant,Please fill out the application in its entirety and include the completed application as well as parts A-E, listed below, when submitting to the IRB. Once the application is completed, please submit two copies of the completed application to the IRB Office or to a member of the Human Subjects Screening Committee. Members of this committee can be found at http://www.lsu.edu/screeningmembers.shtml

-- A Complete Application Includes All of the Following:
(A) Two copies of this completed form and two copies of part B thru E.
(B) A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1&2)
(C) Copies of all instruments to be used.
*If this proposal is part of a grant proposal, include a copy of the proposal and all recruitment material.
(D) The consent form that you will use in the study (see part 3 for more information.)
(E) Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing or handling data, unless already on file with the IRB. Training link: (http://phrp.nihtraining.com/users/login.php.)
(F) IRB Security of Data Agreement: (http://www.lsu.edu/irb/IRB%205ecurity%20of%20Data.pdf)

1) Principal Investigator: Tiah Alphonso **Rank:** Doctoral Student

Dept: ETPP **Ph:** 225-241-4995 **E-mail:** tiah.alphonso@gmail.com

2) Co Investigator(s): please include department, rank, phone and e-mail for each

N/A

IRB# E5705 LSU Proposal #

Complete Application

Human Subjects Training

3) Project Title: Program Evaluation of A Mathematics Teacher Professional Development

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 10-17-2014

4) Proposal? (yes or no) No **If Yes, LSU Proposal Number**

Also, if YES, either ◯ **This application completely matches the scope of work in the grant**

OR ◯ **More IRB Applications will be filed later**

5) Subject pool (e.g. Psychology students) Program director, program instructors, and program participants

*Circle any **"vulnerable populations" to be used:** (children <18; the mentally impaired, pregnant women, the ages, other). Projects with incarcerated persons cannot be exempted.

6) PI Signature Tiah Alphonso **Date** 10/10/2011 (no per signatures)

**** I certify my responses are accurate and complete.** If the project scope or design is later changes, I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at LSU for three years after completion of the study. If I leave LSU before that time the consent forms should be preserved in the Departmental Office.

Screening Committee Action: Exempted ✓ Not Exempted ____ Category/Paragraph 1

Reviewer Mathews **Signature** Robert C. Mathews **Date** 10/18/11

Consent Form

1. Study Title: Evaluation of a Master's Degree Program in Mathematics for Teachers

2. Performance Site: Louisiana State University and Agricultural and Mechanical College

3. Investigators: The following investigators are available for questions about this study:

   Tiah Alphonso 241-4995 (M-F, 1:00 p.m. - 5:00p.m.)

4. Purpose of the Study: The purpose of this evaluation project is to answer evaluation questions regarding the implementation of the LAMSTI program and associated outcomes to inform program planners and to add to the general research knowledge in this area.

5. Subject Inclusion: Current and former participants of the LAMSTI program

6. Number of subjects: 60

7. Study Procedures: The study will be conducted in three phases. In the first phase, all program participants will spend approximately 10-15 minutes completing a computer-based survey including questions regarding their perceptions about activities experienced in the courses of the program. Next, a sample of participants will be selected for 15-20 minute interviews regarding the forces which exist in the classroom affecting their instruction. The final phase will consist of a second survey sent to all participants which will be developed from the interviews in phase two and relate to teachers' perceptions of the forces which affect classroom instruction.

8. Benefits: The data subjects contribute in the study will be analyzed and may yield valuable information which can be used to make improvements to the program.

9. Risks: The only study risk is the inadvertent release of information contributed. However, every effort will be made to maintain the confidentiality of your study records. Files will be kept in a secure location to which only the investigator has access.

10. Right to Refuse: Subjects may choose not to participate or to withdraw from the study at any time without penalty or loss of any benefit to which they might otherwise be entitled.

11. Privacy: Results of the study may be published, but no names or identifying information will be included in the publication. Subject identity will remain confidential unless disclosure is required by law.

12. Signatures:

    The study has been discussed with me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigators. If I have questions about subjects' rights or other concerns, I can contact Robert C. Mathews, Institutional Review Board,(225) 578-8692, irb@lsu.edu, www.lsu.edu/irb. I agree to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

Subject Signature:_____ Date:_____

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
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Exemption Expires: 10-17-2014

Vita

Tiah Alphonso was born in 1973 in Baton Rouge, Louisiana. She finished her undergraduate degree in chemistry and mathematics education from Southeastern Louisiana University in May 1995. She is currently serving as the instructional coach at Walker High School in Livingston Parish but has taught mathematics in various schools in the district for the past twelve years. Teaching positions at both middle and high schools have afforded her the opportunity to teach every grade level from sixth grade mathematics to calculus. Ms. Alphonso achieved National Board Certification in Early Adolescence Mathematics in 2006. She is currently a candidate for the degree of Master of Natural Sciences through the Louisiana Math and Science Teacher Institute (LAMSTI) at LSU, which will be awarded in August 2012. She is also expecting to complete her doctorate at LSU in the spring of 2013 in Educational Leadership and Research with a specialization in applied research, measurement, and evaluation.