A Summary of Mathematics Professional Development Models Used in the State of Texas

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# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>COGNITIVELY GUIDED INSTRUCTION</strong></td>
<td>4</td>
</tr>
<tr>
<td>Overview</td>
<td>4</td>
</tr>
<tr>
<td>Analysis</td>
<td>8</td>
</tr>
<tr>
<td><strong>CONNECTED MATHEMATICS PROJECT</strong></td>
<td>13</td>
</tr>
<tr>
<td>Overview</td>
<td>13</td>
</tr>
<tr>
<td>Analysis</td>
<td>13</td>
</tr>
<tr>
<td><strong>EVERYDAY MATH</strong></td>
<td>17</td>
</tr>
<tr>
<td>Overview</td>
<td>17</td>
</tr>
<tr>
<td>Analysis</td>
<td>18</td>
</tr>
<tr>
<td><strong>FAMILY MATH (EQUALS)</strong></td>
<td>27</td>
</tr>
<tr>
<td>Overview</td>
<td>27</td>
</tr>
<tr>
<td>Analysis</td>
<td>28</td>
</tr>
<tr>
<td><strong>FIGURE THIS! MATH CHALLENGES FOR FAMILIES</strong></td>
<td>31</td>
</tr>
<tr>
<td>Overview</td>
<td>31</td>
</tr>
<tr>
<td>Analysis</td>
<td>32</td>
</tr>
<tr>
<td><strong>INVESTIGATIONS</strong></td>
<td>35</td>
</tr>
<tr>
<td>Overview</td>
<td>35</td>
</tr>
<tr>
<td>Analysis</td>
<td>36</td>
</tr>
<tr>
<td><strong>MATHCOUNTS</strong></td>
<td>41</td>
</tr>
<tr>
<td>Overview</td>
<td>41</td>
</tr>
<tr>
<td>Analysis</td>
<td>41</td>
</tr>
<tr>
<td><strong>MATHWORKS</strong></td>
<td>44</td>
</tr>
<tr>
<td>Overview</td>
<td>44</td>
</tr>
<tr>
<td>Analysis</td>
<td>46</td>
</tr>
<tr>
<td>Topic</td>
<td>Page</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>NCTM NAVIGATIONS</td>
<td>50</td>
</tr>
<tr>
<td>Overview</td>
<td>50</td>
</tr>
<tr>
<td>Analysis</td>
<td>50</td>
</tr>
<tr>
<td>SHARON WELLS</td>
<td>53</td>
</tr>
<tr>
<td>Overview</td>
<td>53</td>
</tr>
<tr>
<td>Analysis</td>
<td>54</td>
</tr>
<tr>
<td>SHELTERED INSTRUCTION (SIOP)</td>
<td>57</td>
</tr>
<tr>
<td>Overview</td>
<td>57</td>
</tr>
<tr>
<td>Analysis</td>
<td>58</td>
</tr>
<tr>
<td>TEXTEAMS</td>
<td>61</td>
</tr>
<tr>
<td>Overview</td>
<td>61</td>
</tr>
<tr>
<td>Analysis</td>
<td>61</td>
</tr>
</tbody>
</table>
A Summary of Mathematics Professional Development Models Used in The State of Texas

Introduction

Reports and research continues to advocate the need for more on-going teacher professional development in the area of mathematics. This induces the more difficult next step in determining what constitutes effective professional development. In solving this problem, a prudent first step would be to analyze and evaluate what professional development models are already in existence and the extent that their use actually shows improved student understanding of standardized mathematical content.

This report takes the first step in this monumental initiative. It identifies twelve models that are being used for teacher professional development in the area of mathematics in the state of Texas. Each model was summarized in a consistent fashion to facilitate a comparison between the various models. The summaries include two main sections: an Overview and an Analysis.

The Overview section provides just the facts about each model. This section can be used to compare the various models' origin, developer or administrator, and dates when the model started being used. It also includes information about how each model is implemented as well as what instigated the original need for the model. The section ends with a brief summary of the guiding philosophy for the model.

The Analysis section for each model goes much further in-depth. There are five major subsections for each analysis, including: Introduction, Details, Specific Applications to ELL, Model Assessment, and Commentary. The Introduction subsection presents each model in a more comprehensive and continuous fashion than is found in the Overview section.

The Details subsection of each analysis is broken down into curriculum and content, pedagogy, and administration. The style and aim of the curriculum and the specific content advocated by the model is outlined under curriculum and content. Whenever possible, information regarding the strengths and weaknesses of the content is also provided. Details about how the teachers are trained as well as unique aspects of the training are presented under Pedagogy. Finally implementation costs and concerns relevant to administrators complete the Details subsection.
Following the Details subsection is the subsection related to the model’s applicability for teachers who teach linguistically diverse classes. Language components of the model are discussed as well as the model’s suitability in addressing social and interpersonal characteristics of English Language Learners (ELL). This subsection also summarizes the language delivery techniques advocated by the model—techniques such as two or one-way bilingual, English as a second language, or immersion, as examples. Information about assessment strategies for ELL is also presented, if available in the model.

The fourth major section of the Analysis summarizes the available information regarding the effectiveness of using each professional development model. As a rule, priority was given to quantitative and qualitative research, however, when such research was not available, less rigorous public commentary was included in the Assessment subsection.

The final subsection of the Analysis section provides opinions and commentary from the Texas State faculty researchers. The section puts forth subjective yet educated concerns. Each concern may be unfounded in light of information as yet uncovered, but each is suggested as a point to consider. In contrast each researcher also presents perceived strengths of the professional development model.

As the degree of development for each model varies widely, so does the depth of each analysis. Some models are in widespread use and have been for years, while others are newly developed or have a smaller scope. The authors of this report have tried to create a cross-section of each model for the purpose of comparison. The hope is that this report will be a next step in the initiative to improve mathematics content knowledge across grade levels, and in particular, for English Language Learners.
Cognitively Guided Instruction

Overview

Origination
The research-based approach was developed by faculty at the Wisconsin Center for Education Research, University of Wisconsin-Madison. Originally developed and tested in Madison, WI and the surrounding area, this program has been replicated in many parts of the United States.

Administration
Some of the development team included education researchers Thomas Carpenter, Elizabeth Fennema, and Penelope Peterson. Contact information may be obtained from Linda Levi at University of Wisconsin in the Center for Education Research. The address is 1025 West Johnson Street, Madison, WI 53706 or e-mail: llevi@factstaff.wisc.edu.

Induction
Cognitively Guided Instruction evolved over a period of years. It seems to have been crystallized in 1996 as a method to help teachers construct conceptual maps of the development of children’s thinking in specific content domains (See Carpenter, Fennema and Franke, 1996). The Cognitively Guided Instruction (GCI) Professional Development Program (Carpenter, Fennema, Franke, Levi & Empson) was established in 1999.

Implementation
Cognitively Guided Instruction (CGI) is a professional development program for teachers that explicitly shows what kind of knowledge students bring to the math learning process and how they connect that knowledge with formal concepts and operations. This one-week institute on how children learn mathematics was designed for teachers of students in grades K-3. The CGI approach focuses on student knowledge and encourages teachers to pose story problems that can be solved by any means chosen by the child. Problem-posing and problem-solving become the foci of the mathematics class, rather than the traditional emphasis on recall of number facts and memorization of algorithms. Cognitively guided instruction is a problem-solving mathematics program for students in kindergarten through third grade. This strategy is not textbook specific and has been proven effective for boys and girls of diverse social class, racial and ethnic, and language proficiency backgrounds.

Instigation
The (CGI) Professional Development Program is associated with the National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA) at the University of Wisconsin. Charged by the U.S. Department of Education in 1995 to build a solid research base about ways instruction can be improved, Center researchers have worked with teachers and diverse student populations to develop new mathematics and science learning environments and professional development models. They investigated:

- student reasoning
- mathematics and science instruction
- student assessment
• teacher professional development and "travel" to new school sites
• school features that support learning and achievement

The Center’s work has yielded classroom-based findings about effective instruction and new professional development models for sustained student learning and achievement in mathematics and science. The Center’s research and professional development work has built on more than two decades of studies conducted by researchers affiliated with several institutions, including: Wisconsin Center for Education Research (mid-1960’s to 2004), National Center for Research in Mathematical Sciences Education (NCRMSE) (1987-1995), National Science Standards Project (1991-1995) and other Collaborating Institutions.

**Philosophy**

Participants explore the principles and methods of Cognitively Guided Instruction (CGI) and enhance their understanding of mathematics content. CGI is an approach to teaching mathematics in which children’s knowledge is central to instructional decision making. Teachers use research-based knowledge about children’s mathematical thinking to help them learn specifics about individual students learning and processing styles. Participants will spend time learning how children think about mathematics and how they solve authentic and interesting problems. Follow-up is available through an on-line course and additional advanced training to assist in implementing CGI principles in the classroom.

Cognitively Guided Instruction (CGI) is a professional development program for teachers which focuses on what kind of knowledge students bring to the math learning process and how they connect that knowledge with formal concepts and operations. Developed by education researchers Thomas Carpenter, Elizabeth Fennema, and Penelope Peterson, CGI is guided by two major theses. The first thesis is that children bring an intuitive knowledge of mathematics to school with them and that this knowledge should serve as the basis for developing the formal mathematics instruction in primary school. This thesis leads to an emphasis on assessing the processes that students use to solve problems. The second thesis is that math instruction should be based on the relationship between skills and problem solving. This thesis leads to an emphasis on problem solving in the classroom versus the repetition of number facts and/or desk work.

CGI provides a basis for identifying what is difficult and what is easy for students to comprehend in their study of math. It also provides a way for dealing with the common errors students make while learning. The emphasis is on what children can do, rather than what they cannot do, which leads to a very different approach regarding wrong answers. With the CGI approach, teachers work backward from the error to identify the valid concepts that students do understand. The program aims to improve children’s mathematical skills by changing teachers’ beliefs regarding how children learn, and ultimately their teaching practices.

The following describes the conceptual framework within which CGI is designed.

Effective professional development does not just “happen.” In order to create high quality professional development programs, designers must understand the needs of their target audience; know what research and the wisdom of practice have to offer; address multiple goals within the constraints of limited resources and the realities of specific contexts; implement activities consistent with their goals; and continually
monitor and fine tune the program to best address their professional development goals. The purpose of this "conceptual framework," outlined below, is to establish a context for professional development designers to use in selecting materials from the TE-MAT database.

Understanding the Needs of the Target Audience

Deciding on the Purposes of the Professional Development

2.1. Deepening Teachers' Content Knowledge
2.2. Understanding Student Thinking and How Students Learn
2.3. Selecting Appropriate Instructional Materials
2.4. Using Appropriate Instruction to Promote Learning for All Students
2.5. Assessing Student Performance

Building on Current Knowledge about Professional Development

Adapting Professional Development Programs to the Particular Context

Selecting Appropriate Professional Development Strategies and Materials

5.1. Examining Classroom Practice
5.2. Immersing Teachers in Inquiry
5.3. Presenting Information to Teachers
5.4. Curriculum Implementation

Preparing Professional Development Providers

Implementing Effective Professional Development

Evaluating the Quality and Impact of Professional Development

References

Weaving together all of these components, while keeping the purposes of the professional development always at the forefront of decision making, is a complex task. We encourage you to explore each of the elements of an effective professional development program represented in the framework outline, to consult materials that are highlighted within this framework, and to search the database for other materials that will be useful to you in designing and implementing high quality professional development programs. Materials cited in the conceptual framework that have been reviewed by TE-MAT are linked to their reviews.

*Designing Professional Development for Teachers of Science and Mathematics* (Loucks-Horsley, et al., 1998) addresses these issues directly. In addition to providing a "design framework to assist professional development in combining strategies uniquely tailored for their contexts and their particular goals in improving science and mathematics teaching and learning" (p. xiii), this book illustrates "the design process in action" by describing the decision-making steps of several different professional development programs. Similarly, an essay prepared by Judith Fonzi
describes the thinking that went into the design (and redesign) of a professional development program for middle school mathematics teachers.

The monograph, *Professional Development that Supports School Mathematics Reform*, prepared by Borasi and Fonzi (2002), further illuminates the design process, identifying a series of "teacher learning needs" and describing a number of professional development programs designed to address those needs. While these particular publications focus on professional development for in-service teachers, many of the design principles are applicable to pre-service programs as well.

In addition, a number of people who have been involved in the development of the TE-MAT database have shared some of their ideas about the professional development of mathematics and science teachers in a series of essays.

We include here #6 and #7 from this outline.

6. Preparing Professional Development Providers

Part of the design process includes considering who will be implementing the professional development and making sure there is a good match between their knowledge/skills and the roles they will be assigned. While the core staff designing a professional development program may have sufficient knowledge of science and/or mathematics content and pedagogy to implement most of the program activities, they may be too few in number to provide in-depth professional development to the entire target population.

Program designers need to include in their plan mechanisms for orienting other professional development providers to the program vision, helping them gain the necessary knowledge and skills, and monitoring professional development activities to ensure high quality throughout the program. For example, *The Role of Scientists in the Professional Development of Science Teachers* (National Research Council, 1996) suggests ways to orient university faculty and industry scientists to the complexities of teaching at the K-12 level. As another example, *Teach-Stat for Statistics Educators: Staff Development Manual* (UNC Mathematics & Science Education Network, 1996) provides a guide for training skilled elementary mathematics teachers to conduct Teach-Stat workshops for other teachers. Similarly, *Teacher Leadership in Mathematics and Science* (Miller, Moon and Elko, 2000) provides a casebook and facilitator’s guide for working with prospective teacher leaders. An essay by Cathy Caroll and Judy Mumme and an essay by James Gallagher describe the challenges involved in preparing teacher leaders to work with their peers. Other professional development programs have compensated for the scarcity of fully prepared professional development providers by creating teams of people with complementary expertise, e.g., pairing a mathematician or scientist with a teacher leader in working with a group of teachers.

7. Implementing Effective Professional Development

Effective professional development depends on a sound design that takes into account the needs of the target audience and incorporates strategies and materials appropriate for achieving a particular set of purposes. However, while a sound design is essential, it does not guarantee a successful professional development program. Professional development providers need to be able to take the plan and implement
it well, which includes emphasizing the key concepts being targeted; asking the "right" questions to check for teachers' understanding; creating a culture where teachers are able to take intellectual risks; and adjusting the pace of the professional development sessions to make sure that teachers' needs and concerns are being addressed. There are also a myriad of logistical issues that need to be handled smoothly so teachers are able to concentrate on the tasks at hand, including ensuring a clean and comfortable environment.

Some of the materials in the TE-MAT database that were specifically designed for professional development include extensive guidance to help the professional development provider be more effective in implementation. These include the *Guide to Facilitating Cases* (Miller and Kantrov, 1998) and *Number and Operations, Part 1 & Part 2* (Schifter et.al., 1997).

Several of the essays described on the TE-MAT essays page provide practical advice about designing, implementing, and redesigning professional development programs. For example, an essay by Judith Fonzi describes how a professional development program for mathematics teachers was initially designed and implemented, and how and why it was revised.

**Analysis**

**Introduction**

Cognitively Guided Instruction (CGI) is a professional development program for teachers that explicitly shows what kind of knowledge students bring to the math learning process and how they connect that knowledge with formal concepts and operations. This one-week institute on how children learn mathematics was designed for teachers of students in grades K-3. The CGI approach focuses on student knowledge and encourages teachers to pose story problems that can be solved by any means chosen by the child. Problem-posing and problem-solving become the foci of the mathematics class, rather than the traditional emphasis on recall of number facts and memorization of algorithms. Cognitively guided instruction is a problem-solving mathematics program for students in kindergarten through third grade. This strategy is not textbook specific and has been proven effective for boys and girls of diverse social class, racial and ethnic, and language proficiency backgrounds.

**Details**

**Curriculum & Content**

The CGI program is designed for professional development and is not based on any particular classroom curriculum. The training is based on the premise that teachers' knowledge of student thinking is a cornerstone of professional development. Attention is focused on ways that teachers examine “student thinking about important mathematics and science ideas, and how their observations about student thinking enhance their classroom instruction and strengthened students' learning.”

**Pedagogy**

CGI has identified the following as guides to improving teacher performance:

- teaching for understanding involves a significant reorientation of teacher beliefs and the acquisition of new forms of pedagogical and content knowledge.
to be productive, teachers’ investigations of student thinking needs to be anchored in their own deepening understanding of powerful ideas in mathematics and science.

when teachers commit to understanding student thinking, their classroom practices change and significant improvements in student achievement result.

teacher inquiry into student thinking can become a generative, ongoing activity that sustains teachers’ long-term professional development.

traditional efforts to help teachers develop as professionals, such as one-shot workshops, are inadequate and contradict what is known about human learning.

teachers’ inquiry does not survive well in isolation.

teacher professional communities are critical to sustaining and generating teacher professional development, for many of the same reasons that mathematicians and scientists conduct their work within larger communities of inquiry.

Another key focus of CGI is that the creation of teacher communities to support inquiry and sustained professional development vary widely and must include substantial collaboration between teachers and administrators. Restructuring is necessary to “provide teachers the necessary resources to conduct practical inquiry in their classrooms and to share the results of their learning with their colleagues and community.”

In the CGI model, the following is a list of key components of school structures that support teacher change and long term reform:

- Resources provided by district and school administrations are essential for the long-term sustainability of teaching reforms. Essential resources include release time for teacher collaboration, material supports, such as curriculum and technological tools, and a work environment that supports teacher decision-making.

- Schools and districts enhance their capacity for reform if they promote teacher leadership, administrative roles recast as facilitators rather than managers, changes in the allocation of time during the school day, materials to implement new teaching practices and resources modified to fit new teaching endeavor.

- When schools and districts allow new roles to emerge, they foster new human and social resources. Schools and districts that force new initiatives to conform to existing arrays of resources, however, risk stifling potential change.

- Even relatively small infusions of resources, when used productively, can support significant change. Conversely, even substantial commitments of resources, if used inappropriately, can fail to support change.

Finally, the CGI model assumes the burden of implementation of the changes identified requires more time on the part of teachers. Therefore, there is a need to reduce other aspects of teacher obligations to support their full participation in the leadership and decision making process required.

**Administration**

The National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA) at the University of Wisconsin continues to be the center of implementation of the CGI model. However, there are several organizations around the nation that offer training using the methodology of Cognitively Guided Instruction. For example, an elementary school in Austin, Texas had a one-day introduction training from experts from the University of Texas for
teachers. The following summer, one teacher was sent to Wisconsin for a 3-day workshop.

There now seems to be a variety of other sources for training in the CGI model. For example, the Educational Services and Staff Development Association of Central Kansas (ESSDACK) is based in Hutchinson, Kansas and is an organization designed to provide additional learning resources to the students and educators of the member districts of ESSDACK. They offer a variety of services and support to member districts and other educators in their area. The program is based on the CGI model.

As a typical regional model, we will list the advertised prices and offerings for their training programs.

Specialist Service Pricing - 2004–2005 -

1. ESSDACK Members - Presentation/Curriculum Services
   - 1 Specialist - half day $300
   - 1 Specialist - full day $500
   - 2 Specialists - half day $500
   - 2 Specialists - full day $900
   - Consulting Services $50 per hour. Consulting is defined as non-presentation activity and will be billed with prep time and travel time one way.
   - Expenses such as travel, lodging, food, etc. will be added to presentations and consulting.

2. Non-ESSDACK Members - Presentation/Curriculum Services
   - 1 Specialist - half day $600
   - 1 Specialist - full day $1000
   - 2 Specialists - half day $1000
   - 2 Specialists - full day $1800
   - Consulting Services $100 per hour. Consulting is defined as non-presentation activity and will be billed with prep time and travel time one way.
   - Expenses such as travel, lodging, food, etc. will be added to presentations and consulting. Out of State Presentations/Consulting $1500 per day.

Specific Applications to ELL

Language Components & Delivery
We surveyed the research and results of projects on the website of the Wisconsin Center for Educational Research (WCER) and its National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA). There is a large body of work on the English Language Learner and the implications for the classroom with such diversity. However, there was very little focusing on mathematics or special implications of general issues for the math classroom.

Model Assessment
CGI has been evaluated extensively. The following is an analysis found at According to Promising Practices Network at http://www.promisingpractices.net.

In 1989, Carpenter et al. studied 40 first-grade teachers, half of whom were randomly assigned to the CGI program. The CGI teachers participated in a four-week summer workshop. The teachers and their students were then observed during the
school year. Measures, such as the teacher belief instrument, were developed to assess the teachers’ knowledge of their students thinking and performance, which was then matched with actual performance. The students were evaluated using the Iowa Test of Basic Skills with a pretest in September and posttests in April/May.

In another study (1993) at a large Midwestern urban school district, CGI was examined by Villaseñor and Kepner.

Two first-grade teachers were voluntarily recruited from schools where there was at least a 50 percent minority population, resulting in a total of 12 treatment classrooms. Comparison classrooms were selected to match the treatment classrooms. The CGI teachers went through a 19-hour summer workshop, a two-hour review in September, and two support sessions. The primary measure was a 14-item arithmetic word-problem test designed by Carpenter et al. (1989), which was given in early October and then given again as a posttest in late February/early March. The results reflect the performance of 12 students randomly chosen from each class (six boys and six girls), for a total of 144 students in the CGI group and 144 in the control group.

In the report at According to Promising Practices Network, several key issues were identified.

This program received a “promising” rating. Although the two evaluations showed significant gains in some measures, there are some areas of concern:

1. First, there were no significant differences between the control and treatment groups on the Iowa Test of Basic Skills in the first evaluation. Rather, the researchers found significant differences between control and treatment students only when looking at student performance on smaller subgroups of test problems. CGI students scored significantly higher on problems identified as number-facts problems or complex addition/subtraction problems, but not on simple addition/subtraction or advanced problems. This finding is of some concern because the Iowa Test of Basic Skills is the only assessment used in the evaluations that was not developed by the program’s designers.

2. Second, the evaluations concentrated on measuring the change in teachers’ beliefs and behavior. While the evaluations provided significant evidence that the CGI program was successful at changing teachers’ beliefs and that this change in beliefs then changed their teaching methods in the classroom, it did not necessarily translate into improved student outcomes.

3. Finally, although the Villasenor and Kepner (1993) study measured outcomes for 288 students, only two teachers were part of the treatment and those teachers volunteered for the program rather than being randomly selected.

At least one evaluation suggested a cumulative effect on student performance. A study by Fennema et al. (1996) followed 21 primary grade teachers over a four-year period. The researchers also assessed children's problem-solving abilities, conceptual understanding, and computation skills using project-constructed tests over the four-year study period. Students showed increasingly greater gains the longer they were in CGI classes. This implies that CGI may be most effective when adopted by all primary teachers in a particular school.
Finally, the evaluations also suggest that successful implementation of CGI requires a substantial amount of training and supervision. The success of the first two pilot studies was linked to intensive involvement with staff developers, who were often the original researchers. While there have been several attempts at scaling-up CGI, none of those efforts has included systematic evaluations of the effectiveness of the program in terms of the children's math performance.

Commentary

An interview was conducted with the principal (Central Texas) from an elementary school. The following is a synopsis of the observations and evaluation of the CGI model used by their school.

The training of the teachers began with a one-day workshop given by a consultant from an area university. The training consisted of studying a book on cognitively guided instruction that had contributions from a number of members of the Wisconsin team from NCISLA. The workshop focused on strategies of instruction, which included listening to how children solve problems. The principal said these were based in meta-cognition and embodied a constructivist viewpoint. The following summer, one teacher was sent to Wisconsin for a three-day training. Upon their return, they worked with the other teachers to disseminate their learning. This sharing was judged as very effective by the principal.

The principal was asked for an evaluation of the strengths and weaknesses in the model. The strength was that the teachers developed strategies and a common language to talk about what they wanted to strive for in the classroom. Especially helpful was seeing how to use individual, small group and whole group work to implement lesson design and to follow how students were making connections in their learning. The weakness of the program was the lack of an emphasis on the importance and need for practice for many of the students. However, the principal noted that the teamwork developed in building a common language for strategies has made modifying other aspects of the curriculum a natural part of the process.


## Connected Mathematics Project

### Overview

#### Origination

Connected Mathematics Project was developed at Michigan State University.

#### Administration

The authors include Glenda Lappan, James T. Fey, William F. Fitzgerald, Susan N. Friel, and Elizabeth D. Phillips. Currently CMP publisher is Prentice Hall.

#### Induction

The model started being used in 1997.

#### Implementation

There is a 63-page implementation guide written by the author’s of CMP. The guide gives an overview of the curriculum and materials, discusses teacher issues, discusses district issues, and outlines a recommended three-year implementation plan. It completes the model by giving a brief outline of effective professional development and advocates building a long-term professional-development plan.

#### Instigation

With the development of NCTM standards researchers at Michigan State University found a framework on which to build a model that would achieve the following overarching goal, that "all students should be able to reason and communicate proficiently in mathematics. They should have knowledge of and skill in the use of the vocabulary, forms of representation, materials, tools, techniques, and intellectual methods of the discipline of mathematics. This knowledge should include the ability to define and solve problems with reason, insight, inventiveness, and technical proficiency."

#### Philosophy

Experience and research suggests that effective professional development models have some common characteristics. To be effective, professional development: begins prior to curriculum implementation and continues for at least the first three years of implementation; is centered on the standards-based mathematics curriculum that will be/has been adopted; develops teachers' knowledge of mathematics and pedagogy; models and reflects good mathematical pedagogy; addresses teacher concerns about change; involves teachers in reflecting and planning for improvement; creates strong leadership; includes a plan for training new teachers as they join the district; reflects strong support from administration and parents; and establishes a "community of learners" among teachers.

### Analysis

#### Introduction

Connected Mathematics Project (CMP) is primarily a curriculum developed by Glenda Lappan and others at Michigan State University. The project received funding from the National Science Foundation starting in 1991 and ending in 1997. The material developed in the project was licensed and published by Prentice Hall. The curriculum is still evolving with updated versions in the works. The authors, publisher, and
affiliates are creating new components, and national workshops and conventions are regularly offered at increasing frequency.

There are several professional development options available for implementing the curriculum as well as for long-term professional development. One option is for an individual school or district to develop its own model. This was done with the Austin Collaborative for Mathematics Education initiative. The CMP website offers a philosophy on professional development with specific guides to implement the CMP curriculum. Another option involves private companies including affiliates of Prentice Hall that offer onsite professional development as well as internet-based courses and labs.

The professional development philosophy outlined on the CMP website starts discussing professional development apart from any particular curriculum. Following the philosophy, the website offers a professional development model of CMP. It shows how the curriculum can be implemented in accordance with the developed philosophy. Then expanding general ideas into specific details, the professional development component suggest specific activities to use during various professional development workshops.

The curriculum focuses on middle school grades 6th through 8th. It has components for teachers and parents to aid the student in learning the curriculum. According to Show-Me Project, the CMP curriculum has been implemented in middle schools in about 2,500 school districts across all 50 states.

Details

Curriculum & Content
The curriculum is standards-based, meaning it was developed around a set of standards. In this case, those were the 1989 National Council of Mathematics Teachers Standards. However, the curriculum has been shown to comply with subsequent updates including the 2000 NCTM Standards.

The content is developed from five mathematical strands: number and operations, geometry, measurement, data analysis and probability, and algebra. There are independent sources that have analyzed how well CMP curriculum addresses the content in these stands.

According to a report from the University of Washington, the content is weak in number sense. There is little about multiplying and dividing fractions, as well as connections between forms of a number, whether it be fraction, decimal, or percent.

The learning style is discovery based as well-posed problems motivate students to create their own understanding of the math content. The title Connected Mathematics Project reflects the author team's interest in developing student knowledge of mathematics that is rich in connections — connections among the various topic strands of the subject, connections between mathematics and its applications in other disciplines, connections between the planned teaching/learning activities and the special aptitudes and interests of middle school students, and connections between the preparation developed by elementary school mathematics and the goals of secondary school mathematics.
Pedagogy
The main thrust of pedagogy, according to the model, is that good decisions and practice rely on deep understanding of the mathematics that is embedded in the problems. Curriculum and instruction are inextricably linked—the circumstances under which students learn affect what they learn. Teaching, learning, and assessing are aligned with each other as integral parts of Connected Mathematics. To accomplish these goals, the development of CMP was guided by the following five fundamental mathematical and instructional themes: (1) CMP is organized around a selected number of important mathematical content and process goals, each of which is studied in depth; (2) CMP emphasizes significant connections, meaningful to students, among various mathematical topics and between mathematics and problems in other disciplines; (3) The instruction in CMP emphasizes inquiry and discovery of mathematical ideas through the investigation of rich problem situations; (4) CMP helps students grow in their ability to reason effectively with information represented in graphic, numeric, symbolic, and verbal forms and to move flexibly among these representations. (5) The goals and teaching approaches of CMP reflect the information-processing capabilities of calculators and computers and the fundamental changes such tools are making in the way people learn mathematics and apply their knowledge of problem solving.

Administration
The CMP is extensively used, well developed, researched, and cleverly advertised with much information that can be used to sway administrators either way in whether to adopt it or not. The cost of implementation is large and variable as the curriculum can be purchased with or without various means of professional development.

Specific Applications to ELL
Language Components & Delivery
A Spanish Student Edition is available for each unit, as well as Spanish ancillaries (Spanish versions of all assessment resources, lab-sheets, transparencies, additional resources, and additional practice) and a Spanish-English glossary of mathematical terms. The teacher’s guide is not available in Spanish.

Throughout the teachers guide there are “Tips for the Linguistically Diverse Classroom.” These tips rely on one of six techniques for delivering the content equally to ELL and English proficient students. The techniques are Original Rebus, Diagram Code, Chart Summary, Rebus Scenario, Enactment, and Visual Enhancement.

One part of a professional development workshop proposed in the model focuses on classroom management, in particular linguistically diverse classrooms. In this part of the workshop teachers are made aware of the six techniques and how they can be employed.

Learning Styles for ELL
As an extensive research based curriculum, there is much that can be analyzed in terms of ELL learning styles, however, there is nothing specifically mentioned in CMP’s literature.
Administration & Student Assessment
The model does not advocate a particular delivery method. Since the student materials are available in Spanish, an administrator could choose to delivery the content bilingually if teachers are capable, however, there are no guidelines on this type of implementation.

As a problem-based curriculum, the authors advocate standardized tests that measure problem-solving abilities as opposed to skill based standardized assessments. They make no suggestions as to the considerations that should be made for ELL students in terms of standardized testing procedures.

Model Assessment
In development, there was a research basis of 45,000 students, 160 teachers over 3-4 year period.

Plano ISD analyzed the effect of implementing CMP as its math curriculum. The district compared TAAS scores from 1998 before implementing CMP to TAAS scores in 2001 after implementing CMP during the 1999-2000 school year. Every demographic group showed positive gain with the greatest gain being for ELL and the least gain for students in the gifted and talented program.

Austin Collaborative for Mathematics Education also implemented CMP in AISD middle school classrooms. ACME’s research ranged from 1997 to 2002. Independent evaluators collected data on the effectiveness of CMP using TAAS scores. They also collected data on the effectiveness of the professional development program. The results are a mix of positive and negative criticisms.

Commentary
CMP is so complete that it might seem oppressive at first. The many details often seem to cloud an understanding of the purpose for each exploration. The placement of activities can seem out of the sequence of ideas. Following PD, however, teachers often feel confident about the activities they are leading.

The one-year of preparation before implementation is a very positive aspect of CMP that other models seem to lack. The amount of ongoing professional development seems to fit the bill that researchers advocate. The problems themselves seem interesting and exciting for middle-school students.

The CMP seems to have few if any significant areas of concern.
Everyday Math

Overview

Origination
Research-based curriculum developed by the University of Chicago School Mathematics Project (UCSMP) in 1983.

Administration
The research and development of curriculum was a collaboration between a UCSMP author team, mathematicians, education specialists, teachers-in-residence, and classroom teachers. The UCSMP author team consists of Max Bell, Director of 1st Edition, Jean Bell, John Bretzlauf, Amy Dillard, Robert Hartfield, Andy Isaacs, James McBride, Director of 2nd Edition, Kathleen Pitvorec, Peter Saecker, Robert Balfanz, William Carroll, Sheila Sconiers.

Induction
The curriculum development went through a three year cycle of one year of writing, a year of extensive field testing, and then a year of revising before final publication occurred. Developed one grade level at a time for all 7 grade levels (K-6) beginning with kindergarten (K) in 1983, the final publication for K was 1986. EDM is currently used in over 175,000 classrooms and 2.8 million students nationwide and a second edition was published in 2004. The teacher training accompanied the implementation that began in 1987.

Implementation
UCSMP utilizes their publisher, the Wright Group, a subsidiary of McGraw Hill, to provide professional development to accommodate EDM implementation. Some options include onsite professional development which customizes professional development for a particular district. The district can choose one-day or multiple days of professional development workshops or have sustained professional development workshops through a menu of workshops. Onsite follow-up support is also available with services including classroom observation to accompany and follow up on the workshops. Contracted workshops can be provided through EDM presenters, usually working with a maximum of 30 teachers. Fees include honorarium, travel, meals, lodging, and costs depend on the number of days, materials, and location. As an example, the fee for “Begin & Build-Teachers,” an onsite professional development workshop that lasts a six-hour day is $2100 for up to 30 teachers. Another onsite professional development workshop, “Differentiating Instruction-General Education 1” is $2400 for a six-hour day.

Another option is the online modules for which teachers can register and participate. A choice of National Module or own District Module can be used for the cost of $90 per person. Participants 1) access classroom video clips, audio segments, and dialogue with a consultant and EDM educators), 2) do in-class assignments, 3) interact for six weeks, and 4) complete 7-8 assignments.

EDM can be used with BRIDGES to Classroom Mathematics, a staff-development curriculum for elementary school teachers that supports teachers who are planning to implement innovative elementary mathematics curricula. In particular, the professional development is designed to emphasize the philosophy, purposes, and approaches of those curricula that are aligned with the NCTM Standards. The
BRIDGES curriculum provides complete presentation instructions and a set of print materials that can be used by the teachers. A menu allows districts/schools to choose specific content areas.

National user conferences for EDM are also provided throughout the year at a cost of $171 for each workshop.

Instigation
Findings from international tests and studies (Brown & Burton, 1978; Van Lehn 1983, 1986, Hiebert, 1984; Cobb 1985; Baroody & Ginsburg, 1986) indicated “our nation was failing to provide its students with an adequate mathematical education. The goal of this on-going project is to significantly improve the mathematics curriculum and instruction for all school children in the US.”

Philosophy
Increasing the mathematical knowledge and competence for today’s school population requires bold initiatives…UCSMP reflects these initiatives through an enriched curriculum for the elementary grades. EDM encourages teachers and students to explore more of the spectrum of mathematical ideas through a deeper understanding of key mathematical concepts and an in-depth study of all the strands of mathematics.

The curriculum allows students to construct an understanding of mathematics from their own experience, and includes practical routines to build arithmetic skills that are essential for building number sense, estimation skills, and flexibility in a problem-rich environment. Important concepts or skills recur with variations throughout the curriculum, and concepts are introduced and revisited in a variety of formats providing considerable practice each time.

The focus of EDM is to have students recognize that there are many ways to accomplish a task and to use the best tools and strategies for solving problems. This is done by establishing a framework for dialogue about mathematics between the teacher and students and among the students themselves, thereby helping students clarify and refine ideas and strategies in problem solving.

EDM respects the student’s ability and desire to learn. It provides a rich context and accommodates a variety of learning styles that help children make the gradual transition from intuition and concrete operations to abstractions and symbol processing skills.

The goal of the program is to establish high expectations for students and teachers. In particular, UCSMP’s key focus for teacher development was building teachers’ understanding of mathematics.

Analysis
Introduction
Everyday Math was developed by the University of Chicago School Mathematics Project (UCSMP). Beginning in 1983, a group of mathematicians, education specialists, teachers-in-residence, and classroom teachers began research on developing a curriculum for K-6 grade students that would “significantly improve the mathematics curriculum and instruction for all school children in the US.”
The first edition for kindergarten was published and implemented in 1987. After a three-year cycle of writing, field testing, and then revising curriculum for each grade (starting with kindergarten), grades 1 through 6 were published. Currently implemented in over 175,000 classrooms throughout the nation, a second edition was published in 2004. Dallas, Temple, San Marcos, and Lockhart ISDs are some of the districts currently implementing EMD at some level (e.g. San Marcos is implementing EDM for only 5th and 6th grades.)

Professional Development is provided to teachers and administrators through the Everyday Math Center, located at the University of Chicago, in four basic forms. 1) Onsite, 2) Online, 3) National User Conference, and 4) Bridges.

Onsite Professional Development provides districts with workshops and ongoing professional development that can be customized to district needs. Over 400 teacher consultants are available to provide training to teachers and administrators in various districts. The consultants have classroom experiencing teaching EDM. Cost depends on the length of professional development plus expenses such as transportation, housing, and meals. The sales department of Wright Group also includes professional development when the school purchases the curriculum, some of which may be complementary.

Online modules are available to teachers who register with a choice of a national or district module at $90 per person. Participants 1) access classroom video clips, audio segments, and dialogue with a consultant and EDM educators, 2) do in-class assignments, 3) interact for six weeks, and 4) complete 7-8 assignments.

National User Conferences are offered by the Wright Group in various parts of the country. Teachers may choose a one day workshop from a menu for the cost of $171 per day. The hotel and incidental fees must be paid by the teacher.

EDM is also linked to BRIDGES to Classroom Mathematics, a Staff Development curriculum for elementary school teachers who are planning to implement innovative elementary mathematics curricula such as EDM. This professional development is used as a supplement and not as the main professional development intended for EDM users. The BRIDGES professional development is used predominantly in the Northeastern region of the US, though Brownsville ISD in the Texas Rio Grande Valley is also currently participating in this model.

Details
Curriculum & Content
The curriculum developed in EDM attempts “to lay the groundwork for mathematical literacy” with mathematical knowledge and skills at levels beyond what has been viewed in the past as possible in young children. It broadens the scope of school mathematics beyond arithmetic and encourages critical thinking and problem solving skills. The scope of EDM includes the following mathematical strands:

- Algebra and Uses of Variables
- Data and Chance
- Geometry and Spatial Sense
- Measure and Measurement
- Numeration and Order
- Patterns, Functions, and Sequences
Some features of EDM curriculum include:

- Real-life Problem Solving (Problems are linked into situations and put into contexts relevant to the everyday lives of students.)
- Balanced Instruction (Whole group, small group, partner, or individual activities)
- Multiple Methods for Basic Skills Practice (Includes math routines, math boxes for review, games)
- Emphasis on Communication (Students are encouraged to verbalize their thoughts and explain their strategies and thinking with others.)
- Enhanced Home/School Partnerships (Grades 1-3 have Home Links as assignments in the textbooks. Home Links are intended to promote follow-up at home, provide enrichment, and provide means of involving parents in their children's mathematical education. Study Links exist for students to do follow-up work at home. Drafts of letters to be sent by teachers to parents are provided for all grades.)
- Appropriate Use of Technology (Calculator use when appropriate or suggested. Computation without use of a calculator is indicated.)

The curriculum encourages student thinking and allows students to find algorithms that make sense to them by letting them discover a way of solving problems without imposing one "right" way. Due to some pressures from parents and traditional teachers, a focus algorithm is included in such areas as division, adding fractions, etc. In EDM, not only are there changes in the mathematical content in the curriculum, there is also change in the way mathematics is taught. The spiraling style of the research-based curriculum utilizes a "spacing" concept rather than "massing", that is to say, it touches on topics at a quick pace. Rather than presenting a topic slowly and attempting to cover all its component parts with hopes of student mastery, the curriculum presents a topic in a context, develops it, allows practice, and then moves on without assuming that mastery or full fluency has been attained. The topic will again be covered with greater depth and with additional opportunities for understanding. This is based on the psychologist, Ebbinghaus' principle that a quick-paced presentation with a distributed frequency of topic rather than massing the presentation will achieve for the learner a long-term memory of the subject matter.

Because the development of the curriculum was sequentially conceived from K to 6 with material presented in a spiraling fashion over the course of years and grades, the teacher would benefit from understanding the entire spectrum of content and presentation. Having students who have been taught with this curriculum from the beginning grades also helps develop each student’s understanding through the premise of spacing vs. massing. Taking a particular grade for implementation without full implementation over all the grades creates potential difficulties. An example may be found at Hernandez Intermediate School in San Marcos, Texas, where the curriculum was adopted for 5th and 6th grades in fall 2004. Both the teachers and students have been challenged by the textbook change despite two types of professional development the district offered teachers. One form of professional development for the teachers addressed Everyday Math implementation and onsite support while the other professional development addressed 5th and 6th
grade math content and pedagogy strategies through a collaborative learning group by Texas Mathworks faculty.

For the success of the curriculum, there is an assumption that the teachers will give strong implementation by utilizing the text presentation without any modification or additional resource. Teachers who have not received thorough training in advance, who do not embrace standards-based curriculum, who are uncomfortable with changes to their teaching, or who have not bought into the textbook or curriculum will affect the implementation of the curriculum making it difficult to assess the success or failings of the curriculum.

Strengths in the curriculum include opportunities for students to work in different group configurations and actively discover some of the mathematical ideas. The curriculum relies on students’ deeper understanding of concepts and not just procedural understanding. In fact, alternative algorithms are often suggested and include technology usage or letting the student opt for algorithms that make the best sense to the student. Models and representations are often presented to make sense of concepts, though educators may argue the optimal order of presentation. For example, through discussing the linear, area and discrete models for fractions with a group of teachers at Hernandez Intermediate School, suggestions were made to modify the order of model presentation. Use of applications to reinforce ideas such as fractions, decimals and percents with data analysis makes a lot of sense in context.

The curriculum is aligned with the NCTM standards but is based on Math Strands reinforced over the seven grades that include:

- Algebra and Uses of Variables
- Data and Chance
- Geometry and Spatial Sense
- Measure and Measurement
- Numeration and Order
- Patterns, Functions, and Sequences
- Operations
- Reference Frames

A Spanish edition is available for adoption. At this time the teacher guide is in English only.

**Pedagogy**

The teachers are trained in the EDM curriculum through workshops that are in lengths specified by the school district. According to the EDM Professional Development spokespeople, there are no unique specific training techniques to this curriculum.

**Administration**

By adopting the textbooks, the sales department offers professional development to suit the school district. As indicated in the introduction, the costs vary according to the type of professional development as outlined below.

Onsite professional development customizes professional development in the following three steps:
1. Assess Your Needs: Choose one-day or multiple days to support staff professional development.

2. Customize a Plan: They can help create and/or support sustained professional development by choosing from the following menu.

- Begin & Build-Teachers*
- Begin & Build-Administrators
- Develop & Fine-Tune-Teachers
- Develop & Fine-Tune-Administrators
- Secure & Extend-Teachers
- Mentoring & Coaching-1
- Mentoring & Coaching 2
- Differentiating Instruction-General Education 1
- Differentiating Instruction-General Education 2
- Differentiating Instruction-Special Education 1
- Differentiating Instruction-Special Education 2

*As an example, here is a description of the professional development for Begin & Build-Teachers:

Learn how to effectively implement Everyday Mathematics for the first time.

Designed for:

Teachers, Coaches, and Curriculum Coordinators with no prior training in Everyday Mathematics

Sessions Organized by:

Grade Levels K, 1, 2, 3, 4, 5, 6

Key Outcomes:

- Understand the unit organization and grade level curriculum
- Discover effective strategies for teaching lessons.
- Experience hands-on activities and games while exploring the mathematical content.
- Gather ideas on assessing Everyday Mathematics students
- Learn how to effectively communicate with parents about the Everyday Mathematics curriculum.

EDM Strand Tracing, Mathematical Content, or Classroom Observations can also be incorporated into the professional development.

3. Terms & Conditions

- Contracted workshops available year round.
- 30 day notice requested.
- Maximum of 30 teachers suggested.
- Cost of customized professional development depends upon the number of days, materials, and location.
- Fees include consultant honorarium, travel, meals, and lodging expenses.
The cost of each Onsite Professional Development Customize-a-Plan is in the range of $2100 to $2400 for each six-hour a day workshop.

**Specific Applications to ELL**

**Language Components & Delivery**
The textbooks are available to the students in Spanish. However the professional development model does not address ELL as a separate issue. If the district wants the ELL issue addressed, the consultant will customize the workshops to meet the requests on a needs basis. The teacher guide is not available in Spanish at this time.

**Learning Styles for ELL**
Several aspects of the curriculum address various learning styles as well as social and interpersonal interactions in the following ways:

1. Activities during the lesson utilize different groupings from individual, paired, small group, and whole class.
2. Multiple representations of concepts are presented.
3. Students are encouraged to make sense of their understanding by coming up with their own strategies or algorithm, (“invent and share,” Carroll 1998).
4. A learning environment of sharing ideas and strategies is promoted.
5. Technology is incorporated in lessons but partnered with encouraging students to make sense of the answer.
6. Student communication of meaning and understanding is encouraged.
7. Games are often incorporated in lessons to motivate students to reinforce and practice skills and concepts and considered an important part of the curriculum.
8. Basic skills problems along with open-ended questions address a range of abilities.
9. Use of manipulatives and hands-on activities “provide support for students as they progress from intuitive to formal thinking.” (Carroll 1998)
10. Home Connection Handbook suggests ways to enhance home-school communication and parent involvement with and support for students.

**Administration & Student Assessment**
Depending on the school district’s adoption, the content can be delivered in a variety of ways:

ESL, bilingual, immersion, or other.

On-site follow-up support is available with follow-up site visits that support the effective implementation of the techniques presented in the workshops. Strategies are practiced with a trained EDM consultant. Classroom observations, lesson demonstrations and pacing charts by grade level are some of the ongoing services WrightGroup provides.

Student outcome is the general means by which teaching effectiveness is measured. Assessment techniques of students suggested by EDM include four basic types: ongoing, product, periodic, and outside tests.

1. Ongoing Assessment is included in the Assessment Handbook found in the Teacher’s Resource Packages that includes, “Class Checklists” of key concepts and skills, as well as “Individual Profiles of Progress” forms that can be used by teachers.
2. Product Assessment may include creating a portfolio of student work such as homework, drawings, written projects such as journals. Suggestions are built into the Teacher’s Guide.

3. Periodic assessments are built-in end–of–unit review and assessment lessons and activities in the textbook.

4. Outside tests include TAKS and other school-district developed tests. A research study by Briars and Resnick entitled "Standards, Assessments-And What Else? The Essential Elements of Standards-Based School Improvement" looked at the program called PRIME (Pittsburgh Reform in Mathematics Education) project which supported standards-based professional development for teachers and administrators. In particular, this NSF-supported Local Systemic Change program implemented in 1996-1997 was “designed specifically to develop teachers’ capacity to implement EDM. PRIME provided in-class support-demonstration lessons, joint planning, and coaching-by the demonstration teachers, in addition to summer and after-school professional development workshops.” The findings indicate that student scores increased significantly when teachers strongly implemented EDM and had the PRIME professional development program. In addition, when an alignment of standards, assessment, curriculum, and professional development is attained, then the greatest student gains were achieved. This also indicates “the important role of a well-aligned instructional program in a standards-based system.”

The Pittsburgh study also indicates that “EDM adoption was the first that no longer considered it acceptable for teachers to modify the program substantially or to teach it “their own way”; but many teachers and schools continued to operate under old assumptions. It goes on to say “EDM also presented new challenges to building and central office administrators in monitoring program implementation. Many teachers were mathematically unprepared to teach the curriculum and needed substantial content preparation. EDM can also exacerbate weaknesses in classroom management, and many principals may not have had the background to help teachers meet the new management demands….These factors all point to a need for considerable professional development for both administrators and teachers if programs such as EDM are to be well implemented across an entire school district.”

Model Assessment

Extensive research has been done on the EDM curriculum since its implementation in 1986. The studies have been “carried out by four principal groups: (i) the elementary and evaluation components of UCSMP, (Carroll, 1996a, 1996b, Carroll & Porter, 1994; Hedges, Stodolsky & Mathison, 1987) (ii) NSF-funded group at Northwestern University, which carried out a five-year longitudinal study of the curriculum, (iii) Individual schools and districts using the curriculum and (iv) independent researchers (Hawkes, Kimmelman & Kroeze, 1997; Woodward & Baxter, 1997; Riordan & Noyce, in press).

In Carroll's 2001 "A Longitudinal Study of Children in the Everyday Mathematics Curriculum," he observes that “EDM teachers might benefit from additional support, based on classroom observations.” Researchers from Northwestern University also indicated that teachers could use support on modeling students’ thinking, orchestrating discussions of alternative solution methods, and streamlining curriculum so that lesson goals were more coherent to the teacher and student.

Fuson, in the Northwestern University’s study, shows that EDM teachers “are very successful in implementing ideas from the NCTM Standards...and more likely than
either US or Japanese teachers to ask problem-solving and conceptual questions. Furthermore, the EDM teachers consistently asked students to explain their own methods and mathematical thinking.” (Carroll 1998)

Temple ISD in 1995 and Dallas ISD began implementing EDM in 1996. Temple has approximately 26% Hispanic (not indicating how many ELL) and Dallas has approximately 32% of the 57% Hispanic population who receive bilingual or ESL instruction.

In Dallas, each principal was strongly supportive of EDM. District-wide implementation began in 2000 with the K-1 grades. By Fall 2002 all grades used EDM because then superintendent, Mike Moses, mandated this professional development for all mathematics teachers.

Temple ISD implemented EDM for Grades K-2 in 1995-1996. “Teachers in Grades 3-6 received EDM Teacher Resource Packages so that they could become familiar with the program and be prepared for the full implementation in the following year. Professional development accompanied all phases of the EDM implementation. Training sessions for teachers were held before the school year began, and bi-monthly, half-day training sessions using EDM materials continued the learning through the school year.”

A grant from the Eugene Education Fund provides funding for the program “Literacy for English Language Learners builds capacity in English through use of supplemental Spanish-language materials.” River Road/El Camino del Rio Elementary School in Eugene, Oregon with 326 students and a 20% ELL population will be targeted by EEF with funding to provide EDM Math CDs in Spanish as additional support for the ELL students.

At Roosevelt Elementary School in Oshkosh Wisconsin, “All classroom teachers at Roosevelt participated in initial and ongoing training in the EDM program. Curriculum support specialists are available to teachers as a resource and to provide training or differentiation strategies and assist with assessment. Teachers collaborate to discuss effective teaching strategies and methods to improve student learning. Roosevelt staff has focused on a common understanding of standards-based learning and implementing grade-level benchmarks as defined by the Oshkosh Area School District.”

Commentary
1. Because the curriculum is written in a scripted form, the teacher’s guide that accompanies the students’ journals and reference books facilitates the lesson for the teacher with directions, time suggestions, activities, questions, and materials. If the teacher does a careful study of the curriculum and lesson using the teacher’s guide, extensive training is not as critical as other PD models.

2. Because the curriculum is scripted and implementation of the curriculum is intended to be used without modification, the teachers’ creativity may be stifled.

3. Because the curriculum has a vision of the entire K-6 spectrum, if it is implemented from the early grades, the teachers’ will have a clear picture of how topics and ideas unfold and are connected from year to year.
4. The curriculum uses the spacing rather than massing concept of presenting ideas that introduces topics then moves on with the plan of seeing it again for reinforcement and mastery. If students begin EDM use in 5th or 6th grade, they and the teachers find gaps in their background since a certain amount of knowledge is assumed. With the time constraints and pacing of the lessons, the teachers fall behind when correcting the deficiency or omit the topic or alter and customize implementation.

5. Teachers are encouraged to communicate with students and visa versa. The culture of the classroom puts more responsibility on the students to explain their thinking.

6. For the teachers accustomed to a traditional classroom with the teacher as the focus of the lesson, the transition to a student-centered classroom, as suggested by the curriculum, requires adjustment. The curriculum also encourages alternative algorithms to procedures that teachers may not be accustomed to.

7. The activities and games encourage reinforcement of mathematical concepts without strictly pencil and paper drill work. The teachers can observe student understanding through alternative assessment.

8. The professional development does not specifically address the ELL students. The teacher’s guide provides sections on diverse language learners that encourage different group interaction among students and that also build on each student’s prior knowledge.
Family Math (EQUALS)

Overview

Origination
Family Math is currently housed at the EQUALS Program at the Lawrence Hall of Science on the University of California campus at Berkeley, California.

Administration
Jose Franco, Director, and Louise Lang, EQUALS.

Induction
Developed in the 1970’s.

Implementation
There are 3 types of workshops: 1. The Family Math Class Leader Workshops prepare educators, parents, and others to lead classes for families (For this kind of workshop, people with less mathematics experience are encouraged to team with someone who has more math experience), 2. Family Math Staff Development Workshops prepare experienced Class Leaders to organize and offer class leader workshops (For this kind of workshop, presenters need to have a good background in math), and 3. Custom designed workshops train school personnel on how to present ways to think about math for a particular school setting in order to guarantee student success in mathematics (These workshops are produced by teachers, counselors, and administrators, designated as the EQUALS academic staff).

The workshops are from 1 day to several weeks in length, for example, a two-day workshop costs $300 per person, which includes lunch and a book or other materials. The workshops goal is to increase math knowledge and classroom strategies for educators. There are separate Family Math workshops in English and Spanish designed to bridge home and school. Some of the topics covered by these workshops include: algebra, changing practices for diverse classrooms, cooperative learning and problem-solving strategies, English language development and math content, Family Math for young children, elementary, and middle school, Family Math Leader Workshops, geometry for the middle school, and middle school investigations. Support materials cover different learning styles and a diverse variety of topics and are delivered through many mediums such as videotapes, books, on-line resources (Parent Portal), and workshops. The program maintains an active network to provide support to class leaders, staff developers, parents, and teachers.

Instigation
The Family Math program began in the 70’s when society recognized the need to re-interest girls in mathematics, but the model worked well for all students so the target population was enlarged. Later, the program was incorporated into the University of California’s EQUALS center. Family Math was created to alleviate the fear of math for parents and students. Family Math helps to construct relationships between teachers and families that might not otherwise occur, especially in remote settings.

Philosophy
Family Math believes that all children can learn and enjoy math and that parents and other family members are their children’s first and most influential teachers. Many parents report that they do not know how to support their children’s mathematical
learning. Family Math focuses entirely on families learning math together. These families reflect a diversity of composition, ethnicity, gender, language, and economic status. In Family Math, mathematics becomes a challenging and engaging learning experience for everyone. The materials are designed to provide all parents with clear and practical advice, active participation tools, and solid math and science problem examples.

**Analysis**

**Introduction**
The principles of Family Math: state that all children can learn and enjoy math, focus entirely on families learning math together, relate topics to the school curriculum, including algebra, probability, statistics, estimation, logic, geometry, and measurement, claim students need to “DO” math, and focus on building problem-solving skills and a conceptual understanding of math with hands-on materials. Family Math is not a tutoring or after-school enrichment program for children nor is it a discussion group for adults. It is not remedial, although it may prevent the need for remedial classes. It is an informal learning experience for everyone.

(1) The roots for the Family Math program began with the 1970’s singular purpose to get girls interested in math, however, the original working project model functioned well for all students, so the target population was expanded. Family Math was later incorporated into the EQUALS program, which is housed at the Lawrence Hall of Science on the University of California campus at Berkeley, California.

(2) Family Math focuses on developing problem-solving skills and building a conceptual understanding of mathematics by using hands-on materials, including many that are found in the average home.

(3) This model is aimed at Pre K-12 teachers, parents, families, and community members.

(4) Family Math is currently used worldwide from South Africa to New Zealand and throughout the United States (34 states have EQUALS or Family Math sites listed, including Alaska and Hawaii). Listed international sites are Australia, Canada, Costa Rica, Mexico, New Zealand, Puerto Rico, South Africa, Sweden, and Venezuela.

(5) The training is conducted through workshops, supported by curricular materials delivered through conferences, videotapes, books, and the popular on-line activities for students and parents, Parent Portal.

There are 2 types of workshops. The Family Math Class Leader Workshops are designed to prepare educators, parents, and others to lead classes for families. For this kind of workshop, people with less mathematics experience are encouraged to team with someone who has more math experience. Family Math Staff Development Workshops prepare experienced Class Leaders to organize and offer class leader workshops. For this kind of workshop, presenters need to have a good background in math. The program maintains an active network to provide support to class leaders, staff developers, parents, and teachers.
Details

Curriculum & Content
The Family Math curriculum, provided by the EQUALS Program in the form of workshops and materials, addresses NCTM Standards as well as the California State Content Standards. Family Math classes focus on developing problem-solving skills, with an emphasis on real world contextual problems, and building a conceptual understanding of mathematics with hands-on materials.

Family Math trained leaders conduct classes, which are designed to have about 25 participants. Students and their family members of any age are welcome. The math topics connect to the school curriculum, including algebra, probability, statistics, estimation, logic, geometry, and measurement.

Pedagogy
The Family Math Class Leader Workshops prepare educators, parents, and community members to lead classes for families. A good mathematics background is helpful but not essential. All community members who are enthusiastic, kind and committed become candidates for a Math Class Leader by taking a two-day workshop. The workshops are given at the Lawrence Hall of Science or at the requesting person's site. The Family Math Class Leader Workshops begin at $300 per person for a two-day workshop.

Administration
Administrators buy into the Family Math model because almost anyone can be trained to conduct classes and the model specifically aims at ELL but works for many types of students.

Problem based learning, involving parents and family, using hands-on activities, and giving challenging content, are a few of the reasons that Family Math is a very viable model for school administrators.

Specific Applications to ELL

Language Components & Delivery
Many of the Family Math materials such as textbooks and curricular activities are produced in English and Spanish. Since the content is real world problem based, it is delivered in the primary language of the Family Math Class Leader.

Learning Styles for ELL
Relative to learning strategies for ELL, Family Math's tenets are: 1. All children can learn and enjoy mathematics, 2. Families play an important role in student learning and academic success, 3. Problem-solving skills are essential to sound mathematics learning, 4. Conceptual learning demands hands-on activities, and 5. Students must "DO" math in order to learn math.

There is no obvious information given that addresses social and inter-personal student skills other than those already mentioned that involve the family.

Administration & Student Assessment
Family Math is described as an informal learning experience for everyone; therefore it has no set delivery personnel or assessment methods.
Model Assessment
Most of the literature that supports Family Math is testimonial in nature, i.e. of a qualitative observation type. Two articles published on Family Math that also contain no quantitative data are: *Doing Mathematics with Your Child*, from the Office of Educational Research and Improvement (OERI), and *Helping your Child Learn Math* from the U.S. Department of Education.

Commentary
This model is problem-based, stresses equity and family involvement, and is an informal learning experience designed to allow everyone to be stimulated by and enjoy doing math. The activities are context based, presented in a hands-on manner and use familiar objects whenever possible. The model has widespread appeal.

Unfortunately, due to the variety of the background knowledge of those leading the classes, it is difficult to imagine whether problems are correctly replicated, actual content delivered is as expected, and time spent on tasks allows for total class content to be completed.
Figure This! Math Challenges for Families

Overview

Origination
Figure This! was developed as a joint project by the National Council of Teachers of Mathematics, the National Action Council for Minorities in Engineering, and Widmeyer Communications with support from the National Science Foundation and the U.S. Department of Education.

Administration
A 13-member advisory board consisting of representatives from academics, industry, and philanthropic organizations administer the program.

Induction
Twenty-eight challenges, a website, and resources have been available since 2001. There are currently 80 challenges available.

Implementation
To start using Figure This! Math Challenges for Families, a parent, teacher, or administrator need only have internet access. The challenges are available free of charge from the Figure This! website. There are introductory materials including slide shows with notes available to present at a family night or PTO meeting. Additionally, sending available letters of introduction home to parents completes the limited information available on or necessary for implementation.

Instigation
The rigors and demands of our increasingly complex, technologically dependent society have made high student achievement in mathematics a top priority among educators, policymakers, and employers. Today’s citizens need more than basic computation and rote mathematical skills. They must master the higher-level concepts and approaches to problem solving that are key to success in work and everyday life.

To meet this need, the National Council of Teachers of Mathematics, in cooperation with the National Action Council for Minorities in Engineering, Widmeyer Communications, and the Learning First Alliance, launched Figure This!

Figure This! demonstrates challenging middle school mathematics and emphasizes the importance of high-quality math education for all students.

Philosophy
Mathematical challenges for families provide interesting math challenges that middle-school students can do at home with their families. Each challenge features: a description of the important math involved; a note on where the math is used in the real world; a hint to get started; complete solutions; a "Try This" section; additional related problems with answers; questions to think about; facts related to the math; and resources for further exploration.
Analysis

Introduction
Figure This! Math Challenges for Families was developed as a joint project by the National Council of Teachers of Mathematics, the National Action Council for Minorities in Engineering, and Widmeyer Communications with support from the National Science Foundation and the U.S. Department of Education. Figure This! website has resources freely available for teachers, to support their efforts in promoting a positive attitude towards mathematics by middle school students and their families. The challenges, website, and resources have been available since 2001 at which time there were about 28 challenges available. There are currently 80 challenges along with a complete set of resources for teachers and families. The teacher training is self-directed through use of ancillaries in the Teacher’s Corner of the Figure This! website as well as the “Ideas for Teachers” brochure.

Details

Curriculum & Content
The curriculum is designed around the National Council of Teachers of Mathematics’ Principles and Standards for School Mathematics. It consists of 80 challenges. There are about 150 challenges listed under the five NCTM Standards for grades 6-8, meaning some of the 80 challenges address more than one NCTM Standard. Each challenge is further categorized according to the more detailed list of expectations described by NCTM as means of achieving each overarching standard. There is no prescribed order that challenges should be complete apart from their sequential numbering from 1 to 80. The “Ideas for Teachers” brochure suggests that teachers can choose to send home challenges that are in-line with their current class content. This seems to indicate that the style of curriculum does not depend heavily on sequence. Since the curriculum was developed in part by NCTM, it stands to reason that is should not be weak in meeting any of the NCTM standards.

Pedagogy
The teachers are given a liberal amount of academic freedom in their use of the Figure This! materials. There are no workshops to attend. There is an extensive amount of reading to do in order for the teacher to familiarize himself or herself with all 80 challenges. The free availability of an extensive collection of interesting questions to use as the teacher determines is a unique feature of Figure This!

Administration
Figure This! is an easy sell to administrators. Since it costs little more than the price of copy paper, there is no financial burden to the school. Involving families in a child’s education effects positive academic results is hardly more than common sense. The difficult aspect to sell an administrator on is that Figure This! can be effective in and of itself. Some administrators are perhaps looking for a more revolutionary change, or an intense series of professional development workshops. Neither revolutionary change nor intense training are aspects of the philosophy that guided the development of Figure This!, and is therefore not an appropriate standalone model for such administrators. There is in fact little research available indicating the effectiveness of implementing Figure This! as the only supplement to a current model. Still for the frugal administrator wanting to make a subtle change, Figure This! is just right and can hardly hurt.
**Specific Applications to ELL**

**Language Components & Delivery**
Figure This! addresses only English Language Learners with a Spanish language background. The introductory letters to send parents are available in English and Spanish. There are five family support brochures available in English or Spanish and each available in black and white or color. The brochures are called Families & School, Families & Math, Families & Homework, Families & Support, and Math & Literature. The information provided in these brochures is intended to promote positive family attitudes towards school and mathematics. Of the 80 challenges, only the first 15 are currently available in Spanish.

**Learning Styles for ELL**
As in many cultures, but particularly in the Hispanic culture, family is an important part of life. Figure This! addresses this characteristic as its foundational purpose is to involve families in the learning process. By providing math questions to answer at home, Figure This! is capitalizing on the idea that learning is most effective in a "safe" or comfortable environment. At home a student is perhaps more willing to risk an answer in their most cognitively advanced language. Concerns that parents may affirm an incorrect answer can be waylaid by the fact that correct answers are provided with each challenge. There are other learning styles that one can infer Figure This! developers addressed, however, there is no specific mention of ELL in the Figure This! literature.

**Administration & Student Assessment**
Figure This! is intended as a supplement to a current curriculum. There is no specific form of implementation in terms of linguistically diverse classrooms. With the availability of Spanish version challenges and ancillaries, there is always the option of using these for students whose most cognitively advanced language is Spanish.

There is no information available on how to assess students' understanding of the mathematical content taught through the use of Figure This! challenges.

**Model Assessment**
There is no research attaining to the effectiveness of Figure This! to improve scores on standardized tests.

**Commentary**
Figure This! Math Challenges for Families doesn't seem to fit the bill for a complete professional development model. There is little in the way of professional development. It certainly contains literature to guide teachers and administrators on ways to utilize the challenges, but it does neither provides training on methods of delivering math content nor addresses learning styles of linguistically diverse classroom.

*Though it is simple, it seems to be based on sound commonsense principles. Dieticians say overweight people can have a positive affect on weight loss by simply climbing the stairs to their offices rather than taking the elevator. Perhaps supplementing an already existing mathematics curriculum with Figure This! can have a similar subtle yet positive effect. Changing attitudes towards math seems to be the goal of Figure This! While there is no research one way or the other on its efficacy, it is certainly plausible that working interesting life-related math problems in*
the psychological safety of a child’s home would positively impact most importantly parents’ attitudes towards math, which in turn can make good impressions on a child’s attitude towards math. Over time this could make a world of difference in any assessment whether it be skills oriented or problem solving.

Several aspects seem sure. Since advocating Figure This! does not require significant change or training for the teachers, it should be widely accepted as a positive supplement to an existing curriculum. Since it is freely available to distribute and use, it does not put any burden on an economically disadvantaged school or district. Since it is not involved and does not require extensive teacher training, it is likely to be met with skepticism as to its efficacy on standardized tests.
Investigations

Overview

Origination

*Investigations in Number, Data, and Space* was developed at Technical Educational Research Center (TERC) by a team of curriculum developers and mathematics educators. TERC is a nonprofit research and development organization whose mission is to improve mathematics, science, and technology teaching and learning. TERC, founded in 1965, is located in Cambridge, Massachusetts.

Administration

Dr. Susan Jo Russell was the Principal Investigator of the National Science Foundation grant that funded the development of *Investigations*. The authors also include Michael T. Battista (Michigan State University), Douglas H. Clements (Univ. at Buffalo, State Univ. of New York), Marlene Kliman (Project Dir. At TERC), Jan Mokros (Developmental Psychologist), Andee Rubin (Senior Scientist at TERC), Julie Sarama (Univ. at Buffalo, State Univ. of New York), Cornelia Tierney (Senior Mathematics Education Researcher), and others. The curriculum was field-tested in a variety of schools over an eight-year period (1990-1998).

Induction

Since 1997, almost 12,000 educators have participated in the *Investigations* Workshops for Transforming Mathematics, a week-long workshop that prepare teachers, staff developers and math specialists to introduce *Investigations in Number, Data and Space* to elementary classrooms.

Implementation

The Investigations for Transforming Mathematics project, developed at TERC, offers the only Investigations professional development created by the authors of the Investigations in Number, Data, and Space curriculum. Investigations Professional Development sponsored by TERC includes the Investigations Implementation Center which provides Investigations Implementation Institutes and the Annual New England Investigations Conferences, also known as the Investigations User’s Conference. Investigations Workshops for Transforming Mathematics consists of five-day workshops in different locations across the country. The Investigations Implementation Institute is a three-day institute designed for teams from schools and districts implementing Investigations curriculum. The Annual New England Investigations Conference is a one-day conference for teachers and administrators using the Investigations.

*Investigations* Workshops for Transforming Mathematics provide professional development opportunities for K-5 teachers, math specialists and administrators implementing the Investigations in Number, Data and Space curriculum. Investigations professional development sessions are designed by curriculum developers, and led by teams of experienced classroom teachers and Investigations authors and staff developers. Technical assistance is provided by email and phone and staff consults with districts that have adopted Investigations or are in the process of adoption. Information relevant to teaching and learning and implementing Investigations is disseminated via print, talks, publications, and the *Investigations* website.
Instigation
TERC developed *Investigations* as a response to the call for a new approach to the teaching of mathematics in the public schools by the NCTM in the early 1980’s. The approach used became known as standards based and focused on problem solving.

Philosophy
The *Investigations* program embodies the vision of the rigorous national standards for mathematics developed by the National Council of Teachers of Mathematics (NCTM). Investigations is based on an extensive body of research on how students learn mathematics.

In each unit, students explore the central topics in depth through a series of investigations, encountering and using important mathematical ideas. Students actively engage in mathematical reasoning to solve complex mathematical problems. They represent, explain, and justify their thinking, using mathematical tools and appropriate technology. Investigations provides meaningful, repeated practice of basic facts and skills through activities and games. The investigations allow significant time for students to think about the problems and to model, draw, write, and talk with peers and the teacher about their mathematical thinking. Investigations is infused with teachers’ practical suggestions and strategies, and provides the information teachers need to implement a complete mathematics curriculum. Each Investigations unit includes information for teachers who want to learn more about the teaching and learning of mathematics. The professional model that has developed since the creation of the curriculum is based on the same assumptions of how one develops a deep understanding of mathematics. Typical training encourages teachers to engage in inquiry based math activities and lessons (often for 1 or 2 days) or to study case studies of situations that arise in a typical classroom. The next part of the training focuses on a reflective process about the content and pedagogy encountered in the demonstration lessons. Some principles that seem to guide this process are as follows:

- Reflection is a powerful tool to use for lessons and training.
- The focus should be on children’s mathematical thinking.
- Engaging in mathematics is important for teachers as well as students.
- The art and practice of questioning is at the heart of effective classroom for Coaches (PDM trainers) and teachers.
- Building a community among teachers, administrators, students and parents is crucial.

Analysis

Introduction
*Investigations in Number, Data, and Space* is a K-5 curriculum developed at TERC by a team of curriculum developers and mathematics educators. The curriculum was field-tested in a variety of schools over an eight-year period (1990-1998). Dr. Susan Jo Russell was the Principal Investigator of the National Science Foundation grant that funded the development of Investigations. TERC is a nonprofit research and development organization whose mission is to improve mathematics, science, and technology teaching and learning. TERC, founded in 1965, is located in Cambridge, Massachusetts. TERC staff includes researchers, scientists, and mathematicians, and curriculum and professional development specialists who ground their work on inquiry-based approaches that deepen all learners’ understandings.
Authors and members of the Investigations Implementation Center and *Investigations* Workshops staff provide direct support to Investigations users by offering research-based professional development and technical assistance. Support is available for the range of *Investigations* users in schools and districts across the country, as well as some outside the United States. The goal is to advance the teaching and learning of mathematics for all students and teachers.

**Details**

**Curriculum & Content**

*Investigations in Number, Data, and Space* is a complete mathematics program. It is designed to help all elementary school children understand the fundamental ideas underlying number and arithmetic, geometry, data, measurement, and algebraic thinking.

Mathematics content in *Investigations* includes computational fluency with whole number operations, the structure of the base ten number system, the meaning of fractions, representing and describing data, examining 2D and 3D shapes, measuring, and change over time. Students are encouraged to reason mathematically, develop problem-solving strategies, and represent their thinking using models, diagrams, and graphs.

The Investigations program embodies the vision of the rigorous national standards for mathematics developed by the National Council of Teachers of Mathematics (NCTM). *Investigations* is based on an extensive body of research on how students learn mathematics. It is designed around key ideas to invite all students into mathematics, providing opportunities and experiences organized to develop mathematical proficiency.

In each unit, students explore the central topics in depth through a series of investigations, encountering and using important mathematical ideas. Students actively engage in mathematical reasoning to solve complex mathematical problems. They represent, explain, and justify their thinking, using mathematical tools and appropriate technology. Investigations provides meaningful, repeated practice of basic facts and skills through activities and games. The investigations allow significant time for students to think about the problems and to model, draw, write, and talk with peers and the teacher about their mathematical thinking.

The professional development model for teacher training seems to consist of workshops (as listed earlier) and extensive documented suggestions in the curriculum materials. Investigations contains teachers’ practical suggestions and strategies, and provides the information teachers need to implement a complete mathematics curriculum. Each Investigations unit includes information for teachers who want to learn more about the teaching and learning of mathematics.

**Pedagogy**

What follows is an account of an interview of a third grade teacher who used Investigations during the school year 2003-2004 in a middle size Texas community and whose classroom contained 100% Hispanic students. What follows is a faithful account of this teacher’s reflection of her experience with the curriculum and the pedagogical training provided for the teachers in her school.
All of the third grade teachers in the school were introduced to *Investigations* in a one-week intensive training in the summer of 2003. The trainer was an outside consultant and was aided by the district math coordinators. The district provided for a large amount of manipulative material. The training consisted of reading material that analyzed what did not work and what did work in teaching elementary mathematics. Much time was spent hearing testimonials of how great the new curriculum is. There was practically no demonstration of the new lessons. The teachers had been using other curriculum (which most of the teachers liked very much) which also used a great deal of manipulatives and activities. There was vocal dissatisfaction at the end of the training as the teachers were sent out to implement the new curriculum without having looked at very much of it. (The teacher interviewed was among this group.)

The result was that only 2 teachers actually used the curriculum on a regular basis. One of these teachers was the interviewed teacher. As she read each new lesson, she began to understand that the value of the curriculum lay not only in the activities but also in the process of letting the students work through a problem in groups. As her students discussed with each other the results of the activities and as she followed the suggestions to use reflection within groups and with the whole class about what they had learned, she began to see a change in the student’s attitude and confidence level. She commented that this process had been missing in the previously popular curriculum.

Early in the semester, her classroom was visited for evaluation purposes and the evaluator questioned her about what was observed. Although the evaluator was impressed by the involvement of the students and the fact that they did not want to stop the lesson to go to recess, the evaluator had not been trained to understand some of the unusual activities seen in the class. The teacher was uneasy about her evaluation, even though she was happy with her student’s progress. She mentioned this as she related her gradual conversion towards the new curriculum.

She related two very key observations at this point. First, the students seemed to be progressing especially well in the area of problem solving. They were very motivated to work on problems. Second, the "low" bi-lingual students, many of whom had low self esteem in the beginning, were flourishing in this atmosphere. They were gaining a lot of self confidence. The writer had talked with this teacher immediately after the early training and then again in December.

The next contact between the writer and this teacher was at the end of the school year. She reported that all of her students had passed the TAKS test and that over half of them had achieved exemplary status on the state exam. Her students had actually out performed the GT class at her school, the only other class in which every student had passed the exam. The math coordinator pointed out this teacher to the writer as an example of a very successful teacher.

This report illustrates how difficult it is to get teachers to embrace and effectively use new curriculum. But it also shows the potential results of using curriculum that incorporates inquiry based activities combined with carefully designed reflection methods. It especially illustrates the potential this approach has for English Language Learners, like those students in the classroom described above.
Administration
Professional development for Investigations consists of several workshops and an extensive collection of online opportunities, including discussion groups. One of the workshops is the User's Conference, which may be held at different sites around the country. Conferences bring together new and experienced users of the Investigations curriculum as a way of building and broadening the network of Investigations users. The User's Conference structure provides a means to discuss aspects of implementation that participants are dealing with everyday. Conference sessions focus on mathematical and pedagogical issues inherent in implementation and efforts to enhance teaching and learning of mathematics.

The format of the conference varies but usually includes:

- a keynote address on a topic of interest
- workshop sessions for teachers, lead teachers, coaches, and administrators facilitated by teachers, lead teachers, coaches and administrators, and professional development providers
- grade-level unit sessions
- facilitated discussion sessions at each grade level for new and experienced Investigations teachers and administrators to share questions and lessons learned

Sessions on specific grade level units are intended for new users who benefit from having this experience prior to teaching the unit. Experienced Investigations teachers lead participants through the mathematics and activities of the focus unit.

TERC, Scott Foresman, and CESAME sponsor the New England User's Conference each fall. Based on the model of the New England User's Conference, Scott Foresman formatted a strategy to link Investigations Users with Scott Foresman representatives to organize and sponsor Local Investigations User's Conferences.

Specific Applications to ELL
Language Components & Delivery
Spanish Teaching Companion, a packet containing small booklets, is an optional resource available. One booklet per unit presents teacher dialogue and instructions in Spanish. A Spanish Vocabulary Package includes a paperback booklet of key terms in each Investigations session with a Spanish translation as well as tips for preview activities to enhance teaching in a linguistically diverse classroom, plus all the Spanish blackline masters needed for the entire year. These materials parallel the English ones in the Curriculum Unit.

In one of the online sections of frequently asked questions, the issue of English language learners is discussed in the following passage:

*Investigations* makes it possible to empower all students, including English learning students since students are involved in collaborative learning. It can be surprising to realize that English learning students will benefit more from working collaboratively with other students than with their teachers. Because Investigations encourages teamwork and learning in groups English learning students are not isolated or marginalized but are able to learn and help others learn. Because *Investigations* supports many different learning styles, English learning students can compensate for their language issue by explaining their thinking through drawings, using
manipulatives or algorithms. Their strategies and understandings can be communicated in many ways. To empower all students we also need to make sure that learning English does not lead to low self-esteem and lack of motivation. The games, hands-on activities, and manipulatives insure an access to mathematics learning that can in some measure reinforce their English learning.

The multicultural extensions for all students are a great idea that encourages teachers to take into account the cultural experiences of their students. This is particularly important with English learning students as it gives them the opportunity to relate their experiences to their learning, an opportunity too easily overlooked. Cultural diversity should be even more strongly encouraged throughout the units of Investigations. I would suggest that in the same way there are teacher notes, there should be specific multicultural extension notes with ideas and examples of how to address this issue. This would help teachers celebrate the cultural diversity in their class and at the same time help stay away from stereotypes. It would serve to reinforce students’ security in their cultural identity.

**Learning Styles for ELL**
(See discussion in Pedagogy.)

There is a large body of support for issues related to children and families. Listed below are samples of the resources available.

- Aunty Math: www.dupagechildrensmuseum.org/aunty/index.html
- Math Challenges for K-5 Learners.

1. The MacTutor History of Mathematics archive: www-groups.dcs.st-and.ac.uk/~history/. The archive includes biographies, a games area mathematical games and puzzles, Homework Help and Ask an Expert, and a section on "math wonders".

2. The Math Forum: Student Center forum.swarthmore.edu/students/


4. MMathStories.com: www.mathstories.com/

**Commentary**
The strength of this model is in the curriculum design. It consists of well sequenced activities and an effective integration of individual, group and whole class discussions and reflections. The weak link is getting teachers to embrace this shift away from traditional or weaker inquiry models. It seems that the amount of time and investment needed for them to do so is more than the 2 or 3 or even 5 day training model. It must be noted that in some of the online discussions (questions and answers), this issue is acknowledged. One discussion noted that effective training started with teachers engaging in actual mathematics, sometimes for 2 days. It was then advised that this should be followed by several days of reflection and analysis of what was experienced and observed in the actual lessons. It should also be noted that when there is buy-in by the teacher, the curriculum along with the teacher’s guides seem to be very effective.
MATHCOUNTS

Overview

Origination
Current curriculum and problems are developed by local NCTM chapters and National Society of Professional Engineers.

Administration
The current program coordinator is Megan Balkovic.

Induction
The program began in 1983, and it continues to grow with the next competition in May of 2005 to be hosted by General Motors in Detroit, MI and to include 228 of the top middle school mathematicians from around the country.

Implementation
To start a local MATHCOUNTS program, there is available a School Kit. The School Kit includes everything needed to start a successful school program. Veteran coaches provide the training offered free of change, and include free materials. Cost for workshop facilities are sponsored by local businesses.

Instigation
As 22 years have passed since the program began, pinning down the impetus for MATHCOUNTS is difficult. There is nothing specifically mentioned in the MATHCOUNTS literature.

Philosophy
MATHCOUNTS motivates and rewards students by fostering teamwork and a competitive spirit. It is more than a competition. It involves students and teachers in year-long coaching sessions and helps students at all levels improve their problem-solving skills. MATHCOUNTS builds math skills, promotes logical thinking and sharpens students' analytical abilities. MATHCOUNTS provides America's middle school teachers with creative, state-of-the-art curriculum materials, free of charge. MATHCOUNTS introduces students to math-related careers through contacts with engineers and other professionals who serve as volunteers. MATHCOUNTS is educator-driven. Materials and activities are structured to meet student needs, as identified by educators. Members of the National Council of Teachers of Mathematics (NCTM) develop these materials in accordance with NCTM curriculum standards.

Analysis

Introduction
MATHCOUNTS is a nationwide program that promotes math excellence for 6th, 7th and 8th grade students and combines the efforts of education, business, government and the technological community. It is a math skills coaching program based on higher-level thinking skills development with a series of progressive competitions at local, state and national levels. It motivates students to do well in math and recognizes and rewards them for achievement. The program also gives the math teachers an incentive to excel in their classrooms. Business and industry partners provide schools with coaches for the Mathletes® and assist in coordinating competitions. They also host local MATHCOUNTS activities, such as workshops for
teachers, minority outreach programs and public awareness events to encourage participation and promote the importance of mathematics. MATHCOUNTS Teachers Workshops are conducted by veteran MATHCOUNTS coaches who share a wealth of information about using the program’s materials in the classroom and prepare coaches and students for the competitions. The workshops are offered free of charge and teachers receive hours toward the Texas Association for the Gifted and Talented Awareness Certificate as well as G/T Professional Development renewal credits. The program began in 1983, since then over six million students have participated.

Details

Curriculum & Content
MATHCOUNTS heightens student interest in mathematics by making math achievement challenging, exciting and prestigious as a school sport. At the beginning of each school year, the MATHCOUNTS Foundation provides a complimentary copy of its School Handbook to every middle school across the country. Teachers and volunteers use these 300 problems and activities to coach student Mathletes®, as part of in-class instruction or as an extracurricular activity.

The problems meet NCTM standards for grades 6-8. They are designed to challenge and accelerate student learning, and questions become progressively more difficult at each level of competition. Possible topics include: algebra; charts, graphs, and tables; computation; consumer math; equations and inequalities; equivalent expressions; estimation and approximation; geometry; logic; measurement; number theory; probability; and statistics.

After several months of coaching, participating schools select students to compete individually or as part of a team in one of more than 500 written and oral competitions held nationwide and in U.S. schools overseas. The first competitions are held at the local level in February with winners progressing to state competitions in March. Results at the state level determine the top four individuals and top coach who earn the honor of representing their state or overseas team at the national finals. At all levels, MATHCOUNTS challenges students' math skills, develops their self-confidence and rewards them for their achievements.

Pedagogy
Teachers receive training from former MATHCOUNTS coaches who explain the program during workshops sponsored by local businesses. The competition structure is explained as well as ways to implement student training. Teachers receive materials to take back to their classrooms including a 128 page School Handbook filled with 300 exciting problems. Teachers can include MATHCOUNTS curriculum in their courses as take home questions or in extracurricular activities. A unique quality of MATHCOUNTS workshops is the generation of energy akin to a sporting event. The program uses modified terms from athletic sports to create the Mathlete® paradigm. Terms such as Stretches, Warm-Ups, and Workouts to describe different types of problems continue the theme. They inspire and motivate sincere effort, which effects a lasting understanding of mathematical content.

Administration
There is information for individuals who want to convince administrators to start a MATHCOUNTS team at local schools. The materials are free of charge. Business sponsors pay for teacher workshops. Team registration fees are $80, while individual registration fees are $20 per student. There are reduced fees for schools that receive...
Title I funds. Expenses for travel to the national competition are paid for by MATHCOUNTS.

Specific Applications to ELL
There does not seem to be any information regarding ELL students. There are no non-English handbooks or materials. The competitions are conducted solely in English. There are minority outreach programs, but nothing language specific.

Model Assessment
MATHCOUNTS participants are high achievers. According to recent surveys of past state competitors, nearly 80 percent of alumni report a combined SAT score of 1400 or above. And, the top three college majors for alumni are engineering, mathematics and computer science.

Commentary
With over 500,000 students participating in MATHCOUNTS annually the program has clearly generated a significant level of interested teachers. The professional development workshops use the same hype that athletic sports use to generate excitement and energy, only for mathematics. If executed correctly, these aspects of MATHCOUNTS professional development addresses the low engagement level that other structured and formal models neglect.

A concern with MATHCOUNTS is that it does not do enough to include all levels of student in math content understanding. It encourages coaches to recruit all levels of students, but if winning is in fact the motivating factor, then many coaches may be inclined to choose only gifted and talented students in math, leaving behind those who struggle. The program also seems to lack sequential structure of mathematical content. Connections between problems and past topics or real world situations also seem weaker than with other models.

MATHCOUNTS seems like a great program to excite some students about ideas in mathematics. Of concern is the prospect that it may leave behind ELL students struggling with math. It seems to lack components to make it a complete professional development model.
Mathworks

Overview

Origination
Research-based curriculum and professional development model developed at Texas State University-San Marcos beginning in 1996.

Administration
The research and development of student curriculum is an ongoing collaboration between faculty at Texas State University and classroom teachers. The mathematics department faculty team includes Max Warshauer, Terry McCabe, and Hiroko Warshauer. Professional development materials link student curriculum to graduate mathematics courses which were designed by Terry McCabe, Joyce Fischer, Sharon Gronberg, Selina Vasquez, and Kay Reinke.

Induction
The student curriculum development began as a project to introduce young students to algebra in summer math camps in 1996. The curriculum was refined with input from classroom teachers, with all of the mathematics topics aligned to the Texas Essential Knowledge and Skills (TEKS). In 1998, support from Eisenhower grants began the PDM linking summer math camps to teacher training. This included a graduate course in Quantitative Methods. In 2000, a grant from FIPSE supported testing the program in different sites, with the graduate courses expanded to include a Masters in Middle School Mathematics Teaching. The student curriculum was expanded to be a multi-tiered student program with 5 levels for students in grades 4-8. The model was further refined to introduce year-long professional development including Math Inquiry Groups supported by a grant from the Meadows Foundation from 2003-2006. Math Inquiry Groups provide a setting for collaboration between university faculty, preservice and inservice teachers, and school district administrators that benefits all of the groups.

Implementation
The training begins with a two-week course of professional development. Teachers observe a math camp in the morning taught by master teachers. In the afternoon, the new teachers take a graduate course that links theory to practice, and covers the content and pedagogy being delivered. Teachers may participate in successive summers to observe different levels of the curriculum, and take further graduate courses that lead to a masters in middle school mathematics teaching.

After completing the initial two-week training, the teachers then teach their own camp, mentored by the master teachers they were previously observing. During the school-year, teachers form Math Inquiry Groups in their local schools, supported by Mathworks faculty. Math Inquiry Groups support a wide range of continued support that is designed to meet the different needs teachers encounter in their own district. Activities include:

1) curriculum workshops that address specific problems teachers have with their own students and curriculum;
2) after school math camps and math clubs;
3) Lesson study facilitated by Mathworks faculty;
4) family math nights; and
5) professional development workshops on topics such as assessment, teacher portfolios, etc.

These activities and continued support are designed to build a community and culture in the district that will raise the level of mathematics for all students and teachers.

The cost of the 4-week summer training and year-long support through Math Inquiry Groups is $2700 per teacher. This includes 3 hours of graduate credit.

Mathworks professional development is linked to state and national standards. It stresses inquiry-based methods for teaching, and shows how these can be incorporated into different curricula and settings. The training is in-depth and sustained through year-long support that builds a structure that districts can continue after the program is completed.

Instigation
Mathworks began as a program designed to prepare all students for success in algebra and more advanced mathematics. The problem being addressed was the large number of students who were not passing the end-of-course exam in algebra, and the growing gap in performance between different groups of students. In particular, African-American, Hispanic, and economically disadvantaged students had much lower passing rates that white and Asian students. The success of the model was recognized by the Texas Higher Education Coordinating Board when Mathworks received the 2001 Texas Star Award for Closing the Gaps.

Philosophy
All students can learn mathematics at a high level if given the proper background and training. Mathworks encourages students and teachers to learn the language of algebra early, with an integrated curriculum that addresses state and national standards.

The curriculum encourages students to construct models for mathematical operations based on sound, fundamental principals and real models from their own experiences. Mathematical skills are developed and practiced through carefully sequenced problem sets where students question, explore, make conjectures, and solve problems using Polya’s approach to problem solving adapted to young students. This 4-step method provides a framework for doing mathematics similar to the scientific method for investigating any new problem in science.

Step 1: Understand the problem—make observations, compute examples. Define variable representing unknown quantities.

Step 2: Make a plan. Draw pictures, and possibly represent the problem algebraically with an equation.

Step 3: Carry out the plan. Solve the problem. Use different math techniques to solve equation or inequality or graphical representation.

Step 4: Check. Does the solution make sense and satisfy the conditions of the problem?
The program shows how to use the language of algebra for young students. This is not a program that teaches algebra using traditional approaches typical in high school with rules that they do not understand. Mathworks curriculum is designed to foster deep understanding of basic ideas through inquiry-based approaches to learning. Mathematics is taught in context, with real world examples motivating deeper understanding. The mathematics is transparent and at the heart of the curriculum. Students learn mathematics by exploring and doing mathematics.

**Analysis**

**Introduction**

Mathworks curriculum was developed by Texas Mathworks faculty originally for use in summer math camps. The curriculum was intended as supplementary material. Beginning in 1998, a teacher training component was added to enable new teachers to begin summer math camps in their own school districts.

The curriculum is aligned to the TEKS, but the current workbooks do not cover all of the TEKS. A three-year curriculum development project is underway to extend this curriculum to cover all of the 6th and 7th grade TEKS, while also weaving in algebra. The curriculum is standards-based, and makes algebra accessible to all students at a young age. The curriculum is especially suitable for ELL since it is hands-on and inquiry based. Moreover, the curriculum has been used with great success in ELL programs in Brownsville, where preliminary results show that learning content enhance language acquisition as well.

The professional development model is basically trainer of trainers. Master teachers and university faculty work together to train new teachers. The critical element is the formation of Math Inquiry Groups (MIGs) that enable school district teachers and administrators to develop a mathematical community that fully utilizes university resources. MIGs also inform university faculty of the real problems encountered in the district. In addition, MIGs provide a way to recruit and introduce undergraduates to the joy and excitement of teaching.

This PDM also provides a mechanism for continued professional growth for teachers as part of a graduate program leading to the masters degree in middle school math teaching.

**Details**

**Curriculum & Content**

Mathworks curriculum is designed to make algebra and more advanced mathematics accessible to all students. This curriculum encourages critical thinking and problem solving. The scope of the curriculum includes the following:

Level 1: Numbers, Integers, and Variables
Level 2: Fractions, Functions, measurement
Level 3: Algebra, Graphing, Geometry
Level 4: Combinatorics, patterns, sequences
Level 5: Higher level problem solving
Special features of the program are:

- Problems are explored in context.
- New mathematical ideas are motivated by examples.
- The program is hands-on and inquiry based.
- Students work both individually and in groups.
- Multiple approaches are used to solve different problems to address different learning styles.
- Teachers are supported through MIGs, that provide a setting for continuous professional growth and development.
- Teacher leaders help train other teachers, while building a mathematical community.
- MIGs encourage parental involvement through activities such as Family Math Nights.
- MIGs provide a way to fully utilize university resources.

The key to this program is the development of new mathematical ideas through carefully sequenced problems. Students learn why and not just how to use mathematical operations. Students have fun exploring challenging problems, and develop confidence in their ability to do higher level math.

Mathematical ideas are developed in a natural, mathematically sound framework. This framework is carefully aligned to state and national standards, while setting a new standard for what young students can achieve. By weaving in algebra, students are given the tools to do real mathematics and express themselves mathematically.

Applications reinforce student understanding. Precise math models are developed, and students learn to use math to solve problems in different areas.

**Pedagogy**
Teachers trained in summer training immediately use what they learn in teaching their own camps. They receive feedback and supervision from master teachers. The unique features of the training are that it is in-depth, provides a way for teachers to practice what they are taught, and builds a network that encourages continuous professional growth and development.

**Administration**
Teachers can participate individually in Mathworks training or as part of a program sponsored by their school district, grants, or other funding. Most participants are supported by school districts.

A critical component necessary to have systemic impact is having administrative support at all levels. This includes the superintendent, curriculum specialists, principal, and teachers. A plan is then developed for the district in conjunction with Mathworks. This plan involves numbers of teachers to be trained, and at what levels. Ideally, a leadership team will be developed that goes across grade levels.

**Specific Applications to ELL**

**Language Components & Delivery**
The Mathworks curriculum is only available in English. However, pre and post tests data have been gathered using the Orleans-Hanna Algebra prognosis test which was translated into Spanish.
The Mathworks program has been delivered through dual language instruction in Brownsville with excellent results.

**Learning Styles for ELL**

The Mathworks curriculum is designed to address different learning styles, which makes it very suitable for ELL. In addition, the hands-on activities and explorations encourage group interactions. Specific ELL needs that are addressed include:

1. Class activities encourage both individual exploration and class discussion.
2. Problems are discussed using multiple representations.
3. Students develop their own understandings of basic concepts, and then discuss and explain these to one another.
4. The learning environment promotes sharing of ideas and solutions.
5. Technology can be used when appropriate.
6. Students have fun exploring challenging problems together.
7. Open-ended questions challenge students to explore new concepts, and also provide the glue that ties together different sections.
8. Use of manipulatives and hands-on activities lead students from concrete examples to develop mathematical models, and then generalize and understand ideas more abstractly.
9. Basic skills are reinforced through spiraling curriculum that fosters deep understanding.
10. Students learn to “think deeply of simple things,” and understand the basic ideas that underlie seemingly complex problems.
11. Students develop confidence in their ability to do mathematics that reinforces language acquisition.

**Administration & Student Assessment**

School districts can begin offering summer math camps using existing curriculum. The present Mathworks curriculum is designed to complement different instructional materials now being used in the schools.

Mathworks is currently extending the curriculum to be a complete curriculum for grades 6 and 7.

Mathworks training for teachers involves a 4 week summer program, followed by school-year MIGs supported by university faculty.

**Model Assessment**

Teachers are observed in teaching both during the summer and school year. Data about the program is collected that measures teacher content knowledge with pre and post tests; teacher efficacy, and student results. General assessment is used, but this is not specifically for ELL. Teachers develop a teacher portfolio that is designed to meet national board standards.

Impact of the program on students is measured by pre and post tests using the Orleans-Hanna algebra prognosis test. Students have shown consistent gains in readiness to take algebra, and the gains are statistically significant for levels 1-3. This test has not been useful for levels 4 and 5 because of a ceiling effect since the students are already advanced past the level of the test.
Commentary

Strengths
1. The curriculum is inquiry-based and engages students in exploring mathematics deeply. The problems are carefully sequenced, and the program is aligned to state and national standards.
2. Teachers are encouraged to work together and share ideas through Math Inquiry Groups.
3. MIGs build a mathematical community that allows for continuous growth and development for all teachers. This allows the program to become systemic.
4. Teachers can further their education by obtaining a masters degree in middle school mathematics teaching.
5. Undergraduates learn about teaching through a field experience working with established teachers and students.
6. The program provides a setting for engaging families.
7. Individual teacher creativity and ideas are encouraged. Teachers learn how to build their own activities, without being forced into a rigid system. This allows teachers to meet the individual needs of their students, since one size does not fit all.
8. Mathworks training is in-depth and produces real change in the teaching of mathematics. It has the potential to be a powerful tool when used with ELL that could be effective in supporting language acquisition as well.
9. Activities and games make student learning fun. They reinforce student understanding, and allow for observing student understanding through alternative assessments.

Weaknesses
1. The curriculum is still under development. The curriculum begins at grade 6-7, so it is not clear how well this will fit with the curriculum that students use in previous grade levels.
2. A teacher guide is not yet completed.
3. There needs to be a system in place to certify master teachers. Currently the master teachers are trained in doing the program itself, but additional training is needed for the master teachers on how to do classroom observations and train new teachers.
4. The program does not address ELL specifically, although it has been effective when used with ELL. More needs to be done. For example, this program would benefit by having specific vocabulary used by ELL done bilingually.
5. The training model uses faculty from one university to work with school districts. To scale this model up, a program needs to be developed to offer this program through other universities.
6. For a teacher who is accustomed to the standard lecture format of teaching, this model will require some transition to a problem-centered and student-led environment. Teachers must learn to guide without telling the answers. This requires training and experience.
NCTM Navigations

Overview

Origination
Developed by various groups under the auspices of the National Council of Teachers of Mathematics (NCTM). Navigations is a collection of supplementary mathematics books for teachers. These are a resource for teachers that are intended to help teachers make mathematics fun for students, while covering key ideas from the NCTM Standards.

Administration
NCTM sponsors and administers the program.

Induction
The Navigations series has been under development since 2001. New books are still being developed.

Implementation
Training is conducted on-line through E-workshops. The idea is to provide for a free flow of ideas between participants, who will share ideas about what works best, what doesn’t, and why.

Instigation
Navigations was developed to help teachers implement the Standards. The intent was to provide a resource that would help teachers regardless of what curriculum they were using.

Philosophy
Navigations is intended to help teachers by providing activities and problems that cover the Standards. Lessons are structured with components that include:

a. Goals of the lesson, and what students will learn
b. Materials and Equipment needed for the lesson
c. Activity that students will explore
d. Discussion of how the lesson might be taught, and possible student reactions
e. What Might Students Already Know about These Ideas?

The model for training teachers is through e-workshops. These workshops provide a forum to discuss the lessons, how to implement them, and possible problems that might be encountered.

Analysis

Introduction
Navigations is a collection of supplementary mathematics books for teachers. Navigations series include Algebra, Geometry, Data Analysis and Probability, Numbers and Operations, Measurement, Problem Solving and Reasoning. The general format for a series is to divide into levels—Pre K-2, Grades 3-5, Grades 6-8 and Grades 9-12. However, Navigations is now developing new books in Discrete Math for PreK-5, and Grades 6-12; as well as Problem Solving and Reasoning for
specific grades. The algebra, geometry, data analysis and probability are completed. The other series are still under construction.

**Who developed the model**
The series was developed under the auspices of the National Council of Teachers of Mathematics, which is the largest professional teacher organization of math teachers in the country. The NCTM selected different groups to work on different grade levels.

**How the model works**
Navigations workbooks are intended as supplementary material for teachers, that will show teachers how to teach NCTM standards-based curriculum. Initially, NCTM tried to train teachers to use the books through academies, but these have been discontinued. Apparently there was a problem with the cost factor ($299 per participant, plus travel), and districts not having enough resources to support this. The newest model of training that is being developed is E-workshops. E-workshops cost $65 per teacher, and are generally 1-2 hours in length. There is then a follow-up session 2-3 weeks later at no additional charge.

**Who is it aimed at**
E-workshops are aimed at teachers who will be using the books. The books and workshops are for teachers, and include Pre K-12 teachers.

**How long has it been used**
Navigations workbooks first began appearing in 2001, with new books still being developed. The E-workshops were introduced in 2005.

**How is the training conducted**
Training is conducted on-line through E-workshops. The idea is to provide for a free flow of ideas between participants, who will share ideas about what works best, what doesn’t, and suggestions for using Navigations with students.

**Details**

**Curriculum & Content**
The aim of the curriculum is to provide teachers a way to make math fun, and help teachers teach algebra and other areas of mathematics.

**Curriculum Style**
The curriculum is supplementary material for teachers, not for students.

**Categorization**
The content is linked to NCTM standards.

**Pedagogy**
Teachers are trained by E-workshops. The unique aspect of the training is that it provides a forum for a free flow of ideas between participants. Another interesting concept is the follow-up session where teachers discuss what is working and any problems that arise. A workshop generally takes 1-2 hours to complete.

**Administration**
The cost of an E-workshop is $65 per teacher. The Navigations Series workbooks cost $31.95 each, $25.56 for NCTM members.
Specific Applications to ELL

Language Components & Delivery
This PDM has not been used specifically for ELL. The content is delivered in English only. Nonetheless, the Navigation series provides an interesting and engaging collection of standards-based activities for teachers, and this type of inquiry-based resource might prove beneficial and useful for ELL.

Learning Styles for ELL
The workbooks provide interesting math activities that address different learning styles—visual, kinesthetic. However, these are not specifically targeted for ELL.

Administration & Student Assessment
The model has not been used for ELL, so no information is available here addressing specific programs that administrators use to deliver the content for ELL.

Model Assessment
No assessment for Navigations has been done.

Commentary
Strengths
1. Navigations provides a valuable resource for teachers that is linked to NCTM standards. The goal is to show how teachers can teach algebra and other mathematics in a fun and interesting way for students.
2. Building a community through e-workshops is a cost-effective way to train teachers.

Weaknesses
1. This is not linked to any school curriculum, and is only intended as supplementary material. In particular, in Texas, the problem is that it is not aligned to the TEKS.
2. There is no data about the effectiveness of the teacher training. The question is what is the effect of the e-workshops on teachers.
3. The training is very limited. A short 1-day E-workshop will not in general improve teacher content knowledge. This may help guide the teacher to other resources, and provide an interesting resource. But there is a question if this will be effective in changing teacher practice.
4. The most interesting aspect is that of possibly extending the E-training to forming on-line mathematical communities, combining this approach with additional in-depth teacher training.
5. The program is not targeted to ELL.
Sharon Wells
Overview
Origination
This model is currently in use by 180 districts in Texas. It is designed specifically for Texas by Sharon Wells, a former Texas teacher, who taught for 28 years in Texas at Brownsville and Lubbock schools. The program originated in Brownsville in 1993.

Administration
Sharon Wells.

(PDM Business name: Sharon Wells Consulting, Inc.).

(Curriculum Business name: Sharon Wells Mathematics Curriculum, Inc.). Sharon Wells Consulting, Inc., is approved by the State Board for Educator Certification as a Provider of Continuing Professional Development (Provider #500252). Teachers receive continuing education hours for all workshops attended.

Induction
Used for in-service teacher training since 1993.

Implementation
Sharon Wells Math is designed specifically for Texas educators by a former Texas teacher with step-by-step guidelines for classroom implementation. This spiraling curriculum is developed for Grades 2-6, with 2-5 also available in Spanish. These levels are in-serviced in the grade specific curriculum, which is aligned to the TEKS and addresses tested areas of the TAKS. All grade levels include a focus on problem solving strategies, graphing skills as required by grade levels, basic facts or review activities, and the use of manipulative materials in a problem-solving format to teach content knowledge.

Teachers attend workshops that are limited to 50 participants per day for each specific grade level. It is highly recommended that content mastery and special education teachers attend these workshops. Each grade level receives a separate 6 hour in-service workshop for each 6 weeks of instruction. The workshops are scheduled for presentation prior to each new 6 weeks. Each contract receives a master curriculum package to be printed for each teacher for the up-coming 6 week session. The packet contains a sequential guide for each 6 weeks, which includes teacher instructions with appropriate materials lists, all necessary black line masters, student assessments, TAKS formatted practice questions, and a classroom profile sheet for tracking student progress. All of these materials for grades 2-5 are available in Spanish.

Instigation
Sharon Wells was a teacher in Texas who saw the need for a curriculum that addressed the specific educational needs in Texas.
Philosophy
Sharon Wells Math is a conceptually based spiraling curriculum that is geared towards the development of student problem solving skills and abilities. The curriculum is designed to provide opportunities for students to actively engage in learning, to offer students challenges, stimulation, and support, and to prepare students for an ever-evolving future.

Analysis
Introduction
Sharon Wells’ curriculum is developed for Grades 2-6 with attention to grade level appropriate scope and sequence, is aimed at teaching students to solve problems, and is conceptually based. The grade specific curriculum, which is aligned to the TEKS and addresses tested areas of the TAKS, is given to the participating in-service teachers at the beginning of each 6 week interval. All grade levels include a focus on problem solving strategies, graphing skills as required by grade levels, basic facts or review activities, and the use of manipulative materials in a problem-solving format to teach content knowledge.

Details
Curriculum & Content
Each contract receives a master curriculum package to be printed for each teacher for the up-coming 6 week session. The packet contains a sequential guide for each 6 weeks, which includes teacher instructions with appropriate materials lists, all necessary black line masters, student assessments, TAKS formatted practice questions, and a classroom profile sheet for tracking student progress. All of these materials for grades 2-5 are available in Spanish. The activities used involve active learning and address different learning styles. The teacher materials state that they are developed by Sharon Wells Mathematics Curriculum, Inc. and presented by one source only, Sharon Wells Consulting, Inc.

Pedagogy
Teachers attend workshops that are limited to 50 participants per day for each specific grade level. It is recommended that content mastery and special education teachers attend these workshops. Each grade level receives a separate 6 hour in-service workshop for each 6 weeks of instruction. The workshops are scheduled for presentation prior to each new 6 weeks. Teachers may receive continuing education hours for each workshop that they attend.

Administration
Administrators buy into the Sharon Wells Math model because a former Texas teacher specifically designs it for the Texas education system and the students in Texas. The model contains elements that directly address ELL but also works for many types of students. The curriculum fee is $7,500 per grade level. There is a $3,750 maintenance fee per grade level. Consultant travel expenses, manipulatives and supplies, and participant handouts, are paid for by the district.
Specific Applications to ELL

Language Components & Delivery
The curriculum for grades 2-5 is available in Spanish. The Spanish version, for Grade 6, is currently being developed. This program is designed for extensive use in the Texas geographical regions with a high level of ELL.

Learning Styles for ELL
All grade levels include a focus on problem solving strategies, graphing skills as required by grade levels, basic facts or review activities, and the use of manipulative materials in a problem-solving format to teach content knowledge. There is no obvious information given that addresses social and inter-personal student skills other than those already mentioned that involve the family.

Administration & Student Assessment
Administration, other than the training workshops, is mandated and handled by the school personnel with back-up support from Sharon Wells, herself. Each contract receives a master curriculum package to be printed for each teacher for the upcoming 6 week session. The packet contains a sequential guide for each 6 weeks, which includes teacher instructions with appropriate materials lists, all necessary black line masters, student assessments, TAKS formatted practice questions, and a classroom profile sheet for tracking student progress.

Model Assessment
In 2004, Sharon Wells paid to have several independent studies run to assess her math program and the effect of her curriculum on student passing rates. The five studies with summary commentary are described below.

Study # 1 is an examination of the passing rates of students in schools characterized by different levels of implementation of the SWM curriculum. Three groups were identified: non-implementing comparison schools, schools with a moderate degree of implementation, and schools with a greater degree of implementation, including more grade levels and over a greater period of time. Commentary were that significant statistical differences existed between schools implementing the SWMC and those not implementing it at grade levels 3, 4, and 5, but not for grade 6.

Study # 2 is an examination of the effects of the SWM curriculum on passing rates of students from different racial/ethnic populations. Commentary were that significant statistical differences existed between passing rates by race/ethnicity for African Americans and Hispanic students but not for Caucasians.

Study # 3 is an examination of the change in student passing rates from 1999 to 2003, and the effect of the degree to which the SWM curriculum was implemented on each campus. Commentary were that significant statistical differences existed for both degree of implementation and year as well as interaction effect, and time on implementation.

Study # 4 is an examination of teacher effects (i.e., years of experience) and degree of implementation on student passing rates in grades 3, 4, and 5. Commentary were that significant statistical differences existed between the degree of implementation
and the teaching experience of those teachers implementing the curriculum and student passing rates at all 3 grade levels tested.

Study # 5 is an analysis of implementing schools that aims at identifying factors that might predict student passing-rates. Commentary from this analysis were that the variable most related to student passing rate was the daily attendance rate of the academically disadvantaged students. Teaching experience of faculty was also significant related to passing rate.

Commentary
This model focuses on problem solving strategies, graphing skills as required by grade levels 2-6, basic facts or review activities, and the use of manipulative materials in a problem-solving format to teach content knowledge. Positive aspects are: the custom design for Texas by a Texas teacher, curricular materials designed by a teacher for teachers, support workshops, and ease of speaking to Sharon Wells herself. Teachers that I have spoken with, who work with ELL students, love this curriculum.

All testing samples viewed were in multiple-choice format only; no open-ended questions were presented. For a problem solving based curriculum, this seems unusual. Some teachers refer to this model as a series of worksheets.
Sheltered Instruction (SIOP)

Overview

Origination
A research grant funded through the Office of Educational Research and Improvement’s Center for Research on Excellence, Education, and Diversity (CREDE). The center has researchers at twenty-six institutions across the US.

Administration
Jana Echevarria, Deborah Short, and Mary Ellen Vogt.

Induction
Developed in 1996.

Implementation
The SIOP Model has 30 indicators of effective sheltered instruction that are organized under two main areas: lesson planning, and coaching and inquiry sessions. SI has eight major components: lesson preparation, interaction, building background, practice/application, comprehensible input, lesson delivery, strategies, and review/assessment.

Lesson preparation involves content objectives, language objectives, meaningful activities, curriculum adaptation, supplementary materials, and content concepts that are age appropriate.

Interaction involves offering frequent opportunities for interaction, using a variety of grouping configurations, using wait time, and using native language support when it is advantageous.

Building background involves linking concepts to background experiences, linking concepts to prior learning, and introducing and teaching key vocabulary.

Practice/application involves providing practice opportunities for students to apply content and language objectives, using hands-on activities and manipulatives, and integrating reading, writing, speaking, and listening.

Comprehensible input involves clear articulation of words and sentences, speech that is neither too fast nor too slow, and the use of visuals, body language, models, film, etc., to make content accessible.

Lesson delivery involves covering the content objectives, pacing appropriately, active participation 90% of the time, and covering the language objectives.

Strategies involve providing opportunities for students to use strategies, using scaffolding techniques consistently, and using a variety of question types.

Review/assessment involves reviewing key concepts and vocabulary, providing feedback regularly, and providing a variety of pathways for students to demonstrate mastery of knowledge and skills.
By their own definition, Sheltered Instruction is a series of methods and techniques that teachers can use to help English Language Learners more easily understand and acquire English and content area knowledge and skills.

Instigation
Research from the CREDE Center found that the best method to encourage long-term academic achievement for ELL that did not involve dual language delivery was transitional Bilingual Education, including ESL taught through academic content. Sheltered Instruction was designed by CREDE researchers to address this need.

Philosophy
The rationale for Sheltered Instruction is: 1. To dispel myths about English Language Learners, 2. To raise teacher and student expectations, 3. To increase academic achievement in the content areas, and 4. To accelerate second language acquisition to ensure adequate yearly progress (AYP).

Analysis
Introduction
The goals of SIOP, the Professional Development Institute, are: 1. To understand the research-based framework of the sheltered instruction approach for ELL, 2. To become familiar with the eight components of effective sheltered instruction lessons, 3. To practice observing and evaluating sheltered instruction lessons, and 4. To develop the skills and strategies for teaching teachers, coaches, administrators, and teacher educators to use the SIOP through professional development.

(1) The current Sheltered Instruction Observation Protocol Model was developed by Jana Echevarria, Mary Ellen Vogt, and Deborah Short; and is designed to teach content to ELL by means of a research based practices framework for instruction. Dr. Jana Echevarria is Chair of the Department of Educational Psychology, Administration and Counseling at California State University at Long Beach and is currently a Principle Investigator for the OERI’s center for Research on Excellence, Education, and Diversity (CREDE). She has made numerous (over 50) related presentations over the past 15 years. Mary Ellen Vogt is a Professor of Education at California State University, and Co-Director of the California State University Center for the Advancement of Reading. Deborah Short is the Director of the Language, Education, and Academic Development division of the Center for Applied Linguistics (CAL) in Washington DC. She has worked on two national research projects through CREDE, including the project that sponsored SIOP’s development in 1996.

(2) The SIOP model is designed to provide a coherent method for schools to assimilate sound practices by: organizing instructional methods and techniques, ensuring that effective practices are being implemented, and providing ways to quantify the extent of this implementation. The model is intended to coordinate, structure, and function with other school programs that improve instruction.

(3) This model is aimed at K-12 teachers, administrators for K-12 instructional programs, Professional and Staff developers, Professors an Teacher Educators, and School Teams (reading specialists, teachers, ESL/bilingual teachers, special educators, principals).
(4) It is currently used in hundreds of schools in most of the 50 states and in several other countries. This model originated from a CREDE National Research Study in 1996.

(5) The training is conducted using a trainer of trainers model delivered through Institutes (workshops), supported by follow-up and mentoring workshops throughout the school year, as necessary.

Details

Curriculum & Content
SI does not have a curriculum component. SI is designed as an umbrella under which any curriculum can be delivered. Sheltered Instruction is a series of methods and techniques that teachers can use to help English Language Learners more easily understand and acquire English and content area knowledge and skills.

Pedagogy
The training is conducted using a trainer of trainers model delivered through a series of Institutes. Some of the Institutes are: SIOP I, SIOP II, and Administrator SIOP. The Institutes are aimed at K-12 teachers, administrators for K-12 instructional programs, Professional and Staff developers, Professors and Teacher Educators, and School Teams (reading specialists, teachers, ESL/bilingual teachers, special educators, principals). There are books, videotapes, observations, and actual lesson plans available to facilitate implementation. Trainee led follow-up and mentoring workshops throughout the school year are recommended.

Administration
The Training Institutes begin at $650 per person. Administrators buy into the SI model because it can be couched in any curriculum already in use, it is research based, a few people can be trained to train others, and it specifically aims at ELL. The concept of instruction delivered through strategies aimed exactly at ELL is highly important to administrators in most geographical regions of Texas.

Specific Applications to ELL

Language Components & Delivery
Research data compiled from the CREDE Center found that the best method to encourage long-term academic achievement for ELL that did not involve dual language delivery was transitional Bilingual Education, including ESL taught through academic content. Sheltered Instruction was designed by CREDE researchers to address this need. The training module includes explicit and implicit connections to the Language Skills in the content areas of the TEKS and TAKS.

Learning Styles for ELL
Relative to learning strategies for ELL, SI tenets are: 1. The curriculum determines the strategy, 2. Start with a small number of strategies, 3. Use tasks of moderate difficulty, 4. Choose strategies with strong empirical support, and 5. Use strategies that apply to different content domains.

Videotapes of the teacher’s interpersonal activities are analyzed by judging: feedback and objective data, safety and trust, reflection and self assessment, and interpersonal process recall techniques, such as, stimulated recall, mutual recall, and
relationship building. Social and interpersonal characteristics for students are
addressed by using various grouping techniques.

Administration & Student Assessment
Based on extensive data from the CREDE Center and a scarcity of Bilingual and ESL
teachers in most states, Sheltered Instruction was designed by CREDE researchers to
address the need for an instructional model that did not involve dual language
delivery but integrated transitional Bilingual Education, including ESL taught through
academic content.

Recommended teacher review/assessment is conducted by means of the Observation
Protocol, which is administered yearly, the first one occurring approximately one year
after training.

Model Assessment
There are numerous articles that exist due to the widespread use of this SIOP model.
Most of these articles are of a qualitative observation type. The strongest
quantitative research found is the foundation Thomas and Collier CREDE work (from
1985-present) supporting the original need for such a model.

Commentary
This model is research based and well thought out. The Institutes are quite costly
and on-going teacher training and mentoring is necessary throughout the school
year. The Observation Protocol is complicated and estimates are that a teacher
should use the SI model at least one year before being graded by this instrument.

The strategies and methods related to the mathematics content area have been
described as weak by a SIOP trainer who is a college level mathematics teacher. A
basic concern is that this model does not address math content specifically.
**Overview**

**Origination**
The Texteams started at Texas Educational Agency (TEA) in the 80’s. The Texteams Math Institute was developed in the mid 90’s by the Dana Center under the Texas Statewide Systemic Initiative as a state-level mathematics program and funded by the Eisenhower Discretionary Funds.

**Administration**
The Charles A. Dana Center, under the direction of Uri Treisman, worked with teams of teachers, former teachers (such as district mathematics supervisors) and university mathematics educators. Cathy Seeley, currently NCTM president, managed Texteams while she was director of mathematics at TEA at its inception.

**Induction**
Texteams began in the 80’s but its current form has been used since the mid 90’s when Texteam Math Institutes began offering professional development.

**Implementation**
Texteams is a comprehensive system of professional development based on the mathematics and science Texas Essential Knowledge and Skills (TEKS). Professional Development is provided through a trained network of leaders who then provide training to teachers from that area on a more local level that is customized to meet the needs of a district or school.

**Instigation**
The implementation of the Texas Essential Knowledge and Skills (TEKS) and TEKS-based assessment formerly called the TAAS and now called the Texas Assessment of Knowledge and Skills (TAKS), created a need to train teachers to understand and implement the objectives in order to promote student achievement on the TAKS.

**Philosophy**
The Institute is developed around the following philosophy and beliefs:

- Teachers at all levels benefit from extending their own mathematical and scientific knowledge and understanding to include new content and new ways of conceptualizing the content they already possess.
- Professional development experiences, much like the school mathematics and science curriculum itself, should focus on a few activities in great depth.
- Professional development experiences must provide opportunities for teachers to connect and apply what they have learned to their day-to-day teaching.

**Analysis**

**Introduction**
Texteams, which stands for Texas Teachers Empowered in Mathematics and Science, is a comprehensive system of professional development based on the mathematics and science Texas Essential Knowledge and Skills (TEKS). Professional Development is provided through a trained network of leaders who then provide training on a more local level that is customized to meet the needs of a district or school. As of
February 2003, over 100,000 teachers statewide had attended at least one mathematics or science Texteams institute.

In the 90's the Dana Center, a research unit of the College of Natural Sciences at The University of Texas at Austin, led the development of the Texas Essential Knowledge and Skills standards in mathematics and science. As part of the Texas Statewide Systemic Initiative, the Dana Center with funding from the Eisenhower Discretionary funds developed Texteams Math Institutes as the state-level math program to provide professional development. The institute used master leaders to train leaders - a trainer of trainer model. Those providers that attended the trainer sessions were allowed to present the institute to groups of teachers. They were required to present the institute as it was presented to them. The trainer of trainer sessions were conducted on consecutive days, but the turn-around sessions could be conducted non-consecutively over the school year.

The training covers teachers for grades pre-K to 12th grade. The Dana Center is no longer actively engaging writing teams to develop new institutes. Currently 17 different institutes are offered.

**Details**

**Curriculum & Content**

The Texteams Institutes feature:

- Integration of manipulative materials or graphing technology. The emphasis of Texteams Institutes is on mathematics or science, not on learning about particular manipulative materials or formulaic approaches.
- Hands-on approach with “get-up-and-move” activities Institutes are designed to foster critical thinking with hands-on experiences.
- Multiple representations (verbal, concrete, pictorial, tabular, symbolic, graphical) Scientific or mathematical ideas are represented in many different formats, helping both teachers and students understand mathematical or scientific relationships in different ways.
- Questioning strategies A variety of questions are developed within each learning experience to elicit deep levels of mathematical or scientific understanding and proficiency.
- Rich connections Institutes focus on using important ideas that connect various mathematical topics and scientific principles to other content areas and applications.

Since the main objective of the institutes is to address TEKS and TAKS objectives, they are thus organized around the five main TEKS content strands: number and operation, patterns and algebraic thinking, geometry and spatial sense, measurement, and probability and statistics. The Mathematics Institutes are usually 3-5 day workshops and focus on the contents indicated above. Participants engage in activities and discussions that examine and explore mathematical concepts and at the same time deepen their content understanding.

The writer e-mailed questions regarding Texteams to the Dana Center. A research associate who has been working with the Dana Center since 1996 responded to the writer’s inquiries. Included are some of her e-mail responses. In terms of the aim of the Texteams curriculum, the respondent writes, “the first iteration of this
professional development was in modules, a collection of activities for teachers to use in the classroom. Around 1995, during the development of the TEKS, the format of Texteams changed to a more in-depth, content-focused professional development experience. The number of days increased and the modules became institutes. The focus of the mathematics was to support teacher’s content knowledge about the mathematics they were teaching, not necessarily classroom ready activities.” Furthermore, the respondent writes, “the institutes were planned to integrate with each other. There was a belief that teachers needed to experience mathematics learning as promoted by the NCTM Standards. Therefore, there was an effort to include technology when appropriate, manipulatives when appropriate, multiple representations and communications.”

Specific Mathematics Institutes include:

Mathematics Institute for Pre-kindergarten and Kindergarten Teachers

Designed to enhance participants’ knowledge and understanding in five content strands: number and operation, patterns and algebraic thinking, geometry and spatial sense, measurement, and probability and statistics. Use student work and videos to focus on young children’s understanding of mathematics.

Rethinking Elementary Mathematics Institute Grades 1-5, Part I

Focus on developing students’ number sense and computational fluency and the effective use of an instructional planning guide that includes identifying mathematical content to be learned, describing evidence of a students’ understanding of that content, and building questions and tasks to elicit evidence of understanding that can be recognized by both teachers and students.

Rethinking Elementary Mathematics Institute Grades 1-5, Part 2

Incorporates aspects of number sense and computational fluency along with the instructional planning process in applications involving measurement, geometry, probability, and statistics.

Rethinking Middle School Mathematics: Using Problem Solving Across TEKS

Focus on helping students use and master problem solving while deepening their own understanding of what problem solving means.

Rethinking Middle School Mathematics: Algebraic Reasoning Across the TEKS

Highlights the algebraic “habits of mind” called for in the TEKS by building and making connections between concrete, verbal, numeric, graphic, and symbolic representations of relationships between quantities.

Rethinking Middle School Mathematics: Geometry Across the TEKS

Focus on geometric concepts: geometric structure, transformations, triangles, plane figures, and solids.

Rethinking Middle School Mathematics: Numerical Reasoning Across the TEKS
Helps teachers bridge the gap from students’ understanding of whole numbers to the understanding of the rational number system.

Rethinking Middle School Mathematics: Proportionality Across the TEKS

Focus on the development of the properties, language, and representations of proportional relationships that arise from number, operation, algebra, probability, statistics, measurement, and geometry.

Rethinking Secondary Mathematics: Statistical Reasoning Across the TEKS

Engage in activities and discussions that strengthen their own content knowledge in probability and statistics.

Algebra I: 2000 and Beyond

Helps teachers bridge the gap from students’ concrete understanding of arithmetic to the functions-based algebra. Participants engage in activities and discussions that promote the teaching, learning, and assessment of algebra for everyone. Using multiple representations, appropriate technology, and concrete models, the institute broadens and deepens teacher content knowledge and instructional strategies.

High School Geometry: Supporting TEKS & TAKS

Focus on Geometric concepts-geometric structure, transformations, triangles, plane figures, and solids for high school TEKS and TAKS.

Part 1: Algebra II/Pre calculus Institute

Designed to extend participants’ understanding of the foundational concepts developed in the Algebra II and Pre calculus TEKS/ Explores functions, transformations, exponential and logarithmic functions, and power functions and polynomials.

Part 2: Algebra Institute

Examine assessments for alignment with TEKS and TAKS. Focus on methods for evaluating student work, developing strategies for classroom implementation, and making instructional decisions based on student work. Strategies for fitting the Algebra II assessments into a district’s yearly plan will also be discussed.

Part 2: Pre calculus Institute

Examine and explore the functions and concepts addressed in the Algebra II TEKS including matrices, linear programming, quadratic and square root functions, rational functions, and conic sections.

Rethinking Secondary Mathematics: Algebraic and Geometric Modeling

Focus on the development of “mathematical modeling” as a powerful process for use in all secondary mathematics courses.

Rethinking Secondary Mathematics: Statistical Reasoning Across the TEKS
Focus on the mathematical foundations of statistical reasoning and sound decision making.

In-depth Secondary Mathematics

Ideas from algebra, geometry and trigonometry are integrated in the analysis of a small number of particular problem situations to show what it means to treat them in a deep and general way.

**Pedagogy**

“The Dana Center believes that Texteams models pedagogy that deliberately engenders collaboration and active participation. It situates the teachers in the role of learners as well as instructors, allowing them to experience mathematics and science instruction from the perspective of their students. Having experienced the lessons from multiple perspectives, teachers gain a clearer understanding of the learning process that the lessons are intended to generate.” - from Lee Holcombe’s paper, “The Charles A. Dana Center’s Texteams Professional Development Model: Evidence for Effectiveness.”

According to the research associate from Dana Center, based on the availability of Eisenhower funding each year, the Dana Center would decide what institutes to develop or re-write. Highly qualified authors were contracted to write the materials and they were then reviewed by an advisory team and Dana Center staff. The authoring process usually took more than one year. The authors then trained a couple of groups of mathematics staff development providers, focused first on education service personnel and large district staff, then on any other providers that signed up and agreed to become a Leader and present this to other teachers in their geographic area in the next year. This group of trainers is referred to as “Leaders,” and those that presented on a frequent basis could document their training and became “Master Leaders.”

Regarding any unique aspects of Texteams training, the Dana Center research associate indicates that “the cluster of problems and the questions that are investigated” are unique to their institute.

**Administration**

An administrator contacts with a Leader or Master Leader to provide the training. The costs are determined between the trainer and the district.

**Specific Applications to ELL**

**Language Components & Delivery**

There was not a specific mandate to provide materials for any specific group of students. The materials were not written in Spanish. Providers could present in Spanish, but there was no recommendation for this.

**Learning Styles for ELL**

Multiple representations, concrete and visual models, and appropriate technology are ways that various learning styles are accommodated. “There is no advocacy for any special group.” according to the Dana Center research associate.
Model Assessment
Lee Holcombe wrote his dissertation on Texteams and used the information to write the article, The Charles A. Dana Center’s Texteams Professional Development Model: Evidence for Effectiveness available at http://www.utdnacenter.org/research/index.php. In Holcombe’s documentation of the Texteams PDM looking at three sections: Standards-Based Education and Effective Reform, Professional Development, and References. Holcombe finds positive effects of teacher participation in the Dana Center’s Texteams Algebra Institute on student learning as measured by student performance on the Algebra I End-Of-Course Exam in San Antonio high schools. Furthermore, Holcombe’s findings indicate that the characteristics of the Texteam PDM are “consistent with those identified in the literature as effective.” Holcombe adds, since “the institutes consist of 30 hours focused on particular grade levels and subjects, they provide teachers opportunities to learn how to question, analyze, change instruction, and teach challenging content.”

Commentary
Strength

1. Because the Texteam institutes were developed and designed using the Texas mathematics curricular framework, the alignment and assessment to the state curriculum and testing are in place.

Concern

2. Currently, with the Eisenhower funding at an end, the Texteams are unable to revise, develop, and offer trainer-of-trainer sessions.

Strength

3. The length of the institutes that extend for 3-5 days can provide time for in-depth discussion of content and pedagogy matters.

Concern

4. Focusing just on TEKS objectives may narrow the view of mathematics and keep the teachers from enriching the students’ learning. The goal becomes passing the TAKS.

Strength

5. Encourages collaboration and active participation at the institutes.

Concern

6. Without follow-up and continued support after the institutes, sustainable reform is difficult to attain.