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Research-Based Curriculum

Teacher Created Materials

Targeted Mathematics Intervention

Supplemental Program for Math Intervention

Mathematics Education Today

For today and tomorrow's worlds, the necessity of mathematical literacy and mathematical education reform have become more important than ever. In a society that has become so technically oriented, "innumeracy" has replaced illiteracy as our principal educational gap. This is the age of science, technology, and mathematics. To have a mathematically literate society, the population needs to have understanding of and proficiency with mathematics concepts and procedures as well as the ability to apply that knowledge, use it to develop models, and apply those models to similar situations.

The Glenn Commission Report, *Before It's Too Late*, states four compelling reasons why students need to become proficient in mathematics (Commission, 2000):

- the need to keep pace with the global economy and the American workplace
- the growing need for mathematics in everyday decision making
- national security interests
- the general value of a strong mathematical background in everyday life situations

The goal of mathematics education is to provide all students with the ability to use mathematics to improve their own lives, to help them become aware of their responsibilities as citizens, and to help them prepare for their futures.

In order to accomplish these goals, state departments of education, school districts, and teachers must set high expectations for all students, and mathematics education needs to be a priority at all levels. According to U. S. Secretary of Education Margaret Spellings, "To compete in the global economy, you must know math. Therefore, it is more important than ever that our students receive solid math instruction in the early grades to prepare them to take and pass algebra and other challenging courses in middle school and high school" (Math Now Initiative, 2006). Mathematics education must begin at a very early age so that students develop the foundational understanding and skills necessary to achieve in mathematics. More instructional time should be dedicated to mathematics instruction, and the curriculum should focus on a depth verses breadth approach so that students have sufficient opportunities to achieve and master the content. Teachers also need research-based curriculum solutions and instructional strategies that will promote mathematical literacy amongst our diverse student populations.

The Need for Intervention in Mathematics Education

Differentiating instruction and providing intervention and instructional support to meet students' needs are also necessities if we are to become a mathematically literate society. The one-size-fits-all curriculum model and instructional plan of yesteryear does not accomplish what is needed in today's classroom to successfully reach all students (Tomlinson, 1999). Students come to the classroom with different learning styles, various levels of mathematics proficiency, language barriers, communication issues, and assorted backgrounds. In addition, student attitudes and personalities affect learning. Many students suffer from math anxiety, an anxiety often supported by their parents who reflect their own negative perceptions of their mathematical abilities on their children. Some students find math boring or unnecessary. And some students do poorly simply because they have a low self-esteem when it comes to math. Other issues stem from the way in which students access mathematical content. Some students struggle to visualize or develop understanding for abstract concepts. Others students struggle to master mathematical procedures because they don't understand the concept of the rational for the steps of the procedure. Many students don't possess strategies for attacking an unfamiliar word problem. Whatever the obstacle, it is essential that our educational systems try to meet the mathematical needs of all students before they fail. This is why intervention is critical.

No Child Left Behind (NCLB) legislation has brought more awareness to the need for mathematical intervention and a mathematically literate society. On January 8, 2002, No Child Left Behind was signed into law, putting in place measures of accountability and requirements for standards and research-based curriculum and instruction. The purpose of high accountability for states and local education agencies (LEA's) is to improve the academic achievement of the disadvantaged and ensure equity in our educational system. As stated in the Public Law print PL 107-110 of the *No Child Left Behind Act of 2001,* "The purpose of this title is to ensure that all children have a fair, equal, and significant opportunity to obtain a high-quality education and reach, at a minimum, proficiency on challenging State academic achievement standards and state academic assessments" (U.S. Department of Education, 2001). NCLB no longer allows LEA's to accept the status quo of only a subset of students reaching mastery and a high level of achievement. It requires that all students master state standards. To accomplish this goal, LEA's are changing their systems of instructional delivery to support and promote achievement among all students. The need for effective instructional delivery systems is evident when looking at state and national assessment data.

Based on students' results on the National Assessment of Educational Progress, the need for intervention and additional instructional support in mathematics is evident. *The Final Report National Mathematics Advisory Panel* (Flawn, 2008) summarizes our nation's progress on such assessments.

> On our own "National Report Card"—the National Assessment of Educational Progress (NAEP)—there are positive trends of scores at Grades 4 and 8, which have just reached historic highs. This is a sign of significant progress. Yet other results from NAEP are less positive: 32% of our students are at or above the "proficient" level in Grade 8, but only 23% are proficient at Grade 12. Consistent with these findings is the vast and growing demand for remedial mathematics education among arriving students in four-year colleges and community colleges across the nation. (p. xii)

The reauthorization of the Individuals with Disabilities Education Act (IDEA) in 2004 has also reinforced the need for intervention, specifically as part of the process in determining eligibility for learning disabilities. This legislation also encourages local education agencies to use the Response To Intervention (RTI) approach to determine educational needs of students (Batshe et. al., 2007). As defined in the publication *Response to Intervention, Policy Considerations and Implementation* (Batshe et. all., 2007, p. 5), "RTI is the practice of (1) providing high-quality instruction/intervention matched to student needs and (2) using learning rate over time and level of performance to (3) make important educational decisions." RTI provide districts with a model for structuring of intervention programs that align with student needs. The following core principles as listed in *Response to Intervention, Policy Considerations and Implementation,* should serve as the foundational tenets for curriculum and instruction used in intervention programs.

- We can effectively teach all children.
- Intervene early.
- Use a multi-tier model of service delivery.
- Use a problem-solving method to make decisions within a multi-tier model.
- Use research-based, scientifically validated interventions/instruction to the extent available.
- Monitor student progress to inform instruction.
- Use data to make decisions. A data-based decision regarding student response to intervention is central to RTI practices.
- Use assessment for three different purposes.
  (Batshe et.al. 2007)

As reflected in the definition and core principles of RTI, a sound intervention program must be multi-faceted in order to address the various needs of students. The product should be research-based, aligned with National Council of Teachers of Mathematics (NCTM) Principles and Standards, and present a balanced approach to mathematics instruction. NCTM also supports the belief that classroom products should be related to current research trends and address what is considered important mathematical content.

The *NCTM Principles and Standards for School Mathematics* (NCTM, 2000) and the *Curriculum Focal Points for Prekindergaten through Grade 8 Mathematics* (NCTM, 2007) also clearly reflect a balanced approach to mathematics instruction. Such an approach was recommended in *The Final Report National Mathematics Advisory Panel* (Flawn, 2008, p. xix), "To prepare students for algebra, the curriculum must simultaneously develop conceptual understanding, computational fluency, and problem solving skills…The capabilities are mutually supportive, each facilitating learning of the others."

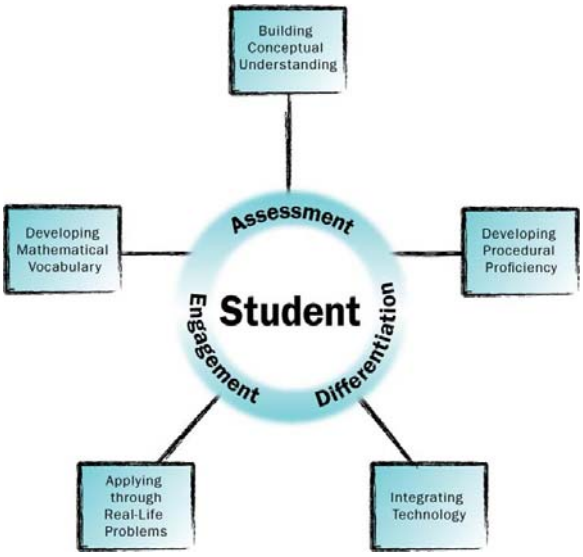

Figure 1 reflects the Teacher Created Materials (TCM) philosophy of a balanced approach. The branches of a balanced approach are developing mathematical vocabulary, building conceptual understanding, developing procedural proficiency, integrating technology, and applying concepts through real-life problems. The student is in the center of the icon because student needs should be the focus of all mathematics curriculum and instruction. To support the student in accessing the mathematical content for each of these branches, the student should be engaged, instruction should be differentiated, and summative and formative assessments should be used to measure student progress and diagnose student needs. *Targeted Mathematics Intervention* is a research-based program that aligns with NCTM Principals and Standards and provides a balanced approach to mathematics intervention.

Alignment with NCTM Standards and Principals

NCTM Principles and Standards for School Mathematics (NCTM, 2000) were thoroughly reviewed by Teacher Created Materials as they developed the *Targeted Mathematics Intervention* materials. *Targeted Mathematics Intervention* was developed to meet or exceed the NCTM Principles and content standards while meeting the needs of students and teachers.

NCTM Principles

The NCTM Principles have six themes, all of which are found in *Targeted Mathematics Intervention.*

- ***Equity:*** *high expectations and strong support for all students.* By providing research-based lessons for key grade level objectives, *Targeted Mathematics Intervention* ensures all students have access to rigorous mathematics instruction. The lessons are interactive and designed to engage students. Student engagement in the curriculum serves as an entry point through which all students can access the content. As stated by Cathy

Seeley (2004), "Student engagement is perhaps the most important tool in our battle for equity."

- ***Curriculum:*** *well-structured, relevant, and more than just a collection of activities.* Teacher Created Materials held true to this Principle in *Targeted Mathematics Intervention* by providing a scope and sequence for grades 1–8. The scope and sequence promotes mastery for a focused group of skills and concepts at each grade level, thus building a strong mathematical foundation for all students.
- ***Teaching:*** *effectively teaching students what they need to know and supporting them to learn it well.* This has been done by Teacher Created Materials in *Targeted Mathematics Intervention* through the use of research-based instructional strategies and activities that meet diverse learning styles and needs. A comprehensive Teacher's Guide offers step-by-step lessons, so teachers can focus on delivery of instruction rather than development of the lessons.
- ***Learning:*** *must be relevant, sequential, and build on prior knowledge and experience. Targeted Mathematics Intervention* uses problem-solving strategies applied through real-life contexts as building blocks for the problem solving lessons in the program. The real-life contexts are high-interest for students and build on students' prior knowledge of the problem-solving scenario. The problem-solving strategies also serve as tool box for students to attack a word problem. The program's sequential scope and sequence ensure that a strong foundation is in place for all learners.
- ***Assessment:*** *support important learning and provide useful information to students and teachers.* Teacher Created Materials has included both summative and formative assessments in *Targeted Mathematics Intervention*. A diagnostic assessment serves as both a pretest and post test for each level of the program. Guided practice activities and standardized-test practice serve as formative assessments.
- **Technology:** *essential in the teaching of mathematics it influences what is being taught and what students are learning.* In each *Targeted Mathematics Intervention* kit, a CD-ROM provides *Powerpoint* lesson presentations to enhance and support student learning. The Teacher Resource CD also contains PDF's of the activities sheets. Both the *PowerPoint* presentations and the electronic versions of the activities sheets are compatible with Smartboard technology.

Content Standards

The NCTM content standards were set forth as guidelines for states to use when developing and defining expectations of instruction and to establish goals to be attained. High but attainable curriculum standards in mathematics are required to produce a society that has both the capability to think and reason mathematically and to command a useful base of mathematical knowledge and skills needed in real life situations. The contents of each *Targeted Mathematics Intervention* kit encompass the most critical standards for each grade level.

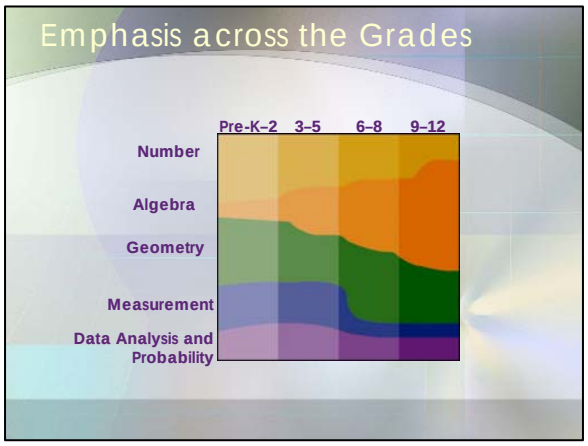

Figure 2: From Cathy Seeley's PowerPoint presentation "You've heard it all before… or have you…?" Teacher Created Materials Mathematics Summit, Newport Beach, CA, June 22, 2007

The NCTM Standards (2000) are comprised of five Content Standards and five Process Standards. The Content Standards include:

- Number Sense and Operations
- Algebra
- Geometry
- Measurement
- Data Analysis and Probability

Each level of *Targeted Mathematics Intervention* includes 30 lessons that encompass skills and concepts from each of the five NCTM content strands. Figure 2 entitled, "Emphasis Across the Grades" was used in the development of the scope and sequence for *Targeted Mathematics Intervention* and to determine the number of lessons for each strand. The following paragraphs describe general student expectations for each of the NCTM Content Strands and how *Targeted Mathematics Intervention* aligns and supports those expectations.

Number Sense and Operations

Students should be able to:

- Understand numbers
- Develop the meaning of operations and
- Compute fluently (NCTM, 2000)

For students to be successful in mathematics, number sense is critical. It is the foundation of mathematics. In *Targeted Mathematics Intervention*, number sense begins in the early grades with the students' ability to compare numbers and understand place value, order, fractions, and more. In the upper grades, number sense includes computational skills, the meaning of operations, and multiple representations, much of which are prerequisites to Algebra I.

Algebra

Students should be able to:

- Understand patterns, relationships, and functions
- Use algebraic symbols
- Use mathematical models to represent and understand quantitative relationships
- Analyze change (NCTM, 2000)

Teacher Created Materials included algebra standards in *Targeted Mathematics Intervention* kits. In the earlier grades, algebra is introduced through number and shape patterns, and in the upper grades, there is more focus on formal algebra, such as solving and graphing linear inequalities. The United States Department of Education's, *The Final Report of the National Mathematics Advisory Panel* released in March 2008 states, "…many observers of educational policy see algebra as a central concern" (Flawn, 2008). If students are to be prepared for algebra in middle and high school, they must begin learning the foundations of it in the early grades. *Targeted Mathematics Intervention* addresses this need by including algebra prerequisites in the first grade kit and continuing them through each grade level.

Geometry

Students should be able to:

- Analyze characteristics of geometric shapes
- Make mathematical arguments regarding geometric relationships
- Use visualization, spatial reasoning, and geometric modeling to solve problems (NCTM, 2000)

With the focus today on preparing students for Algebra I, geometry is considered by some as the forgotten strand. The lessons in each level of *Targeted Mathematics Intervention* include geometry standards that are most appropriate for that grade. In level one, students begin to examine and understand the basic properties, similarities, and differences of geometric shapes. Level three has lessons on two-dimensional shapes, three-dimensional shapes, congruency, symmetry, and shape patterns. In level seven, students are introduced to the Pythagorean Theorem.

Measurement
Students should be able to:

- understand the attributes, units, systems, and processes of measurement
- apply the techniques, tools, and formulas to determine measurements (NCTM, 2000)

In *Targeted Mathematics Intervention*, measurement is included at every level. Students in levels one and two will practice using nonstandard measures and the concept of time. By level three, students will have practice with measuring length, finding perimeters, estimating measurements, measuring capacity, and practicing with time and temperature. In level eight, students will extend their learning of formulas to find measures.

Data Analysis and Probability
Students will be able to:

- formulate questions and collect, organize, and display relevant data to answer these questions
- learn to use appropriate statistical methods to analyze data
- make inferences and predictions based on available data
- understand and use basic concepts of probability (NCTM, 2000)

In level one of *Targeted Mathematics Intervention*, students will begin representing information in different types of charts, graphs, and tables. In level seven, students will understand the basic characteristics of frequency and distribution. Students in level one will recognize the probability of whether events will occur while students in level eight will determine probability using mathematical/theoretical models.

NCTM Process Standards

Process Standards highlight different strategies for acquiring and applying content knowledge (NCTM, 2000). Teacher Created Materials recognizes the importance of the Process Standards in *Targeted Mathematical Intervention*. The Process Standards include:

Problem Solving
Students should be able to:

- use a variety of appropriate strategies to solve problems
- solve problems that arise in mathematics and other content areas
- increase mathematical knowledge through problem solving (NCTM, 2000)

According to one research study, problem solving is the reason for mathematics. A primary goal of teaching mathematic is to be able to solve problems (Wilson & Fernandez, 1993). Problem-solving skills are essential if students are to compete effectively in a global, technologically

oriented society. Thus, explicit attention must be given to it on a regular and sustained basis (Grouws & Cebulla, 2000). *Targeted Mathematics Intervention* presents students with the opportunity to daily develop those critical problem-solving skills with problem-solving strategies and real-life application problems.

In addition, *Targeted Mathematics Intervention* helps students acquire a tool box of problem-solving strategies that they can use when "attacking" a mathematical problem. Many students dread solving word problems and get easily frustrated when they try solve them. Students lack strategies for "attacking" problems. In *Targeted Mathematics Intervention,* a new problem solving strategy is modeled and scaffolded each week for students. With sufficient practice, students will be able to apply the newly learned skills to other situations (Sousa, 2006). To support the teacher in modeling the problem-solving strategy, the lessons feature callouts, guiding teachers through each problem. After learning the strategy, students apply the strategy to real-life scenarios. Research has shown that real-life activities and problem solving activities establish a contextual setting for students, providing them with a natural curiosity to learn more (Hiebert & Carpenter, 1992). The real-life scenarios are high-interest, engaging, and illustrate the connection of mathematics to everyday life.

Reasoning and Proof

Students should be able to:

- recognize that reasoning and proof are important aspects of mathematics
- investigate mathematical conjectures
- make mathematical arguments as a way of solving problems
- select and use various kinds of reasoning and methods of proof (NCTM, 2000)

Communication

Students should be able to:

- use oral and written communication to share and explain their understanding (NCTM, 2000).

In today's world, it is not enough that students can do the mathematics; they must be able to communicate their thoughts and ideas. In *Targeted Mathematics Intervention,* there is an opportunity in nearly every lesson for students to share their mathematical thought processes and their reasoning with peers in either partner activities or small groups. The Warm-Up activities, Vocabulary activities, and Differentiated Guided Practice in each lesson promote discussion among students and provide teachers with opportunities to evaluate students' thinking. Talking about mathematics provides opportunities for students to learn from one another and helps to further develop students' mathematical understanding and listening skills.

Listening skills are a critical part of communication. This is also one of the four areas of language acquisition for English language learners. In order for students to be considered a good listener, they must be able to: 1) hear and repeat information, 2) follow oral directions, 3) comprehend and respond appropriately to information, 4) distinguish between relevant and non-relevant information, and 5) be able to paraphrase or summarize information presented orally. These are all skills necessary when sharing math ideas and problem-solving ideas. As with any skill, the more practice a student gets in developing good listening habits, the better he or she will become (Engraffia, Graff, Jezuit, & Schall, 1999). In *Targeted Mathematics Intervention* listening practice is presented in vocabulary activities such as "Sharing Mathematics" and "Sentence Frames." When participating in the activity "Sharing Mathematics," students do share meanings of vocabulary words, but they must also listen to others after they have used their turns. The activity "Sentence Frames" provides students with a chance to communicate orally with a partner as they write their own sentences using vocabulary terms from the lesson.

Connections

Students should be able to:

- make mathematical connections to other math topics as well as other content areas (NCTM, 2000).

Students should learn that math is involved in most every aspect of their lives and education. The problem solving lessons in *Targeted Mathematics Intervention* demonstrate how math connects to real-life as well as other content areas.

Representations

Students should be able to

- represent mathematical ideas in a variety of ways. This may be done through written expression, discussion, use of manipulatives, using different strategies and /or algorithms (NCTM, 2000).

A representation is something that symbolizes or stands for something else. Numbers can be represented by counters, points on a number line, words, numerical expressions, or pictures. Students need to see that numbers can be represented in different ways (Rosengrant, Etkina, & Van Heuvelen). Many educators believe that students need to understand multiple representations for problem solving as early preparation for algebra. For students to develop number sense, the ability to understand multiple representations is also essential (Ghazali & Zanzali, 2000).

Targeted Mathematics Intervention uses multiple representations to develop problem-solving strategies, conceptual understanding, procedural proficiency, and mental math skills. The program integrates multiple representations into problem solving by having students act out the problem, create a table or diagram, draw a picture, or use manipulatives to solve the problem. Multiple representations, such as manipulatives and pictorial models, are also used in the program to develop conceptual understanding. For example, pictures are used in one lesson to compare fractions. Teaching alternative algorithms is another representation used in the program. Students who struggle to learn the traditional algorithm can understand the procedure through alternative approaches for solving addition, subtraction, multiplication, and division problems. The Curriculum and Evaluation Standards for School Mathematics states that "children must understand numbers if they are to make sense of the ways numbers are used in their everyday world" (National Council of Teachers of Mathematics, 1989). The daily Warm-Up activities in *Targeted Mathematics Intervention* allow students to dissect numbers and use them in different ways. Students develop mental math skills and number sense as they transpose and translate numbers in their head. These types of activities foster in children a love of numbers and serve as the foundation for all other areas of mathematics.

A Balanced Approach to Mathematics Intervention

As is evident, the NCTM Principals, Content Standards, and Process Skills are embedded into the lessons throughout the *Targeted Mathematics Intervention* program. NCTM has set high standards for today's students. They want students to calculate efficiently, become problem solvers, be able to communicate mathematically and make mathematical connections to the world around them (NCTM, 2000). To achieve these goals, we must provide students the support they need during intervention by implementing a balanced mathematics curriculum.

Vocabulary Development

Ensuring that every student develops a strong mathematical vocabulary is one of the key components that an intervention program must address. Teachers must foster in their classrooms and support students in developing both types of language, BICS (Basic Interpersonal Communication Skills) and CALP (Cognitive Academic Language Proficiency). BICS is social language, the language students use when communicating with each other at home, on the playground, in the lunchroom, etc. CALP is acquisition of content and academic language. A strong CALP vocabulary usually takes between five to seven years to develop (Haynes, 2008). Just because students can communicate socially does not mean that they have a firm understanding of the formal academic vocabulary needed in a content area (Haynes, 2008). A student is not going to be successful if their formal academic vocabulary is a weakness (Whitin & Whitin, 2000). This is true of any subject area and includes formal and informal education.

It is difficult to master a skill if the vocabulary is a stumbling block. CALP includes more than just vocabulary. It also encompasses skills such as classifying, synthesizing, evaluating, and inferring.

Becker states that mathematics deficiencies are often the result of poor vocabularies. With today's emphasis on science, mathematics, and technology, educators cannot afford to fail students in this area (Becker, 1977). In discussions with students following high-stakes testing, students often say that they just did not know the meanings of specific mathematics terms. Teachers frequently get so involved in teaching the concept that the supporting vocabulary is overlooked or imbedded in the instruction. Teachers need to provide direct instruction for both mathematical and academic vocabularies, and teachers should use terms beyond what is given in a textbook.

Developing a strong mathematical vocabulary can be done in many ways (R.J. Marzano, 1999). To acquire the language of mathematics, students should use mathematics vocabulary in speaking, listening, reading, and writing. The Vocabulary activities in each lesson of *Targeted Mathematics Intervention* integrate these four areas of language acquisition. The Vocabulary activities in the program also incorporate multiple modalities of learning, such as kinesthetic, visual, and musical. As Amy Benjamin in *Differentiated Instruction: A Guide for Elementary School Teachers* (2003, p. 9) states, "The chances for durable learning are increased if there is multiplicity of learning modes: imaginative, inquiry, facts, multisensory, technology, socialization." One multimodal activity is "Total Physical Response." Students represent concepts and vocabulary with kinesthetic movements, while chanting a word or phrase.

The inclusion of so many varied ways to strengthen a student's mathematical vocabulary demonstrates that *Targeted Mathematics Intervention* is committed to ensuring that students understand the terms necessary for mathematical learning. Consistent and pervasive attention to building strong word knowledge has tremendous potential for raising achievement for our students (Riedl) (Corona & Spangerberger, 1998). Max Thompson says that systematic vocabulary instruction is one of the most powerful tools we have for raising mathematics achievement and learning (Thompson, 2002). *Targeted Mathematics Intervention* offers a consistent and systematic approach to vocabulary development with practice in every lesson.

Using Manipulatives to Build Conceptual Understanding

Using concrete models and manipulatives provides students with an authentic context in which to discuss and utilize mathematical language while building students' conceptual understanding. Using manipulatives in combination with other instructional methods can deepen a student's understanding of mathematical concepts (Sowell, 1989). For example, most children are not automatically able to visualize a number. They might memorize an algorithm or a basic fact and know that $5 + 2 = 7$, but they don't understand and often can't explain what the symbolic

representation means. By having children use manipulatives to "see' what a written number represents, they develop a sense of numbers more quickly. Manipulatives come in a variety of sizes, shapes, and colors. They do not have to be new, colorful, and expensive to be effective either. Sometimes the best manipulatives are pieces of paper that students can use for counting, comparing, or measuring. The document *Professional Standards for Teaching Mathematics* (2000) published by the NCTM does not limit itself to manipulatives but instead articulates that teachers should use a wide range of tools for exploring, representing, and communicating mathematical ideas. Tools include concrete models and materials, graphs and pictures, calculators and computers, and use of nonstandard and conventional notation (Ball, 1992).

Student achievement can be increased through the effective use of manipulatives. Manipulatives help students access mathematical content through both visual and kinesthetic modalities. The more modalities used to receive mathematical data, the more connections the human brain can make. The more connections that are made, the deeper the student understands a new idea. Students do not learn simply by having manipulatives though; but they learn when mathematics teachers intervene to demonstrate how the manipulatives relate to the mathematical concept. As Deborah Ball (1992, p.18) states, "Unfortunately, creating effective vehicles for learning mathematics requires more than just a catalog of promising manipulatives. The context in which any vehicle——concrete or pictorial—is used is as important as the material itself." *Targeted Mathematics Intervention* supports the teacher's use of manipulatives in the classroom by providing instructional guidance in the lesson.

Procedural Proficiency

Once students have acquired conceptual understanding through the use of manipuatives and models, the teacher should scaffold the procedural process for the skill or concept. Procedural proficiency is defined as skill in performing procedures or operations efficiently, accurately, and appropriately. The role of procedural proficiency in mathematics, as in sports and music, is to be able to execute procedures automatically, without conscious thought (Kilpatrick, Swafford, & Findell, 2001). This means that students can perform basic calculations and operations. *Targeted Mathematics Intervention* helps students develop procedural proficiency through the Warm-Up activities, Whole-Class Skills Lesson, and Differentiated Guided Practice. The Warm-Up activities are designed to develop mathematical reasoning skills, number sense, and mental math skills. The authors of *Reaching for Common Ground in K-12 Mathematics Education* (Ball, Ferrini-Mundy, Kilpatrick, Milgram, Schmid, Wilfried, & Schaar, 2005, p. 1056) provided the following statement of agreement regarding automatic recall of basic facts in the article: "Certain procedures and algorithms in mathematics are so basic and have such wide application that they should be practiced to the point of automaticity."

The introduction of algorithms in the Whole-Class Skills Lesson further promotes the development of procedural proficiency. *Targeted Mathematics Intervention* introduces different ways to implement the algorithms that support the development of conceptual understanding while providing students with alternative entry points for developing procedural fluency. The authors of *Reaching for Common Ground in K-12 Mathematics Education* (Ball et. al., 2005, p. 1056) also provided a statement of agreement for learning algorithms. They assert, "Students should be able to use the basic algorithms of whole number arithmetic fluently, and they should understand how and why the algorithms work."

Development of procedural proficiency requires instruction and practice. According to Robert Marzano, it is important for teachers to allow enough time for students to practice what has been taught. Practice should be done on a continuous basis rather than waiting until the end of a unit. If practice is focused on a single operation or process, it makes working through the entire process more successful (Marzano, 2001). If students need to stop and analyze what to do next or use manipulatives to solve even the basics, then the problem solving process is slowed down and often clouded by having to recall each step involved. *Targeted Mathematics Intervention* includes Differentiated Guided Practice, so students can develop procedural proficiency at their levels of readiness. Besides Warm-Up activities, the Whole-Class Skills Lesson, and Differentiated Guided Practice, students have further opportunities to practice and apply procedures through games and real-life problem-solving scenarios that are in each lesson.

Games

Because many students who struggle with mathematics either dislike the subject or have a low self-esteem about their mathematical abilities, it is sometimes very difficult to motivate them. One strategy that often helps struggling students with their math skills is to teach the skills through the use of games (McAllister, 2002). Using games is an effective instructional strategy that motivates students, increases their self-esteem, and provides opportunities for them to practice and apply mathematics concepts and skills. Game time is an effective routine for developing social skills and for building a strong classroom community. For English language learners, this is a time when they can develop their social language and form relationships with native language speakers. For this reason, *Targeted Mathematics Intervention* has included playing games as part of each lesson. Students will find that the games will spark their interest and add some fun to the lessons.

Cooperative Learning

The Warm-up activity, Vocabulary, Whole-class Skills Lesson, Differentiated Guided Practice, Problem Solving, and Learning Game provided in each lesson of *Targeted Mathematics Intervention* integrate cooperative learning and promote collaboration among students. Cooperative learning is described as learning that occurs when students work together to accomplish a shared learning goal (Johnson, Johnson, & Stanne, 2000). Cooperative learning has many positive effects on student learning. Research shows that students learn more when working cooperatively rather than working in an isolated, competitive fashion. Well-structured cooperative learning activities should have the following components:

- Individual accountability (each person in the group is responsible for learning the material)
- Supportive interaction (students share information and help each other)
- Positive interdependence (students know they are working together and support each other as needed)
- Positive social skills (communication and leadership)
- Group analysis (how well did the group work together)

When students work successfully in a cooperative setting, their learning achievement increases, their self-efficacy rises, and they often have a better opinion of the subject and of school (The College of Education and Human Development, 2007). The cooperative learning activities in *Targeted Mathematics Intervention* will increase student achievement by providing students with opportunities to discuss mathematics and share problem-solving methods with one another.

Differentiation

Students do not all learn at the same pace, but given adequate opportunities, all students can learn mathematics. Rick Wormeli (2006) defines differentiated instruction as what's fair for students. Being fair to students is adapting curriculum and instruction to meet students' needs, learning styles, levels of readiness, and interests. Below-grade-level students may need to spend more time working with manipulatives and concrete models. The curriculum may need to be compacted for above-grade-level students so that they can spend more time with real-life problem solving and the application of the concepts and skills. English language learners may need more support with academic and mathematical content language; they may need to have pictures and diagrams provided to support their comprehension of word problems. *Targeted Mathematics Intervention* meets this challenge with Differentiated Guided Practice in each lesson of the program. The Differentiated Guided Practice activities are tiered to meet students' readiness levels. Tomlinson and Eidson define *tiering* as adjusting or differentiating instruction to match a student's current readiness level (2003). The tiered activities include hands-on

activities, open-ended tasks, student driven activities, concrete examples, and multiple representations to help all students access the curriculum. The *PowerPoint* presentations that accompany each lesson can also be used for differentiated instruction. For example, teachers can use these for small group or individual instruction, or they can be used to provide visual support for English language learners during whole group instruction. A key feature of an effective intervention program is diagnosing students' needs and providing instruction to meet those needs. The differentiation components in *Targeted Mathematics Intervention* will provide teachers with the necessary support to effectively implement mathematics intervention that targets students' weaknesses.

Implementing a Mathematics Intervention Program

Response to Intervention

Response to Intervention (RTI) is an intervention model designed to provide a systematic approach to diagnosing the needs of struggling students and delivering instruction to meet those needs. For example, a student struggling in one area of mathematics may not necessarily struggle in another area (Cruey, 2007). The purpose of RTI is to provide struggling students with the necessary assistance to prevent the student from failing or needing special education services at a later date. Curriculum used in a RTI model must include diagnostic assessment, research-based methods, progress monitoring assessments, and reteaching tools.

The curriculum must support differentiated instruction and flexible grouping to meet student needs. RTI uses a tiered model to deliver intervention services to students (Batshe et.al. 2007). The system is structured to raise the level of intensity of instruction if students do not respond to the intervention. These decisions are based on student data from progress monitoring assessments (Batshe et. al., 2007). Provided below is a summary of each of the tiers of the level intervention and instruction that is to be provided to students.

Tier One students are, for the most part, on grade level and may be struggling to understand a specific concept or skill. These students' needs are addressed during the core mathematics instructional block. Teachers differentiate instruction and utilize flexible grouping to address students' needs. The intervention at this level is preventative and proactive (Batshe et.al. 2007). Many of the lesson components in *Targeted Mathematics Intervention* can be used to address students' needs during the core mathematics instructional block and whole-group instruction.

Tier Two students have not demonstrated growth on the progress monitoring assessments as a result of Tier I interventions, and are considered at-risk students. They encounter more struggles in math and it affects their overall successful performance. In most situations this involves 20–30% of the students. Supplemental instruction in addition to core program instruction is

provided to this group of students, usually in a small group setting. *Targeted Mathematics Intervention* can be used solely in a Tier II instructional setting, or specific lesson components can be used to support students in this setting. The alternative algorithms, manipulatives, pictorial models, and multiple representations included in the *Targeted Mathematics Intervention* lessons will provide students with the support they may need for this level of intervention.

Tier Three students are those students in need of intensive instructional intervention. They are seriously at risk, have fallen behind, and/or are in danger of low scores on standardized and high-stakes testing. These students need regular monitoring, individual interventions, and structured guidance. For these students, the lesson components in *Targeted Mathematics Intervention* can support such individual instruction in Warm-Up activity, Vocabulary activity, Learning Games, PowerPoint presentations, and problem solving strategies.

RTI is a data-driven approach to help students before they become seriously at risk. RTI is a fluid model. Students' placements in specific tiers are not static. Students can move among the tiers as their needs change. By using diagnostic and progress monitoring assessments, teachers can determine when students need to be placed in a specific tier or moved to another tier. *Targeted Mathematics Intervention* provides a diagnostic assessment and tools for monitoring progress that will support implementation of RTI.

Assessment

Information about what students need to learn is crucial to a teacher's ability to determine the tasks and lessons that students need in order to master skills and gain understanding (Kilpatrick, Swafford, & Findell, 2001). Education Secretary Margaret Spellings sums it up by saying, "When it comes to our children's futures, I like to say 'In God we trust, all others bring data' " (Spelling, 2006). In *Targeted Mathematics Intervention*, teachers have multiple opportunities to assess students and diagnose their needs. Students begin with a 30 question diagnostic test that give teachers baseline data for determining what students need. A test item analysis is provided on the Teacher Resource CD for analyzing student performance on each test item. Each item is correlated to one of the thirty lessons in the program. Based on the item analysis, teachers can determine differentiated groups for each lesson. If students correctly answer the question for a given lesson, then they can be assigned to those activities established for the on/above-level students. If the students miss the question for a lesson, then they can be placed in the below-level group.

Teachers have ample opportunities to assess students each day through the many components of the lessons. The Warm-up activity provides teachers with an opportunity to assess students' understanding of numbers and numeration as well as their mental math skills. Teachers can qualitatively assess students' mastery of the targeted objective for that lesson during the

modeling and discussion opportunities provided in the Whole-Class Skills Lesson. The Differentiated Guided Practice gives teachers formative data regarding the students' progress toward mastery of the targeted objective. If a student is struggling, this is where teachers would utilize differentiated strategies and reteaching to assist the student. By checking on student progress often, problems can be found early and remediated before they hinder further learning.

Preparation for high-stakes, end-of-year testing is also included in the *Targeted Mathematics Intervention* program with one-page assessments presented in testing format. This on-going practice helps students become familiar with the testing format and offers another opportunity to gather formative assessment data. The Diagnostic Test can also serve as summative post-test to determine student overall progress in the program.

Understanding and using data about student performance is fundamental to improving schools. Without analyzing and discussing data, teachers are unlikely to identify the problems that need attention, select appropriate interventions to solve those problems, or know whether they are progressing toward the achievement of their goals (Killion & Bellamy, 2000).

When Intervention Should Be Done

To accommodate school districts' needs, Teacher Created Materials developed four and six-week pacing charts for summer school implementations of *Targeted Mathematics Intervention* and a pacing plan for implementation in an after-school program. These sample pacing charts show teachers how to adapt the program for use in any a variety of instructional settings. The lesson structure is also flexible. The components of each lesson are carried out in short and consistent blocks of time. This serves at least two purposes. First, it supports teachers in systematically partitioning lessons into a variety of instructional time frames. Second, at-risk students with short attention spans are more likely to remain focused if a lesson is broken into smaller blocks of learning.

Summer School

Research shows that at-risk students lose an average of 2.6 months of grade level accomplishments every summer. This is referred to as "summer learning loss" (Center for Summer Learning). Children making normal academic progress lose a little less. But all students will lose some of their progress from the school year. Cumulative summer learning losses may explain as much as 50% to 67% of our widening achievement gap in learning (Cooper, Nye, Charlton, Lindsey, & Greathouse, 1996). In an era when parents are working more than ever before, many students are not presented with opportunities for summer camps, culturally-based family vacations, and other learning opportunities (Boss, 2002). Summer school can make up for some of these missed opportunities. Research shows that "nearly all the

differences in achievement between poor and middle class children can be attributed to changes in learning that take place over the summer" (Miller, 2007). Students that attend summer school have a chance to master math skills that were lagging during the regular school year. During summer school, students have the advantage of experiencing smaller and more informal classes. Students do not feel the grading pressures that they do during the regular school year. Because summer school subject matter normally consists of only math and/or reading, there is less to study. Most summer programs involve a lot of hands-on learning, games, and vocabulary development that at-risk students need. Research shows that schools offering summer school will most likely:

- Have a higher attendance rate during the school year
- Increase their achievement levels
- Have higher promotional rates
- See an increase of motivation and a desire to learn from it's participants
- Show stronger bonds between teachers and pupils (Brady, 2007)

Teacher Created Material's *Targeted Mathematics Intervention* program provides schools with an easy-to-implement intervention program designed to focus on key math skills and concepts at each grade level. All the materials and lessons are provided for the teachers. The program does not require a lot of planning and preparation in order to implement it. The flexible lesson components and active learning approach are ideal for a summer school setting.

After-School Programs

After-school programs can play a large role in improving math skills and math achievement, especially with targeted instruction. Focused, active learning will improve school performance. After-school programs must offer alternative approaches to learning than those used during the regular school day. "If we always do what we have always done, we will get what we've always had." Students that need intervention in an after-school program need to be actively engaged in their mathematics lessons. *Targeted Mathematics Intervention* offers active learning in the form of skill and vocabulary games, small group activities, and problem solving. Research has shown that after-school programs can increase educational equity and decrease the educational gap. By allowing students extra time in a small group, focused setting, they will have the opportunity to develop those lacking skills and increase their self-confidence in math. A targeted program helps students build the vocabulary weaknesses and math skills necessary to master regular classroom curriculum. The small group environment provides students with additional guided learning time. Many times students perform better in this setting because it reduces the anxiety related to failure (Miller, 2003). In an after-school setting, it is easier to focus on those key math standards and concepts that students need in order to be successful.

Conclusion

Diversity is everywhere, and student needs reflect this diversity. Nonetheless, adequate preparation in mathematics is essential in this ever-changing global environment if we expect our children to keep up with the world market, lead in technological advances, be prepared for national security, and provide a satisfying livelihood for themselves. Mathematics intervention, if needed, should begin in the early grades so that students will be able to meet the challenges of algebra by middle school. As educators, it is our responsibility to help students when they begin to struggle. It is critical that students have every opportunity to master significant mathematics. *Targeted Mathematics Intervention* offers that opportunity.

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