An Analysis of Existing Professional Development to Support Mathematics for English Language Learners (MELL) Using the Texas State University System's MELL Classroom Practices Framework

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The MELL initiative is a partnership between the Texas State University System (TSUS), its component universities, and the Texas Education Agency (TEA).

Texas State University – San Marcos

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Introduction

During Phase I of the Year One scope of work, contingents from the five component schools of the Texas State University System (TSUS) worked in collaboration with the Texas Education Agency (TEA) to compile research on the various aspects of a multifaceted, multiyear initiative to address the mathematics achievement gap between English Language Learners (ELL) and English proficient students. Researchers and developers involved in the TSUS MELL initiative include statisticians, mathematicians, math educators, education specialists, learning theorists, and schoolteachers, with many of these fields represented by individuals from differing specialties. Their knowledge and experience along with a wealth of Year I research coalesced and was distilled into the TSUS MELL Classroom Practices Framework (CPF), a document of classroom practices that articulate the qualities of the classroom, instruction, and curriculum, that is ideally suited for ELL.

Previous Texas State University-San Marcos products that resulted from Year I of the TSUS Mathematics for English Language Learners (MELL) initiative include: (1) a report identifying twelve professional development programs currently used to train mathematics teachers in the state of Texas, (2) A matrix of traits and characteristics necessary for mathematics success for ELL, and (3) A matrix of traits and characteristics necessary for successful mathematics workshops for teachers of ELL.

The report identifying twelve professional development programs (PDPs) is designed to be a tool that teachers and administrators can use to compare various aspects of these professional development programs (PDPs). Using a custom formed template, researchers compiled a report that presents a cross-section of each PDP by describing origination, instigation, implementation strategies, costs, pedagogy styles, associated curricula, assessments of the program, and specific language aspects. The report then served as a tool for Texas State MELL researchers and developers to identify features that were consistent across programs or unique to a specific program.

The analysis document of professional development programs was created relative to the TSUS MELL CPF rubric. Each program is given a brief introduction that includes a summary of its particular features and strengths. Following the introduction is a set of six paragraphs. Each of these paragraphs highlights features of the program that correspond to one of the six main sections of the TSUS MELL CPF.

The six main sections articulated in the TSUS MELL CPF represent ideal practices for ELL that are classified under six category headings: (1) Learning Atmosphere & Physical Environment, (2) Instructional Practices, (3) Mathematics Content & Curriculum, (4) Language Practices, (5) Family & Community Involvement, and (6) Assessment of Student Learning. A copy of the TSUS MELL Classroom Practices Framework is found in Appendix A.

Analyzing each professional development program in terms of the TSUS MELL CPF allows for a more standardized assessment of the PDPs and shows how closely each program aligns with the prior research and analysis performed by the TSUS MELL research team. The best and most compatible components of these programs can, in the future, be assimilated into a best practices professional development program that is designed and customized for math teachers of ELL and administrators of ELL programs.

Cognitively Guided Instruction

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. 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.

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. This strategy is not textbook specific and has been proven effective for boys and girls of diverse social class, racial, ethnic, and English language proficiency backgrounds.

Learning Atmosphere & Physical Environment

One of the program's authors, Elizabeth Fennema, says about observing teachers who have experienced the CGI institute, "Certainly they know their children much better." This phrase alone seems to embody the sentiment in this section of the TSUS MELL CPF.

Instructional Practices

Teachers who have gone through the CGI summer institute and who implement the CGI techniques in their classrooms, foster cooperation and collaboration through the use of problem posing and problem solving activities. The program asks teachers to act as facilitators rather than presenters, but to be creative in posing problems that do allow students to move through multiple representations. The program promotes English language development through the use of peer and group problem solving.

Mathematics Content & Curriculum

Since CGI is a professional development program used with teachers of mathematics, there is no specific mathematics curriculum associated with the program. Nevertheless, curriculum style is put forth as an important component of the program. According to CGI literature, most U.S. elementary mathematics curriculum is filled with rote learning of low-level arithmetic. Incorporating CGI into classrooms precipitates a change in curriculum to one that is built around problem

solving. One activity for the teachers involves filling out problem templates to incorporate student realities.

Language Practices
The websites for both the Wisconsin Center for Educational Research (WCER) and its affiliated National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA) include a large body of work on the English Language Learner and the implications for the classroom with language diversity.

Family & Community Involvement
This section of the TSUS MELL CPF does not seem to be addressed in CGI institutes or in literature on CGI. One key focus of CGI is to create teacher communities that support and sustain professional development. Teachers in these communities conduct practical inquiry in their classrooms and share the results of their learning with their community.

Assessment of Student Learning
The CGI institutes encourage teachers to invite ELL students to first express themselves in the language they can use most comfortably. Extra time may then be necessary for translation. The benefit is that students are learning to communicate using math language that can later be transferred as students' English fluency increases. Homework that takes the form of problem solving not only promotes students' English language and thinking skills, but can help parents better understand the value of learning mathematics.

Connected Mathematics Project

The Connected Mathematics Project (CMP) is primarily a curriculum for grades 6 to 8, but its developers from Michigan State University have also produced an implementation guide as part of a larger professional development program. The curriculum is used in over 2,500 individual school districts and in all 50 states. The project has been rated highly by the American Association for the Advancement of Science and has been identified as one of the best mathematics curricula by the U.S. Department of Education's Mathematics and Science Expert Panel.

CMP is designed for teachers and students, research-based, standards-based, and it has been shown to be effective in numerous quantitative studies. One of CMP's most outstanding strengths is summed up in the "Connected" part of its name. The curriculum connects to student's prior knowledge (by reinforcing and building on it), it connects to student's lives, it connects various mathematical topics together, and it connects mathematics to other disciplines. This connected theme along with its carefully planned lessons make CMP easy for teachers to implement instructional practices that aid ELL.

Learning Atmosphere & Physical Environment

The connected mathematics project addresses many of the items in this section of TSUS MELL CPF very well. The *For CMP Teachers* area of the CMP website contains sub-areas titled *Organizing the Classroom* and *Special-Needs Students*. Here one finds, as one example, a teaching tip suggesting that teachers find opportunities for students who are struggling to present when the teacher knows the student has the correct answer, thus building confidence and esteem. Suggestions also include arranging the room to facilitate transitioning quickly from individual work to small group work and back.

Instructional Practices

Each Exploration in the Connected Mathematics Project curriculum encourages cooperation and collaboration through the use of group activities and discovery based learning. One of the foundational principles of CMP is built from the need to present concepts accurately, logically, and in engaging ways; always connecting to prior learning. While manipulatives are often used, it is not expressly clear that ideas progress in representation from the concrete to the abstract, though students are certainly surrounded with multiple modalities.

The main thrust of pedagogy, according to the program, is that good decisions and practice rely on deep understanding of the mathematics

that is embedded in the problems. According to CMP literature, curriculum and instruction are inextricably linked indicating that 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. The professional development portion of CMP emphasizes nearly all of the instructional practices articulated in the TSUS MELL CPF document.

Mathematics Content & Curriculum

Being a curriculum with national scope, the CMP was designed around the National Council of Mathematics Teachers *Standards*. 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. The CMP addresses this area of the TSUS MELL CPF better perhaps than any of the other five areas.

Language Practices

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.

Despite the availability of a Spanish Student Edition for each unit, as well as Spanish ancillaries (Spanish versions of all assessment resources, lab-sheets, transparencies, additional resources, and additional practice worksheets) and a Spanish-English glossary of mathematical terms, the CMP aligns only in part with the ideas embodied in the Language Practices section of the TSUS MELL CPF.

Family & Community Involvement

The *Implementation Guide* emphasizes community and family involvement, mostly to promote the benefits of implementing the CMP curriculum. It does not seem to emphasize frequent communication with families; nor are there projects that promote family involvement. There are pre-written letters for teachers to send to parents encouraging them to become involved in their child's math education. There is also a parent guide available titled, *Parent/Guardian Guide for*

Helping Your Child Learn Mathematics. CMP seems most weakly aligned to this section of the TSUS MELL CPF.

Assessment of Student Learning

The authors of CMP have extensive writing explicitly covering nearly all of the ideas in this section of the TSUS MELL CPF. In the *Teaching CMP* section of the CMP website, there are subsections titled *Homework*, *Grading*, and *Special Needs Students*. Not only do these areas address assessment abstractly, but they also provide examples that show flexibility in applying the assessment suggestions.

Everyday Math

Everyday Math is a research-based curriculum developed for K - 6 by the University of Chicago School Mathematics Project (UCSMP) in 1983. The Everyday Math textbooks are currently implemented in Dallas, Temple, San Marcos, and Lockhart ISDs, and over 175,000 classrooms throughout the nation. Professional development supports for Everyday Math implementation include: Onsite Professional Development, Online Modules, National User Conferences and a Staff-Development Curriculum, via a link to BRIDGES to Classroom Mathematics.

The teacher's guide is well scripted with directions, lesson time frames, activities, assessment questions, and materials, as well as suggestions for addressing diverse learners. The curriculum provides a flow of topics and ideas for teachers and students. The curriculum encourages students to construct their own understanding through exploring mathematical ideas, utilizing alternative algorithms and strategies, and communicating their findings. Teachers have opportunities for assessment of student work through activities and games—not merely pencil and paper work.

Learning Atmosphere & Physical Environment

Everyday Math 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 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. Establishing a framework for dialogue about mathematics between the teacher and students and among the students helps students clarify and refine ideas and strategies in problem solving.

Instructional Practices

Problems are linked into situations and put into contexts relevant to the everyday lives of students. Balanced instruction that includes whole group, small group, partner, or individual activities is encouraged. Multiple methods for basic skills practice that includes math routines, math boxes for review, and games, incorporate different modalities and homework formats. 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.

Mathematics Content & Curriculum

The curriculum allows students to construct an understanding of mathematics from their own experiences. Important concepts or skills recur with variations throughout the curriculum, and concepts are introduced and revisited in a variety of formats providing practice each time. Multiple representations of concepts are also presented. A glossary of mathematical terms is available in the Student Reference book and key terms are available in the Teacher's Guide. The content is aligned to NCTM standards and based on the Math Strands (Algebra and Uses of Variables, Data and Chance, Geometry and Spatial Sense, Measure and Measurement, Numeration and Order, Patterns, Functions, and Sequences, Operations and Reference Frames).

Language Practices

Everyday Math addresses diverse learners without, for the most part, targeting English language learners. However, the following practices can support ELL students through practices that include: activities utilizing different groupings from individual, paired, small group, and whole class, multiple representations of concepts, and invented strategies or algorithms. A learning environment of sharing ideas and strategies is promoted. Technology is incorporated in lessons that also encourage students to make sense of the answer. Student communication of meaning and understanding is encouraged. Games are often incorporated in lessons to motivate students to reinforce and practice skills and concepts and considered an important part of the curriculum. Basic skills problems along with open-ended questions address a range of abilities. Use of manipulatives and hands-on activities "provide support for students as they progress from intuitive to formal thinking." (Carroll 1998).

Family & Community Involvement

Grades 1-3 have Home Links as assignments in the textbooks. Home Links are intended to promote follow-up at home, offer 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. Home Connection Handbooks for parents are also available that suggest ways to enhance home-school communication and parent involvement with and support for students.

Assessment of Student Learning

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.

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. Product Assessment may include creating a portfolio of student work such as homework, drawings, and written projects such as journals. Suggestions are built into the Teacher's Guide. Periodic assessments are incorporated via end-of-unit reviews and assessment lessons and activities in the textbook.

FAMILY MATH (EQUALS)

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. The roots for the FAMILY MATH program began with the 1970s singular purpose to get girls interested in math, however, the original working project program 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.

This program is founded on problem solving, 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, available in Spanish and English, and use familiar objects whenever possible. The program has widespread appeal.

Learning Atmosphere & Physical Environment

FAMILY MATH is designed around the need for a safe environment in which at-risk students can learn math. The Math Class Leader acts as a facilitator who may not know each of the participants in the FAMILY MATH class as individuals, but who provides a venue for the child and family members to work on math together. Thus, in a FAMILY MATH class, the family members fill the role of teacher. The first chapter of the FAMILY MATH text entitled *A Mathematical Environment* expounds upon many of the components of an emotionally safe environment described in the TSUS MELL CPF.

Instructional Practices

FAMILY MATH intends for family members to work together in collaboration. The Math Class Leader need only be a motivated member of the community; thus, the program does not necessarily include any of the instructional practices listed in the TSUS MELL CPF.

Mathematics Content & Curriculum

The FAMILY MATH curriculum addresses NCTM Standards as well as California Standards. The curriculum focuses on developing problem solving skills with an emphasis on real-world contextual problems, and building a conceptual understanding of mathematics with hands-on materials. The FAMILY MATH content connects to content taught in schools including algebra, probability, statistics, estimation, logic, geometry, and measurement.

Language Practices
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. By encouraging family members to speak in their most cognitively advanced language during the math sessions, this program could impress upon all members of the family the importance and utility of carrying this practice back to the home. This would, in turn, cause the effect on mathematical content development to be, not only perceptible, but also lasting.

Family & Community Involvement
This section of the TSUS MELL CPF is where FAMILY MATH really shines. A school that supports FAMILY MATH connects to family-life through the curriculum, which embeds contextual experiences and promotes family interaction. Teachers who instigate and set up a FAMILY MATH event necessarily communicate with families to solicit involvement for the event. They will likely also utilize community resources in the process.

Assessment of Student Learning
Valuing a safe environment over measured progress, FAMILY MATH purposely leaves out assessment. The program is intended to be an informal learning experience for everyone. FAMILY MATH also places an emphasis on the process of doing mathematics rather than on getting a correct answer. There are some remarks about the uses and meanings of results from standardized tests as well as conclusions that cannot be drawn from these tests, but FAMILY MATH suggests that attributes such as sticking with a problem or using multiple strategies to solve a problem are more important than attributes that can be measured by standardized tests.

Figure This! Math Challenges for Families

Figure This! Math Challenges for Families is in essence a set of 80 intriguing, middle-school-level math problems created by NCTM. This problem set is designed to evoke a positive attitude towards mathematics from middle-school-level students. The family members certainly know their child as an individual, and should, in general, support the qualities of the ideal teacher that are presented in the first section of the TSUS MELL CPF.

The outstanding strength of Figure This! is that its impact is subtle and non-disruptive of established teaching styles or curriculum. In much the same way as medical professionals have suggested the subtle change of taking the stairs rather than the elevator to reverse the rampant increase in obesity in this country, Figure This! authors seem to be suggesting that the subtle change of involving families in a child's study of interesting contextual mathematical problems could change prevalent social attitudes and perceptions towards mathematics. The effect would increase motivation, which is believed, by many, to be the key to unlocking the mathematical problem solving potential of every child.

Learning Atmosphere & Physical Environment

In general, a student's home is an emotionally safe environment. Unfortunately, this is neither true for all students nor is it an aspect teachers have control over. Figure This! seems to offer little in addressing this portion of the TSUS MELL CPF.

Instructional Practices

The teachers are given a liberal amount of freedom in their use of the Figure This! materials. There are no workshops, institutes, or seminars to attend. There are no online courses. There is, however, an extensive amount of reading to do in order for the teacher to become familiar with all 80 challenges. Since Figure This! was not designed to be used in a classroom it does not explicitly address many points in this section of the TSUS MELL CPF.

Mathematics Content & Curriculum

The curriculum is designed around the National Council of Teachers of Mathematics' *Principles and Standards for School Mathematics*. It consists of 80 challenges. There is no prescribed order that challenges should be completed 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 it should not be weak in meeting any of the NCTM standards. Still it only aligns in part with the ideas presented in this section of the TSUS MELL CPF.

Language Practices
The language used in each Figure This! challenge is age and grade level appropriate, although this is inferred from reading each challenge and not explicitly stated in literature about the program. There are Spanish versions available for some of the challenges as well as brochures and letters to send parents in Spanish, but as with the other sections, Figure This! is not well aligned with this section of TSUS MELL CPF.

Family & Community Involvement
Family is a foundational aspect in Figure This! Math Challenges for Families. Every challenge promotes family interaction, and with the availability of some Spanish versions allows some linguistically diverse families to work together in the parent/guardian's most cognitively advanced language. The teacher-parent communication that does take place cannot necessarily be considered frequent. That teachers are not essential players in this program keeps it from aligning well with even this section of the TSUS MELL CPF.

Assessment of Student Learning
Assessment is not a component of Figure This!, therefore it does not address this section of the TSUS MELL CPF.

Investigations

Investigations in Number, Data, and Space, is a K-5 curriculum developed at the Technical Educational Research Center (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.

The main strength of this program is in the curriculum design. The curriculum consists of well-sequenced activities that demonstrate an effective integration of individual, group and whole class discussions and reflections. This program values family interaction and varied assessment strategies. Other strengths of the program are: the research-based professional development—Bridges to Classroom Mathematics, a year-prior planning stage, and deliberate and paced implementation.

Learning Atmosphere & Physical Environment

Since games are used throughout the *Investigations* program, the classroom arrangement and resources must facilitate these cooperative and sometime competitive activities. *Investigations* classrooms are equipped with a variety of concrete materials and appropriate technology, including calculators and computers. The atmosphere is designed to empower all students making sure that learning English does not lead to low self-esteem and lack of motivation. The context of the problems often calls on students to share experiences from their family, culture, or community.

Instructional Practices
Investigations encourages teamwork and learning as a whole group, small group, or in pairs, so that 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, thus their strategies and understandings can be communicated in many ways. The games, hands-on activities, and manipulatives insure an access to mathematics learning that can in some measure reinforce their English learning.

Mathematics Content & Curriculum
The content and curriculum is aligned with the goals and direction of the NCTM *Principles and Standards*. Each curriculum unit provides lesson plans, materials lists, reproducible student sheets for activities and games, a family letter, homework suggestions, opportunities for skills practice, assessment activities, notes to the teacher (about the mathematics students are encountering), and examples of classroom dialogues. 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.

Language Practices
Investigations produces a reading list, sorted by grade-level, of children's literature that supports the mathematical ideas the students investigate. The curriculum is supplemented with Spanish booklets that present teacher dialogue and instruction in Spanish. There are also Spanish vocabulary booklets along with tips for preview activities to enhance teaching in a linguistically diverse classroom. Finally, all the English black line masters, overhead transparencies, and family letters have a parallel version in Spanish, Hmong, Vietnamese, Cambodian, and Cantonese.

Family & Community Involvement
Investigation provides numerous links for online activities and explorations that can include families. All student pages include a

Family Connection to support learning at home. There are notes to parents on the back of homework sheets in the *Student Activity Booklets* and *Investigations at Home* booklet. Teachers are encouraged to plan a Family Math Night or Family Math Saturday with activities chosen from *Investigations*. The use of a website to host information about the math program and events along with samples of student work are other examples of how *Investigations* advocates family and community involvement.

Assessment of Student Learning

Investigations makes available a variety of assessment activities from writing and reflecting to the creation and explanation of a product. Assessment is touted as an ongoing process that plays a critical role in teaching and learning. End-of-Unit Assessments are designed to assess students' understanding of the most important mathematical ideas of a unit through their solution of problems. Flexible time allotments are left to the prerogative of the teacher.

MATHCOUNTS

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. Business and industry partners provide schools with coaches for the student 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. The program began in 1983 and since then over six million students have participated.

MATHCOUNTS 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. The program's industry support is a key strength as these commercial entities fund the purchase of classroom materials as well as coach training.

Learning Atmosphere & Physical Environment

Before MATHCOUNTS fosters a competitive atmosphere its goal is to foster a fun one. The program explicitly recruits students at all academic standings for the school level training where the program's greatest benefits are realized. Training sessions aim to equip math coaches with tools to promote the MATHCOUNTS program to the same level as other sport models. The coaching sessions develop teamwork, spur students to view mathematics as exciting, challenging, and rewarding, and always provide pizza or refreshments to create a relaxing fun atmosphere.

Instructional Practices

The Warm-Up and Workouts at coaching sessions are designed to promote peer learning and encourage a variety of methods for solving problems. The use of calculators is supported even during competitions. The coaches invite parents and school principals to offer words of support and to motivate the Mathletes® by making them feel like an important part of the school. Coaches inspire and motivate sincere effort, which serves to effect a lasting understanding of the mathematical content.

Mathematics Content & Curriculum
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.

Language Practices
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. Mathematics vocabulary is explicitly and implicitly taught in the School Handbook and the questions are worded with age-appropriate grammar and vocabulary. There are minority outreach programs.

Family & Community Involvement
Since MATHCOUNTS is funded and sponsored by commercial and industrial companies and groups, it is built around community involvement and cooperation. The program varies meeting locations by requiring community centers, libraries, and schools, to provide meeting facilities. If parents are unable to participate directly with a team, they still are sent regular updates about team progress or often interact with the team coach, as with any sports club. As with the other sections, language components in this section of the TSUS MELL CPF are not addressed by MATHCOUNTS.

Assessment of Student Learning
MATHCOUNTS coaches are expected to administer a School Competition to use in assessing the abilities of students at the school level. Coaches are urged to select team members at their discretion and not solely based on School Competition scores. While this does allow some flexibility, it still does not seem to align well with the ideas presented in this section of the TSUS MELL CPF.

Mathworks

Mathworks is an integrated program linking research-based curriculum, teacher training, and math inquiry groups (MIGs), with university faculty in a PDP that strives to support both in-service and pre-service teachers. Professional development leads to both undergraduate teacher certification as well as Masters degrees in middle school math teaching. The program has significant measurable impact on both students and teachers in areas like content mastery and efficacy. Mathworks curriculum is aligned to state and national standards, weaving algebra into the mathematics for younger students.

A dominant strength of the Mathworks curriculum is that it prepares all young students for success in algebra and more advanced mathematics. The curriculum was developed with direct input from students and teachers and has been field tested in summer math camps for over eight years. This curriculum encourages both teachers and students to explore problems deeply, utilize multiple problem solving strategies, and communicate their ideas precisely. Teachers have opportunities to assess student work through a rich collection of problems and activities. MIGs provide a unique yearlong professional development opportunity for in-service teachers to interact with university faculty and to incorporate Mathworks training into their classroom.

Learning Atmosphere & Physical Environment

Sharing student work in class, both verbally and in written form, is encouraged and practiced by the participating teachers. The classroom norm is to respect students' ideas and strategies by allowing the students to present and justify their reasoning and solutions to the class. The students are able to discuss and question each other with the teacher as facilitator and not as the source of answers. Classrooms are arranged to encourage student collaboration and interaction. Mathworks encourages a sense of adventure and exploration in the process of learning.

Instructional Practices

In math camps, students work on problems individually and in groups. Students are engaged through activities that develop student understanding based on concrete models. This process addresses different learning styles as well as provides a setting that encourages cooperation and collaboration. Students gain a deeper understanding of the mathematics when they are able to explain their ideas to other

group members. Students learn to design multiple representations for a problem as they share solutions with one another.

Mathematics Content & Curriculum
The Mathworks curriculum was developed with input from classroom teachers. It is aligned to both state and national standards. As suggested by NCTM, Mathworks weaves in algebraic concepts throughout the curriculum while preparing students to begin algebra early. Students develop mathematical and conceptual understanding by computing examples, looking for patterns, and then attempting to justify why things work. Rote memory is replaced by the excitement that comes from a deep understanding of basic principles. The curriculum is carefully sequenced and spiraled, with problem solving woven into each section. Problems are taught in context and motivated by real world examples.

Language Practices
Mathworks curriculum is particularly suitable for ELL students because it is inquiry based and constructivist in its approach. The program has been delivered to classes of ELL students with great success. Mathematics specific vocabulary is taught through dual language instruction when available. Otherwise, teachers attempt to address the needs of ELL students on an individual basis.

Family & Community Involvement
Mathworks supports family and community involvement by working with teachers and districts to begin programs such as FAMILY MATH Nights as part of regular MIG activities. In addition, Mathworks works closely with other groups including The Austin Project (TAP), and Upstarts in New Braunfels to address the needs of underserved at-risk students. Upstarts provides special seminars for teachers as part of the Mathworks summer program while helping teachers recognize the importance of working directly with parents and families.

Assessment of Student Learning
Mathworks uses both formative and summative assessments during its summer programs. Teachers use a variety of assessment techniques including both written and oral instruments. A pretest and posttest measure the improvement of student readiness for algebra. Based on feedback from daily observations, teachers adapt their teaching strategies and plans to the student's abilities and not to an absolute standard. Assessments include an emphasis on each student's ability to explain his/her answer and thus to demonstrate his/her understanding.

Navigations

Navigations was developed by various groups under the auspices of the National Council of Teachers of Mathematics. *Navigations* is a collection of supplementary mathematics books that act as a resource for teachers, which are intended to help them make mathematics fun for students while covering key ideas from the NCTM Standards. The program of teacher training that is being developed involves e-workshops that are generally 1-2 hours in length.

The *Navigations* program provides teachers with a valuable resource that is linked to the NCTM's *Principles and Standards for School Mathematics*. The goal of this program is to show how teachers can teach algebra and other topics in mathematics in a fun and interesting way for students. Books containing the activities support a variety of math content areas in a complete spectrum of grade bands including pre-K through 12. Building a community through e-workshops is a cost effective way to train teachers.

Learning Atmosphere & Physical Environment

The *Navigations* program does not seem to address this section of the TSUS MELL CPF.

Instructional Practices

The *Navigations* books are rich with activities that make learning math fun for students. Unlike many programs, *Navigations* explains in detail the math content that each activity is intended to support. The activities are designed to connect to prior learning and approach content from a constructivist method.

Mathematics Content & Curriculum

The aim of the curriculum is to provide teachers with a way to make math fun and to help teachers teach algebra and other areas of mathematics. The curriculum is only supplementary material intended for teachers, not for students. The workbooks provide interesting math activities that address different learning styles—visual, aural, and kinesthetic, however, these are not specifically targeted at ELL.

Language Practices

The program 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.

Family & Community Involvement
NCTM also produced a text titled: *A Family's Guide: Fostering Your Child's Success in School Mathematics*. This guide does provide strategies aligned with the TSUS MELL CPF. *Navigations* does not seem to provide explicit information on language aspects of family involvement or information on using a community liaison.

Assessment of Student Learning
The *Navigations* program expressly refrains from providing specific rubrics with which to assess student understanding of the ideas presented in each of the activities. Instead they encourage teachers to develop more general rubrics that translate to habits of mind for the students. There are examples of general assessment components such as, "Estimate, carryout, check, think back". This approach seems more abstract than called for by this section of the TSUS MELL CPF.

Sharon Wells

This program is currently in use by around 180 districts in Texas. It is designed specifically for Texas by Sharon Wells, a former Texas teacher, who taught for 28 years in Texas. The program originated in Brownsville in 1993, and includes step-by-step guidelines for classroom implementation. This program 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.

The strengths of this program lie in the custom designed curriculum and materials for Texas by a Texas teacher, the support workshops, and the ease of speaking to Sharon Wells herself. Teachers who work with ELL students, reportedly, "love this curriculum."

Learning Atmosphere & Physical Environment

Sharon Wells Math does not seem to address this section of the TSUS MELL CPF.

Instructional Practices

Sharon Well math incorporates many concrete activities that lead to the abstract understanding necessary to do well on TAKS questions with the content built around the TEKS.

Mathematics Content & Curriculum

At the professional development workshops, each teacher receives a master curriculum package for the up-coming 6-week session. The packet contains a sequential guide for each six 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. The spiraling curriculum style is aligned to the TEKS and addresses tested areas of the TAKS. The activities used involve active learning and address different learning styles.

Language Practices

All the curriculum materials for grades 2-5 are available in Spanish. This program is designed for extensive use in the Texas geographical regions with a high level of ELL. There is no obvious information given that addresses social and inter-personal student skills.

Family & Community Involvement

Sharon Wells Math does not seem to address this section of the TSUS MELL CPF.

Assessment of Student Learning

The Sharon Wells cumulative six weeks assessments are written in both Spanish and English. After the assessment each student's answers are entered onto a student performance sheet to monitor student progress and identify problem areas; thus, allowing the assessment data to shape instruction. In this way, the Sharon Wells program provides a method that allows teachers to document their students' test taking skills and to incorporate procedures into the classroom that are necessary for student success when answering TAKS questions.

Sheltered Instruction (SIOP)

The current Sheltered Instruction Observation Protocol program 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. The SIOP program 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 program is intended to coordinate, structure, and function with other school curriculum programs to improve instruction.

Perhaps the greatest strength of the SIOP program with respect to the TSUS MELL initiative lies in its design purpose. SIOP was specifically designed for ELL and every technique and component has them in mind. Moreover it includes training not only for the teachers of ELL but for administrators and other school personnel who work with ELL. The intent of SIOP is to support English language learning through content delivery.

Learning Atmosphere & Physical Environment

The SIOP program offers classroom organization suggestions interspersed throughout, however, these are not fundamental components of the program. The authors intend for the program to supplement each teacher's individual style with minor tweaking and altering rather than revolutionary remodeling. The use of dynamic word walls to teach key vocabulary words is an example of one such suggestion. There is a repeated expectation that teachers will have supplementary materials in the classroom for students to reference. Sheltered instruction strives to create an emotionally safe environment for ELL as a fundamental directive as is evidenced in its chosen name.

Instructional Practices

The SIOP program aligns well with this section of the TSUS MELL CPF. This program puts considerable emphasis on using materials that support different learning styles and multiple intelligences. It gives a comprehensive list of categories to inspire teachers to use the types of supplementary materials that create context and support content concepts. The use of instructional scaffolding is another technique the program advocates and explains in considerable detail. The SIOP program's focus seems fixed on instructional practices.

Mathematics Content & Curriculum
The SIOP program is content and curriculum independent. Its aim is to simultaneously teach English language and content wherein there may be multiple interdisciplinary content goals, for instance, a thematic lesson may teach objectives from mathematics, language arts, music, science, and art. The techniques presented in SIOP are very adaptable to accommodate content from all grade levels and many curriculum styles.

Language Practices
The SIOP program maintains that language objectives of a lesson should be stated clearly, the same as with the content objectives, and these should be given both orally and in writing. It also stresses that in addition to vocabulary, grammar is an important component of language development. Since the SIOP program was developed specifically with ELL in mind, it addresses this section of the TSUS MELL CPF better than probably any of the other programs.

Family & Community Involvement
Certainly SIOP supports connections to each student's family-life through lessons that embed contextual experiences and skills, however, there does not seems to be much information about explicit interaction between the family and the student's learning. Neither does the program specifically advise teachers to engage in frequent communication about a student's progress. The collaborative approach of SIOP encourages pairing weaker students with stronger ones in terms of both language and content, but more exact information about pairing techniques are not explicitly mentioned.

Assessment of Student Learning
SIOP authors support teacher assessment strategies that offer multiple pathways for students to demonstrate their understanding of the content. The authors' claim that a variety of assessments allow teachers to create a more accurate appraisal of content knowledge and skill level. The appraisal is then used for instructional planning.

TEXTEAMS

Texteams, developed by the Dana Center in the mid-90s 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 pre-K to 12th grade teachers from that area on a more local level that is customized to meet the needs of a district or school.

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. The length of the institutes that extend for 3-5 days can provide time for in-depth discussion of content and pedagogy matters. This also encourages collaboration and active participation among teachers at the institutes.

Learning Atmosphere & Physical Environment

Professional development experiences, much like the school mathematics and science curriculum itself, focus on a few activities in great depth. The professional development also provides opportunities for teachers to connect and apply what they have learned to their day-to-day teaching. The main focus is on addressing the content knowledge of teachers.

Instructional Practices

Texteams is designed to model pedagogy that deliberately engenders collaboration and active participation. Hands-on approach with "get-up-and move" activities is also modeled as a way to foster critical thinking through hands-on experiences. Questioning strategies are featured with variety of questions developed within each learning experience to elicit deep levels of mathematical or scientific understanding and proficiency for teachers.

Mathematics Content & Curriculum

The TEKS and TAKS objectives are the main objectives of the Texteams institutes and hence the curriculum and content are organized around the five main TEKS content strands: number and operation, patterns and algebraic thinking, geometry and spatial sense, measurement, and probability and statistics. Teachers engage in exploring and examining mathematical concepts in order to deepen their content understanding. The use of multiple representations, including verbal, concrete, pictoral, tabular, symbolic, and graphical, is encouraged.

Language Practices
There is not a mandate to provide materials for any specific group of students, therefore, the materials were not written in Spanish. Providers could present in Spanish, but there was no recommendation for this by Texteams. Multiple representations, concrete and visual models, and appropriate technology, are ways that various learning styles are accommodated.

Family & Community Involvement
Texteams does not address this aspect specifically in its professional development institutes.

Assessment of Student Learning
The main objective of the Texteams professional development is strengthening the teacher's content knowledge to more effectively teach the TEKS objectives to their students with results from the TAKS tests and the End-of-the-Year tests as the main assessment tools. The Algebra Institute, for example, examines assessments for alignment with TEKS and TAKS, focusing on methods for evaluating student work, developing strategies for classroom implementation, and making decisions based on student work. Strategies for fitting the Algebra II assessments into a district's yearly plan are also discussed. Some of the Texteams institutes' multiple tools for assessment are: "describing evidence of a student's understanding of content that was to be learned, and building questions and tasks to elicit evidence of understanding that can be recognized by both teachers and students."

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Appendix A –

MELL Classroom Practices Framework

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For The

Math for English Language Learners (MELL) Initiative

A Texas State University System (TSUS) and Texas Education Agency (TEA) Collaborative

Participating TSUS Institutions Include:
Angelo State University
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MELL Classroom Practices Framework

Introduction:

The MELL Classroom Practices Framework (CPF) is a synthesis document compiled by the Texas State University System (TSUS) Math for English Language Learners (MELL) Initiative and funded by a grant from the Texas Education Agency (TEA). In the summer of 2004, TEA, in response to the lingering achievement gap in mathematics between Limited English Proficient (LEP) students and other students, worked with TSUS and its five partner institutions to establish the MELL Initiative. The primary purpose of the MELL Initiative is to develop resources for professional development targeted at improving mathematics instruction for English Language Learners, especially those at the secondary level. MELL and TEA staff identified the need for a concise document that could not only capture the essence of the research but could also provide a roadmap for use in future resources. The MELL Classroom Practices Framework was developed in response to this need.

The MELL CPF was generated collaboratively by MELL and TEA staff and was guided by the question of "What do the findings of our research investigations suggest in regard to classroom practices that contribute to successful math instruction for English Language Learners." This framework represents the collective thinking of the MELL partners about what the research investigations revealed and it is our intention that all of the MELL professional development products support teachers in implementing these classroom practices. Over time, as additional insights are gleaned from ongoing work, it is likely that this evolving framework will be revised.

Much, perhaps most, of this framework is comprised of elements of effective instruction that is appropriate for all students, and clearly all students would be well-served by these suggested practices regardless of their language proficiency. It appears, however, from our investigations, that the success of ELL students is more highly dependent on receiving instruction geared to their specific needs. In other words, while many students who are not experiencing a language barrier might be able to experience success with less than optimal instructional practices, few ELL students can thrive in such an environment. For this reason, creating a rich classroom experience for ELL students is not simply desirable, but rather is necessary if they are to have a chance to succeed. The MELL Classroom Practices Framework is targeted at achieving this goal.

1 Learning Atmosphere & Physical Environment

1.1 A caring classroom atmosphere of mutual respect and support is facilitated by the teacher who:

- 1.1.1 Knows each child as an individual,
- 1.1.2 Embraces languages, customs, and cultures of ELL students,
- 1.1.3 Provides culturally rich learning materials,
- 1.1.4 Encourages self-expression and provides positive recognition,
- 1.1.5 Builds student confidence and esteem,
- 1.1.6 Fosters an emotionally safe environment that allows students to feel secure and to take risks.

1.2 The classroom is visually rich to support student learning.

- 1.2.1 Incorporates displays of student produced work, whenever possible,
- 1.2.2 Is colorful and thought stimulating,
- 1.2.3 Contains pertinent, real-world information and applications,
- 1.2.4 Reinforces math-specific vocabulary and concepts,
- 1.2.5 Provides color-coded learning supports when appropriate.

1.3 Room arrangement facilitates student interaction and group work.

2 Instructional Practices

2.1 Instructional practices foster cooperation and collaboration.

2.2 Concepts are presented accurately, logically, and in engaging ways.

2.3 Multiple representations incorporate mathematics learning levels: concrete, semi-concrete, and abstract.

2.4 The teacher employs student-centered instructional practices.

- 2.4.1 Approaches content from a concept-oriented constructivist method,
- 2.4.2 Surrounds students with different modalities (e.g., aural, visual, kinesthetic),
- 2.4.3 Connects new concepts to prior learning,

2.4.4 Encourages students to refine and reflect about their own work and verbalize concept understanding "in their own words",

2.4.5 Chooses homework to optimize individual content development,

2.4.6 Provides extra help and resources on an individual basis.

2.5 Students are frequently partnered with peer learners to enhance learning opportunities.

2.5.1 To develop math content,

2.5.2 To aid English language development,

2.5.3 To insure sustained active participation in the class,

2.5.4 To welcome new students into an established learning community.

2.6 Instructional activities are varied and support diverse learning styles and multiple intelligences, including for instance:

2.6.1 Frequent use of models,

2.6.2 Music as a motivator and anchor,

2.6.3 Mind maps, poster-walks, and word walls

2.6.4 Key vocabulary and cognates presented in different forms,

2.6.5 Vivid adjectives.

3 Mathematics Content & Curriculum

3.1 Glossary of mathematical terms is always available for reference.

3.2 Content is aligned to appropriate grade-level, mathematics TEKS and professional standards.

3.3 Content is based on diagnosed student needs.

3.4 Content is systematically designed to incorporate sound learning principles.

3.4.1 To incorporate increased complexity,

3.4.2 To present a cohesive big-picture through chunking,

3.4.3 To connect concepts through bridging and scaffolding,

3.4.4 To emphasize multidisciplinary understandings,

3.4.5 To reflect on inherent patterns by comparing and contrasting concepts.

3.5 Curriculum is challenging, relevant, age-appropriate, and well-paced
- 3.5.1 To include contextually-based problems,
- 3.5.2 To incorporate student realities,
- 3.5.3 To involve interactive problem solving.

4 Language Practices

4.1 Language support is offered without supplanting English instruction.

4.2 Support is aligned with student's diagnosed language needs.

4.3 Language used is appropriate to age and grade level and presented in a socially meaningful context.

4.4 Mathematics-specific vocabulary is explicitly and implicitly taught and reinforced through repetition.

4.5 Teachers are knowledgeable about the second language acquisition theories and best practices embodied in Texas Administrative Code, Title 19, Part II, Chapter 128.

4.6 Ideally, dual language instructional support should be offered.

4.7 When dual language teachers are not available, sheltered instruction should be utilized to provide strong language support by addressing content through ESL.

5 Family & Community Involvement

5.1 Schools connect to student's family-life by embedding contextual experiences and skills in teaching and curriculum.

5.2 Projects are relevant and promote family interaction.

5.3 Opportunities are available for English-speaking higher grade-level students to mentor ELL lower grade-level students either in an in-school or after-school program, as appropriate.

5.4 Teacher engages in frequent communication with families
- 5.4.1 About activities and events in which parents can participate,
- 5.4.2 About student progress.

5.5 Teacher utilizes services provided by a community liaison and is knowledgeable about community resources.

5.6 Parents are informed about the benefits of using their most cognitively advanced language at home.

6 Assessment of Student Learning

6.1 Classroom assessment is designed to foster student success.

6.2 Assessment methods allow students frequent opportunities to demonstrate mastery in a variety of ways.

6.3 Various assessment techniques are used to measure student understandings.

6.4 Grades are oriented to promote and emphasize valid step-by-step logical reasoning processes.

6.5 Assessment data and results shape instructional planning.

6.6 Flexible time allotments are given to demonstrate concept mastery.

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