

Improving Arizona English Language Learners' Mathematics  
Achievement Using Curriculum-Based Measures

by

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## ABSTRACT

This study was an investigation of the effectiveness of curriculum-based measures (CBMs) on the math achievement of first and second grade English Language Learners (ELL). The No Child Left Behind Act (NCLB) of 2001 led to a new educational reform, which identifies and provides services to students in need of academic support based on English language proficiency. Students are from certain demographics: minorities, low-income families, students with disabilities, and students with limited English proficiency. NCLB intended to lead as to improvement in the quality of the United States educational system.

Four classes from the community of Kayenta, Arizona in the Navajo Nation were randomly assigned to control and experimental groups, one each per grade. All four classes used the state-approved, core math curriculum, but one class in each grade was provided with weekly CBMs for an entire school year that included sample questions developed from the Arizona Department of Education performance standards. The CBMs contained at least one question from each of the five math strands: number and operations, algebra, geometry, measurement, and data and probability.

The NorthWest Evaluation Assessment (NWEA) served as the pretest and posttest for all four groups. The SAT 10 (RIT scores) math test, administered near the time of the pretest, served as the covariate in the analysis. Two analysis of covariance tests revealed no statistically significant treatment effects, subject gender effects, or interactions for either Grade 1 or Grade 2. Achievement levels were relatively constant across both genders and the two grade levels.

Despite increasing emphasis on assessment and accountability, the achievement gaps between these subpopulations and the general population of students continues to widen. It appears that other variables are responsible for the different achievement levels found among students. Researchers have found that teachers with math certification, degrees related to math, and advanced course work in math leads to improved math performance over students of teachers who lack those qualifications. The design of the current study did not permit analyses of teacher or school effects.

To my family, colleagues, and students.

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# CHAPTER 1

## INTRODUCTION

Both native peoples and immigrant students are expected to learn English in countries where English is one of the dominant languages. In the United States, Native Americans were mainstreamed into the White man's world; the education of Native Americans was viewed as a means of assimilation (Webb, 2006). According to Callaway (2004), education was seen as the key to saving the Indian children. Like the children of European immigrants, Indian children were expected to jettison their old ways and become English-speaking "Americans." The Board of Indian Commissioners in 1880 described their views of the Indian:

As a savage we cannot tolerate him any more than as a half-civilized parasite, wanderer or vagabond. The only alternative left is to fit him by education for civilized life. The Indian, though a simple child of nature with mental facilities dwarfed and shriveled, while groping his way for generations in the darkness of barbarism, already sees the importance of education. (quoted in Callaway, 2004, p. 344)

In countries where the dominant language has different orthographic and lingual bases than the native languages, such as the Navajo language, the second language is especially difficult for students to learn.

Language issues aside, by the early 1990s, President George H. W. Bush, along with the National Governors Association, agreed that the states should focus on increasing student achievement by raising academic standards and holding schools accountable for the results (Webb, 2006). These recommendations were included in Bush's educational plan, *America 2000: An Education Strategy*. Congress failed to adopt Bush's recommendations, but it passed President Bill Clinton's educational plan, the

*Goals 2000, Educate America Act*. This Act began a review of school readiness, student achievement, teacher education, mathematics and science, and lifelong learning.

The election of President George W. Bush led to another educational reform initiative, the No Child Left Behind Act (NCLB) of 2001. NCLB is a reauthorization of the Elementary and Secondary Education Act's (ESEA) Title VII Bilingual Education Act of 1968, according to which schools were to identify and provide services to students in need of academic support based on English language proficiency. Taylor, Stecher, O'Day, and LeFloch (2010) succinctly summarized the mission and focus of NCLB: by the 2013-2014 school year, all children will be proficient in reading and mathematics. They also described further requirements of the Act, stating that schools and school districts will be held accountable for their students' progress and mastery of the Arizona State Standards, as measured by state tests. Furthermore, students with limited English proficiency (LEP) and students receiving special education services would be included and reported separately. The five specific areas addressed in NCLB are (a) proficiency in reading, writing, and mathematics; (b) highly qualified teachers; (c) limited English proficiency in reading, writing, and mathematics; (d) safe and drug-free schools; and (e) high school graduation rates. Since NCLB became law, the accountability reporting requirements have clearly shown an achievement gap between LEP and non-LEP students.

Throughout the years different terminologies have been used to describe and label students who may have deficiencies in English. When NCLB was reauthorized, the LEP terminology was replaced with the term *English Language Learner* (ELL). As used in the present study, ELL indicates a person who is in the process of acquiring English skills

and has a first language other than English. It is a new singular title given to several unique groups. Other terms commonly found in the literature include *language minority students*, *limited English proficient (LEP)*, *English as a second language (ESL)*, and *culturally and linguistically diverse (CLD)*. Bank Street College (n.d.) identified ELL as the new label for students whose second language is English. This shift in language represents a more accurate reflection of the process of language acquisition. The focus of the federal law is on promoting English language development and providing appropriate grade-level academic content to students. NCLB included requirements that states establish standards and benchmarks for English language proficiency and academic content. According to Webb (2006), with NCLB, the most sweeping educational reform legislation since the ESEA, President Bush created “a much larger federal presence in educational policy and funding and set the foundation for a national testing system. NCLB provided the framework and impetus for standards-based reform of education in state after state” (Lewis, cited in Webb, 2006, p. 184). In addition, NCLB included “English Language Learners” as a demographic subpopulation that is measured and must meet Adequate Yearly Progress (AYP) goals. State departments of education are required to complete an annual AYP analysis for all public schools and districts that serve these students.

Concerns are expressed when there is an increase of newcomers. Many immigrants and refugees have come to the United States; over the past 30 years, the foreign-born population has tripled in the United States. More than 14 million individuals immigrated to the United States during the 1990s alone, and another 14 million were expected to arrive between 2000 and 2010 (Passel & Cohn, 2008).

The ELL population is the fastest growing segment of the student population. The largest growth has occurred in Grades 7–12, where ELL students increased by approximately 70% between 1992 and 2002. ELL students now comprise 10.5% of the nation’s K–12 enrollment, compared to 5% in 1990. ELL students do not fit easily into simple categories; instead, they comprise a very diverse group. Recent research shows that 57% of adolescent ELL children were born in the United States. ELL students differ in their language proficiency, socio-economic standing, schooling and content knowledge, and immigration status. These numbers have led to reports about an emerging and underserved population of ELL students. Some reports portray ELL as a new and homogenous population (Passel & Cohn, 2008).

ELL children could also be seen as a highly heterogeneous and complex group of students with diverse gifts, educational needs and backgrounds, languages, and goals. Some ELL students come from families in which no English is spoken; some come from families where only English is spoken; still others have been exposed to or use multiple languages. ELL students may have a deep sense of their non-United States culture, but they also have a strong sense of multiple cultures and/or identity. Some ELL students are stigmatized for the way they speak English, and some are stigmatized for speaking a language other than English (National Council of Teachers of English, 2008).

Many ELL students go through a *silent period* during which they listen and observe more than they speak. During this silent period, ELL students benefit from opportunities to participate and interact with others in activities who use gestures, physical movement, art, experiential activities, and single words or short phrases. Most ELL students acquire the ability to understand and use the predictable oral language

needed for daily routines, play, and social interaction before they develop the ability to understand and use academic and written English. Unfortunately, this discrepancy between Basic Interpersonal Communication Skill (BICS) and Cognitive Academic Language Proficiency (CALP) is not widely understood (Brown University, 2005). BICS are language skills needed in social situations, the day-to-day language needed to interact socially with other people. Those in the ELL population employ BIC skills while on the playground and school bus, in the lunch room, at parties, playing sports, and talking on the telephone. Social interactions are usually context embedded; that is, they occur in meaningful social contexts. They are not very demanding cognitively, and the language required is not specialized. These language skills usually develop within six months to two years after arrival in the United States. CALP refers to formal academic learning, including listening, speaking, reading, and writing about subject area content material, a level of language learning essential for student success in school. Students need time and support to become proficient in academic areas, a process that usually takes from five to seven years (Schon, Shaftel, & Markham, 2008).

Thomas and Collier (2002) reported that with no prior schooling and no support in native language development, it may take seven to ten years for ELLs to catch up to their peers. Academic language acquisition is not just the understanding of content area vocabulary, it also includes skills such as comparing, classifying, synthesizing, evaluating, and inferring. Academic language tasks are context reduced. Information is read from a textbook or presented by the teacher. As a student becomes older, the context of academic tasks becomes more and more restricted while the language becomes more



demanding cognitively. New ideas, concepts, and language are presented to the students simultaneously.

Jim Cummins (2000) also advanced the theory that there is a common underlying proficiency (CUP) between two languages. The term *common underlying proficiency* has also been used to refer to the cognitive/academic proficiency that underlies academic performance in both languages. Skills, ideas, and concepts students learn in their first language will be transferred to the second language.

When students with little or no experience in speaking and understanding English well in their daily lives do not perform well academically, they are often assumed to have special needs or lack of motivation. In fact, many ELL students are simply at a developmental stage in which they have acquired interpersonal language, but cannot yet fully understand or express more complex thoughts in English. These students need numerous opportunities to listen, speak, read, and write across the curriculum. With sufficient time and opportunities to listen, observe, participate, and interact, ELL students are able to progress in understanding and produce language that is increasingly understandable, complete, and grammatical.

In addition, NCLB includes English Language Learners as a demographic subpopulation that is measured and must meet AYP goals. Each state department of education must complete an AYP analysis for all public schools and districts serving such schools. Arizona's definition of AYP is based primarily on the results of Arizona's Instrument to Measure Standards (AIMS) in reading and mathematics. The state of Arizona has developed academic standards, and it administers yearly assessments in reading, writing, and mathematics for Grades 3-8 and Grade 10. The schools are held

accountable for making AYP to ensure student achievement. To meet AYP, schools must disaggregate scores to show they met AYP in each subgroup as specified by NCLB requirements, including the ELL subgroup. That is, all students must be assessed for accountability, including the subgroup of ELL students.

Although many young ELLs have immigrant parents or caregivers, the vast majority of these students are native born United States citizens and have been legally granted the same rights to education as their native English-speaking peers. Benefiting from valid educational assessment is one of these rights. Although the current knowledge base and legal and ethical standards governing ELL assessments are limited, they are sufficient to provide guidance for the development of appropriate and valid assessments. Making improvements in existing assessments will require commitments from policymakers and practitioners to (a) develop and implement appropriate assessment tools and procedures, (b) link assessment results to improved practices, and (c) utilize trained staff capable of carrying out these tasks. Researchers can facilitate the improvement of assessment practices by continuing to evaluate implementation strategies in schools, and by developing systematic assessments of contextual factors relevant to linguistic and cognitive development. Assessments of contextual processes are necessary if current assessment strategies, which largely focus on the individual, are to improve classroom instruction, curricular content, and, therefore, student learning (Schon et al., 2008).

Several skills and developmental abilities of young children are assessed in early educational programs, including preschool and the first few elementary school years. Sensing an increase in demand for greater accountability and enhanced educational

performance of young children, the National Education Goals Panel developed a list of principles to guide early educators through appropriate and scientifically sound assessment practices (Schon et al., 2008). Moreover, the panel presented four purposes for assessing young children. The assessment of young ELL children are pertinent to the purposes of (a) promoting children's learning and development; (b) identifying children for health and special services; (c) monitoring trends and evaluating programs and services; and (d) assessing academic achievement to hold individual students, teachers, and schools accountable (i.e., high stakes testing). Embedded within each of these purposes are important considerations for practice so as to preserve assessment accuracy and support interpretations of results that lead to increased educational opportunity for students.

The AriZona English Language Learner Assessment (AZELLA) is used by the Arizona Department of Education (ADE) to determine which children should receive English support services. AZELLA is a criterion-referenced test used by the state of Arizona to assess English proficiency for the purpose of determining which students receive ELL services. Developed alongside Arizona's K-12 English Language Proficiency standards, AZELLA was developed from the Stanford English Language Proficiency (SELP) test, and was intended to replace it.

The SELP test was developed to meet the requirements of federal NCLB and state legislation (i.e., AZ Proposition 203 in 2000). The NCLB legislation required that every state develop its own set of English language development standards and to align its English language proficiency test with those standards. The SELP was adopted by the Arizona Board of Education for statewide use beginning in fall 2004, and it was

implemented in its original form for two years. The SELP was then revised, renamed the AZELLA, and adopted by the Arizona Board of Education for statewide use in fall 2006.

Depending on grade level, several forms of the AZELLA are administered. The elementary form is used for students in Grades K-6. The test contains items such as multiple-choice and extended response, and it yields scores on four subtests: speaking, listening, reading, and writing. AZELLA results are used to determine whether students are proficient in English and to place their English language skills in one of five categories: (a) Pre-Emergent, (b) Emergent, (c) Basic, (d) Intermediate, or (e) Proficient. Students who test at or above the proficient cut score in English are placed in mainstream classes without English language support. Students who obtain scores below the proficient cut scores receive English language support services in state-mandated Structured English Immersion (SEI) classes. Table 1 reflects the total composite scale score range on first and second grade AZELLA testing.

Table 1

*Total Composite Scaled Score Range on the AZELLA for Grades 1 and 2*

Grade	Pre-emergent	Emergent	Basic	Intermediate	Proficient
First grade	Below 506	506-529	530-587	588-636	Above 636
Second grade	Below 512	512-536	537-589	590-645	Above 645

Returning to NCLB and AYP, as stated above, states must disaggregate school and district scores to show proficiency in each student subgroup (including ELL).

The ADE has also developed Annual Measureable Objectives (AMO) to ensure that the percentages of students passing the state reading, writing, and mathematics

assessments (AIMS test) were sufficient for a school to make AYP. AMOs differ by subject and grade levels, not by subgroups. For the purposes of determining AMOs for schools, 95% of students enrolled must be assessed. However, only students enrolled for a full academic year must be included in the AMO (ADE website: [www.ade.state.as.us](http://www.ade.state.as.us)).

Arizona has established separate reading and mathematics AMOs for Grades 3-8 and 10 that serve to identify a minimum percentage of students (for all students and for each subgroup) that must meet or exceed the standard. For the present study, the reading and mathematics AMO was applied to each school, including each subgroup at the site, as well as at the state level. The rationale for setting all AMOs (and corresponding intermediate goals) in the progressive manner demonstrated in this document is based on three key principles:

1. The ADE had recently completed a grade-level articulation of Arizona's Academic Content Standards. The progressive setting of annual measurable objectives and corresponding intermediate goals allows schools the necessary time to align these grade-level standards with school curricula/resources and to implement the standards via instruction.
2. The ADE was developing new assessments for Grades four (4), six (6), and seven (7) for reading and mathematics, as well as a science assessment to be administered on an annual basis in Grades three (3), five (5), eight (8), and high school as mandated by the NCLB Act of 2001. The progressive setting of annual measurable objectives and intermediate goals allows schools the opportunity to effectively prepare students for these assessments.

3. Currently, the academic performance of several disaggregated student subgroups is below (in some cases, far below) the state's starting points in reading and mathematics. Many schools and districts have initiated scientifically based research programs and other instructional practices to assist students in this circumstance. In addition, the ADE has implemented a comprehensive K-3 reading program designed to help all students become proficient in the state's reading standards by the third grade. By setting the state's annual measurable objectives and corresponding intermediate goals in a progressive manner, schools, districts, and the state are given the necessary time to effectively implement these programs and initiatives, giving students in this circumstance an opportunity to catch up with the aggregated student population as represented by the respective states' starting points. Students must meet all AMOs and must demonstrate adequate gains (ADE, 2009).

In addition to meeting the requirements of NCLB, Arizona schools must also meet the ARIZONA LEARNS (AZ LEARNS) requirements under the Arizona Revised Statutes, ARS 15-241. To meet the requirements of AZ LEARNS the following Grade K-8 constraints are necessary: (a) Arizona Measure of Academic Progress (MAP), (b) percentage of students who pass the AIMS test, and (c) percentage of students who pass the AZELLA test. AZ LEARNS has some similar requirements to those of the NCLB shown in Table 2 below.

Table 2

*AZ LEARNS and NCLB Comparison of Arizona’s Accountability Systems*

AZ LEARNS	NCLB
Required by federal law	Required by federal law
Longitudinal examination of student performances	One-year snapshot of student performances
Components of evaluation:	Components of evaluation:
AIMS scores	AIMS scores
Measure Academic Progress (MAP)	Percentage of students assessed
Graduation/dropout rates	Attendance/graduation rates
Adequate Yearly Progress (AYP)	
Labels schools on a graded scale:	Labels schools on a yes/no system
Failing to meet academic standards	
Underperforming	
Performing	
Highly performing	
Excelling	

*Note:* Adapted from ADE website: [www.ade.state.as.us](http://www.ade.state.as.us); retrieved October 10, 2010.

In 2004, the ADE published profiles for K-2 schools for the first time. K-2 schools serve only kindergarten and first and second grades. Because AIMS is not administered to any of these lower grade levels, the AZ LEARNS profiles are based solely on the performance of the schools’ second graders on the state’s norm-referenced test. The method of calculating the profile for these schools is straightforward:

1. The mean normal curve equivalents (NCE) on the reading and mathematics portions of the test are calculated for the most current year for a given school’s second graders.
2. The average NCEs for the school are added together.

3. The aggregate NCEs are compared to a scale to determine the school's label.

Table 3 displays the AZLEARNS scale for performances of K-2 schools.

Table 3

*AZ LEARNS Scale for K-2 Schools*

Achievement Profile	Points
Underperforming	< 70
Performing	70 to 96.9
Highly Performing	97 to 105.9
Excelling	106 and more

*Note:* Adapted from ADE website: [www.ade.state.as.us](http://www.ade.state.as.us); retrieved October 22, 2010.

Although NCLB has focused on equalizing educational opportunities for poor and minority at-risk children and the intention is to leave no child behind, in reality many students are being left behind. The law contains provisions that permit states to direct and focus more attention on low-achieving students and to intensify efforts to improve consistently low-performing schools. Peregoy and Boyle (2005) stated that the current emphasis on curriculum standards and high-stakes testing as required by NCLB has placed tremendous pressure on students, teachers, and administrators for ELL students to test well. Although NCLB targets poor and minority children, it also attempts to ensure that every child will be taught by highly qualified teachers and will reach proficiency on a state-adopted achievement test. NCLB embodies test-driven accountability and has been a major influence on public schools nationwide.



The problem of ELL student achievement is well documented. ADE reported in 2009 that ELL students lagged significantly behind their peers and that the achievement gap was widening. *Education Week* devoted its entire annual 2009 “Quality Counts” issue to ELL matters. Edwards (2009) reported that at the national level the achievement gap was significant between ELL and “ALL” student groups. Only 9.6% of ELL students were proficient in mathematics on the National Assessment of Educational Progress (NAEP) examination, whereas 34.8% of the all student group was proficient. For some students, mathematics seems to be a foreign language, consisting of words and concepts that do not mesh with their everyday experiences. Mathematics classes for ELL students can be especially challenging because students are faced with learning mathematics and English at the same time.

Vocabulary instruction is essential to effective math instruction. Not only does it include teaching math-specific terms such as *percent* or *decimal*, it also includes understanding differences between the mathematical definition of a word and other definitions of the same word. The example shown in Figure 1, used in a presentation by Moschkovich (2008) of the University of California at Santa Cruz, underscores why vocabulary must be introduced within the context of the content:

3. Find  $x$ .

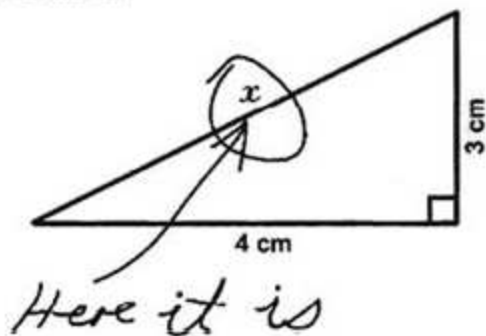


Figure 1. Example of a mathematics solution

In this problem, the student is instructed to "find  $x$ ." The student obviously knew the meaning of the word *find* because he/she *found* it on the page and circled it. The student even put a note on the page to help the teacher locate the lost "x." The student understood the meaning of *find* in one context, but not in the appropriate mathematical context. The lack of familiarity with the words hinders the ability to do the math problem, as reflected in this example, which shows one way how some ELL's struggles with vocabulary can hinder their comprehension of math assignments. Following is a list of tips for explicitly teaching mathematical academic vocabulary:

- Demonstrate that vocabulary can have multiple meanings.

Help students understand the different meanings of words such as *table* and *quarter*, as well as how to use them correctly in a mathematical context.

- Encourage students to offer bilingual support to each other.

Students understand material better when they explain it to another student, and the new student benefits from hearing the explanation in his or her first language.

- Provide visual cues, graphic representations, gestures, regalia, and pictures.

Offer students opportunities to work with objects and images to help them master vocabulary. If the number of items for each student is insufficient, use manipulatives on the overhead or posted material throughout the classroom, and demonstrate the vocabulary in front of the students. For example, a “math word wall” could be employed that has three parts: key vocabulary, “in your own words” definitions, and a variety of ways to portray a function.

- Identify key phrases or new vocabulary to preteach.

This strategy helps students decide which math function they should apply.

Example: “more than” means “add.”

- Modify the linguistic complexity of language and rephrase math problems.

Students understand the problem better when it is stated in shorter sentences and in language they understand.

- Guide students to cross out the unnecessary vocabulary in word problems.

Doing so allows students to focus on the math function required. For example, one problem students came across referred to a “school assembly.” Even though the meaning of that phrase was not important in the solving of the math problem, students did not know it was not important, and the lack of understanding contributed to their confusion.

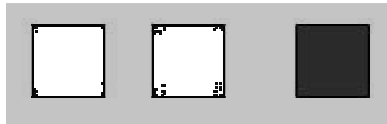
- Build knowledge from real world examples.

Try to reinforce concepts with examples that students can picture, and talk students through the situation. For example, if one needs to paint a room, one needs to know how much area will be covered and therefore know how much paint to buy. Look for familiar ideas or props that can be used to engage students

such as recipes, news stories about the economy, or discussions of personal spending habits.

- Use manipulatives purposefully.

This is important at all grade levels. Math cubes are very useful in having students represent the numbers in the problems and then manipulate the cubes to get the answer. Moschkovich (2008) used the cubes and the terms *hot* and *cold* numbers when teaching with the concept of negative numbers. Students used the red cubes as *hot* or positive numbers and the blue cubes as *cold* or negative numbers. As students laid out the number of hot cubes and cold cubes represented, they could easily see if the answer would be a positive or negative number by which color had the most cubes. A problem such as  $-2 + 1 = -1$  would look like this:



- The student then removed pairs of cubes, one red (darker color), one blue (light color), until no more blocks could be removed. The remaining blocks represent the answer.

Written word problems present a unique challenge to ELL students and teachers alike. In reading and understanding written math problems, word problems in mathematics often pose a challenge because they require that students read and comprehend the text of the problem, identify the question that needs to be answered, and finally create and solve a numerical equations. ELLs who have had formal education in their home countries generally do not have mathematical difficulties; hence, their

struggles begin when they encounter word problems in a second language that they have not yet mastered (Bernardo, 2005).

Researchers have always indicated that encouraging students to share their thoughts with their peers makes them more aware of their strengths and weaknesses. Teachers are encouraged to use cooperative learning and activities that will help students learn at their rate and level. Robertson (2009) described what she calls the importance of increasing student language production in the content area with the following mathematic strategies:

- Have students translate symbols into words and write the sentence out.

Use a variety of strategies to check students' comprehension of problems before they solved them. For example,  $3x + 4 = 16$  would be written out, "Three times X plus 4 equals 16." This helps students process the operations involved in the question and gives them an opportunity to think through how to solve it. It also gives students a chance to familiarize themselves with important vocabulary words.

- Create a sentence frame and post it on the board.

Write the format of the sentence you would like students to use in discussion, and then hold them accountable for using it. For example, "The answer is \_\_\_\_\_ degrees because it is a \_\_\_\_\_ triangle."

- Have students share problem-solving strategies.

This involves asking a simple question such as, "Did anyone else get the answer in a different way?" Then allow enough wait time so students can think through how their problem-solving process was similar or different to the one offered.

- Allow students to discuss how they are thinking about math.

This is a way of redirecting the lesson from teacher-to-student to student-to-student. For example, a student might ask a question, “How do you know what kind of triangle it is?” Instead of the teacher answering and going to the board and pointing out the names and different triangles, the teacher can simply ask, “Does someone have an answer?” Or “\”Would someone like to offer help to Mario?” Allow students to share how they think about the math concept and any tips they have for remembering the information.

- Incorporate writing activities like math journals.

This is an excellent way for students to process what they have learned and any remaining questions they may have. The journal could start with simple prompts such as, “One thing I learned today . . .” “One thing I still don't understand . . .” “One way I can get the help I need . . .” “The answer to this problem is . . .” Writing out the answer to a problem is a very important skill to develop because many state math tests require a constructed response to questions.

- Challenge students to create their own math problems.

This can be a fun activity if students create a problem similar to the ones used in class and they exchange problems with a partner. By creating the problem and checking the answer students can reinforce their own learning.

Most of the literature on the impact of NCLB on public schools reports the following recurring themes: inadequate school funding to carry out the NCLB testing and accountability mandates; the challenge of meeting highly qualified teacher requirements; difficulty in implementing scientifically research-based instructional practices; and

attaining sufficient student achievement and proficiency levels in reading, writing, and mathematics. Focusing on attaining higher proficiency levels for ELL students in mathematics is one primary purpose of this research project.

NCLB addresses five specific areas: (a) proficiency in reading, writing, and mathematics; (b) highly qualified teachers; (c) limited English proficiency in reading, writing, and mathematics; (d) safe and drug-free schools; and (e) all students will graduate from high school by 2014. Moreover, teachers and administrators have been voicing their frustrations over how the NCLB mandates have affected curriculum and instructional practices. Without adequate resources, NCLB has imposed new requirements that states must fulfill. NCLB requires schools to maintain their daily roles of trying to meet the needs of their students while maintaining requirements of writing school improvement plans, replacing staff members, reorganizing the schools, receiving outside consultants, and providing parents a choice in transferring their children from a failing school to schools that have demonstrated AYP. According to NCLB, 100% of students will be assessed and will be proficient in the state's academic standards (reading and math) by 2014.

### **Statement of Purpose**

This study consists of an experimental investigation of the effects of a weekly curriculum-based (CBM) measures program and math achievement for ELL students. The problem was to determine whether using CBM measurements would improve ELL students' mathematics achievement scores on the Arizona Standard Achievement Test (Stanford Achievement Test, 2010). Mathematics is a complex subject, encompassing everything from simple addition to calculus. In elementary schools, mathematics often

consists of addition, subtraction, multiplication, division, and some introduction to algebra or geometry. In Arizona, the mathematics standard articulated by grade level is divided into five main strands: number and operations; data analysis, probability, and discrete mathematics; patterns, algebra, and functions; geometry and measurement; and structure and logic.

### **Number and Operations**

Number sense is the understanding of numbers and how they relate to each other and how they are used in specific context or real-world applications. It includes an awareness of the different ways in which numbers are used, such as counting, measuring, labeling, and locating. It includes an awareness of the different types of numbers, such as whole numbers, integers, fractions, and decimals, plus the relationships between them and when each is most useful. Number sense includes an understanding of the size of numbers, so that, for example, students should be able to recognize that the volume of their room is closer to 1,000 than 10,000 cubic feet. Students develop a sense of what numbers are and how to use numbers and number relationships to acquire basic facts, solve a wide variety of real-world problems, and estimate and determine the reasonableness of results.

*Concept 1: Number sense:* Understand and apply numbers, ways of representing numbers, the relationships among numbers, and different number systems.

*Concept 2: Numerical operations:* Understand and apply numerical operations and their relationship to one another.

*Concept 3: Estimation:* Use estimation strategies reasonably and fluently while integrating content from each of the other strands.



## **Data Analysis, Probability, and Discrete Mathematics**

This strand requires students to use data collection, data analysis, statistics, probability, systematic listing and counting, and the interpretation of graphs. This prepares students for the study of discrete functions as well as to make valid inferences, decisions, and arguments. Discrete mathematics is a branch of mathematics that is widely used in business and industry. Combinatorics is the mathematics of systematic counting. Vertex-edge graphs are used to model and solve problems involving paths, networks, and relationships among a finite number of objects (ADE Standards and Assessment Division Approved 6.24.08).

*Concept 1: Data analysis (statistics):* Understand and apply data collection, organization, and representation to analyze and sort data. This is considered to be the analysis and interpretation of numerical data in terms of samples and populations.

*Concept 2: Probability:* Understand and apply the basic concepts of probability. This is the field of mathematics that deals with the likelihood that an event will occur expressed as the ratio of the number of favorable outcomes in the set of outcomes to the total number of possible outcomes.

*Concept 3: Systematic listing and counting:* Understand and demonstrate the systematic listing and counting of possible outcomes. This field of mathematics is generally referred to as Combinatorics.

*Concept 4: Vertex-edge graphs:* Understand and apply the concepts of vertex-edge graphs and networks. This field connects graph theory with practical problems.

## **Patterns, Algebra, and Functions**

Patterns occur everywhere in nature. Algebraic methods are used to explore, model, and describe patterns, relationships, and functions involving numbers, shapes, iteration, recursion, and graphs within a variety of real-world problem-solving situations. Iteration and recursion are used to model sequential, step-by-step change. Algebra emphasizes relationships among quantities, including functions, ways of representing mathematical relationships, and the analysis of change.

*Concept 1: Patterns:* Identify patterns and apply pattern recognition to reason mathematically. Students begin with simple repetitive patterns of much iteration. This is the beginning of recursive thinking. Later, students can study sequences that can best be defined using recursion.

*Concept 2: Functions and relationships:* Describe and model functions and their relationships. For example, distribution and communication networks, laws of physics, population models, and statistical results can all be represented in the symbolic language of algebra.

*Concept 3: Algebraic representations:* Represent and analyze mathematical situations and structures using algebraic representations. Algebraic representation is about abstract structures and about using the principles of those structures to solve problems expressed with symbols.

*Concept 4: Analysis of change:* Analyze how changing the values of one quantity corresponds to change in the values of another quantity (ADE Standards and Assessment Division Approved 6.24.08).

## **Geometry and Measurement**

Geometry is a natural place for the development of students' reasoning, higher thinking, and justification skills culminating in work with proofs. Geometric modeling and spatial reasoning offer ways to interpret and describe physical environments and can be important tools in problem solving. Students use geometric methods, properties and relationships, transformations, and coordinate geometry as a means to recognize, draw, describe, connect, analyze, and measure shapes and representations in the physical world. Measurement is the assignment of a numerical value to an attribute of an object, such as the length of a pencil. At more sophisticated levels, measurement involves assigning a number to a characteristic of a situation, as is done by the consumer price index. A major emphasis in this strand is becoming familiar with the units and processes used in measuring attributes.

*Concept 1: Geometric properties:* Analyze the attributes and properties of two- and three-dimensional figures and develop mathematical arguments about their relationships (in conjunction with Strand 5, Concept 2).

*Concept 2: Transformation of shapes:* Apply spatial reasoning to create transformations and use symmetry to analyze mathematical situations.

*Concept 3: Coordinate geometry:* Specify and describe spatial relationships using coordinate geometry and other representational systems.

*Concept 4: Measurement:* Understand and apply appropriate units of measure, measurement techniques, and formulas to determine measurements.

## Structure and Logic

This strand emphasizes the core processes of problem solving. Students draw from the content of the other four strands to devise algorithms and analyze algorithmic thinking. Strand 1 and Strand 3 provide the conceptual and computational basis for these algorithms. Logical reasoning and proof draw their substance from the study of geometry, patterns, and analysis to connect remaining strands. Students use algorithms, algorithmic thinking, and logical reasoning (both inductive and deductive) as they make conjectures and test the validity of arguments and proofs. Concepts to develop the core processes are when students evaluate situations, select problem-solving strategies, draw logical conclusions, develop and describe solutions, and recognize their applications.

*Concept 1: Algorithms and algorithmic thinking:* Use reasoning to solve mathematical problems. Determine step-by-step series of instructions to explain mathematical processes (ADE Standards and Assessment Division Approved 6.24.08).

*Concept 2: Logic, reasoning, problem solving, and proof:* Evaluate situations, select problem-solving strategies, draw logical conclusions, develop and describe solutions, and recognize their applications. Develop mathematical arguments based on induction and deduction, and distinguish between valid and invalid arguments ([www.ade.state.as.us](http://www.ade.state.as.us); retrieved October 10, 2010).

Once students reach the high school level and beyond, mathematics is often taught in segments, focusing on one area at a time. People who choose to major in mathematics in college and graduate school often become experts in one area such as algebra or geometry.

### **Need for the Study**

The achievement gap between ELL and non-ELL students requires the development of testing programs and strategies that could help close the gap. The results of the present study have the potential to help Arizona public schools close the achievement gap and realize the ultimate goal of NCLB. Effective weekly CBM measures may become an additional high-yield strategy for working with ELL students. The result may also serve to encourage schools to revise their school improvement plans, curriculum, and testing procedures that impact not only ELL students, but also other students who fall into the achievement gap.

### **Delimitations**

This study was conducted in a single K-2 elementary public school in Arizona. It was also delimited to CBM measures being used in mathematics. NCLB has the potential to affect education in a variety of ways. This study was delimited to the following:

- (a) assessment requirements on curriculum and instructional practices (mathematics), and
- (b) requirements for meeting the needs of ELL students in the area of mathematics.

### **Definition of Terms**

*Arizona Department of Education (ADE)*: This is the state of Arizona's education department that assists in all curriculum and assessment for Arizona schools.

*Adequate Yearly Progress—Under NCLB (AYP)*: Each state establishes a definition of “adequate yearly progress” (AYP) to use each year to determine the achievement of each school district and school. States are to identify for improvement any Title 1 school that does not meet the state's definition of adequate yearly progress for two consecutive school years.

*Arizona Instrument to Measure Standards (AIMS):* AIMS is a standardized achievement measure designed to assess student performance in three academic categories: mathematics, reading, and writing (ADE: AZELLA Technical Manual). Reliability of the 2009 AIMS reading and math subtests was estimated with Cronbach's (1982) measure of internal consistency. For English language learners in the grades targeted in this study, Alpha coefficients ( $\alpha$ ) ranged from .82 to .91. Internal consistency was generally higher for mathematics than for reading, and higher for lower grades than for upper grades.

*Annual Measureable Objectives (AMO):* Criterion objectives expressed in the percentages of students passing the state reading, writing, and mathematics assessments, measured by the AIMS test, for a given school to make AYP.

*AriZona English Language Learner Assessment (AZELLA):* AZELLA is a criterion-referenced test used by the state of Arizona to assess English proficiency for the purpose of determining which students receive ELL services. Developed alongside Arizona's K-12 English Language Proficiency standards, AZELLA was adapted from the Stanford English Language Proficiency (SELP) test, and was intended to replace it.

*AriZona LEARNS (AZ LEARNS):* In addition to meeting the requirements of NCLB, Arizona schools must also meet the AZ LEARNS requirements under the Arizona Revised Statutes, ARS 15-241.

*Basic Interpersonal Communication Skills (BICS):* Describes social, conversational language used for oral communication. Also described as social language, this type of communication offers many cues to the listener and is context-embedded language. Typically it takes approximately two years for students from different linguistic

backgrounds to comprehend readily context-embedded social language. English language learners can comprehend social language by observing speakers' non-verbal behavior (gestures, facial expressions, and eye actions); observing others' reactions; using voice cues such as phrasing, intonations, and stress; observing pictures, concrete objects, and other contextual cues that are present; and asking for statements to be repeated and/or clarified.

*Cognitive Academic Language Proficiency (CALP):* CALP is the context-reduced language of the academic classroom. It takes five to seven years for English language learners to become proficient in the language of the classroom because non-verbal clues are absent; there is less face-to-face interaction; academic language is often abstract; literacy demands are high (narrative and expository text and textbooks are written beyond the language proficiency of the students); and cultural/linguistic knowledge is often needed for full comprehension.

*Common Underlying Proficiency (CUP):* Cummins' common underlying proficiency model of bilingualism can be represented pictorially in the form of two icebergs. The two icebergs are separate above the surface. That is, two languages are visibly different in outward conversation. Underneath the surface, the two icebergs are fused such that the two languages do not function separately. Both languages operate through the same central processing system.

*Curriculum-based measures (CBM):* Curriculum-based measures are assessments created from or aligned to the curriculum, and are used to measure student performance and progress within the curriculum.

*English Language Learner (ELL):* The term *English language learner* (ELL), as used here, indicates a person who is in the process of acquiring English and has a first language other than English. Other terms commonly found in the literature include *language minority students*, *limited English proficient* (LEP), *English as a second language* (ESL), and *culturally and linguistically diverse* (CLD).

*English as a Second Language (ESL):* Formerly used to designate ELL students, this term increasingly refers to a program of instruction designed to support these students. It is still used to refer to multilingual students in higher education.

*Limited English Proficient (LEP):* Term employed by the United States Department of Education for ELL students who lack sufficient mastery of English to meet state standards and excel in an English language classroom. Increasingly, English Language Learner (ELL) is used to describe this population, because it highlights learning instead of suggesting that non-native-English-speaking students are deficient.

*Measure of Academic Progress (MAP):* The NWEA computerized adaptive tests. For each individual taking a MAP test, the difficulty of each question is based on how well a student answered all the previous questions.

*No Child Left Behind Act of 2001 (NCLB):* This was the reauthorization of the Elementary and Secondary Education Act of 1965 that was in force by federal law and that affected K-12 schools at this time of this study.

*Primary home language other than English (PHLOTE):* This particular survey was developed and completed by parents. PHLOTE students were administered the AZELLA to determine the level of their English language proficiency and their correct placement in classes.



*Rasch UnIT (RIT)*: This is a measurement scale developed to simplify the interpretation of test scores. The RIT score relates directly to the curriculum scale in each subject area. It is an equal-interval scale, like feet and inches, so scores can be added together to calculate accurate class or school averages. RIT scores range from about 140 to 300. RIT scores make it possible to follow a student's educational growth from year to year.

*Stanford English Language Proficiency (SELP)*: This test, was adopted by ADE for statewide use. It was implemented in its original form for two years. SELP was then revised, renamed the AZELLA, and adopted by the ADE for statewide use in fall 2006.

*Stanford Assessment Test (SAT 10)*: This test is given to students at the end of each school year. It is intended to determine AZ LEARNS outcomes.

### **Questions to be Answered**

This study addressed the following primary and secondary research questions.

The primary question asked,

1. What are the effects of CBM's on the math achievement of ELL students?

The secondary question asked,

2. What are the effects of CBM's on the math achievement of male and female ELL students?

## CHAPTER 2

### REVIEW OF THE LITERATURE

#### **English Language Learners**

An act to enforce the constitutional right to vote, to confer Jurisdiction upon the district courts of the United States of America to provide relief against discrimination in public accommodations, to authorize the Attorney General to institute suits to protect constitutional rights in public facilities and public education, to extend the Commission on Civil Rights, to prevent discrimination in federally assisted programs, to establish a Commission on Equal Employment Opportunity, and for other purposes (Johnson, 1963, quoted by Caro, 1982, p. 275)

Commitments to improving education made by United States presidents also inspired the law's passage. American leaders began discussing the need for a competitive technological industry during President Harry S. Truman's administration, at the beginning of the Cold War. As the Cold War progressed during the Eisenhower and Kennedy administrations, improving the educational system came to be understood as an imperative. The Soviet Union's successful launching of the Sputnik spacecraft on October 4, 1957, raised concerns that the Soviet school system was superior to that of the United States, and therefore could produce superior scientists (Jeffrey, 1978).

The Civil Rights Act of 1964, enacted on July 2, 1964, was a landmark piece of legislation that outlawed major forms of discrimination against Blacks and women, including racial segregation. It provided a legal basis for ending unequal application of voter registration requirements and racial segregation in schools, at the workplace, and by facilities that served the general public ("public accommodations"). Powers given to enforce the act were weak initially, but were supplemented during later years. Congress asserted its authority to legislate under several different parts of the United States

Constitution, principally its power to regulate its duty to guarantee all citizens equal protection of the laws under the Fourteenth Amendment (Johnson, 1963, cited by Caro, 1982).

The bill was called for by President John F. Kennedy in his civil rights speech of June 11, 1963, in which he called for legislation “giving all Americans the right to be served in facilities, which are open to the public such as hotels, restaurants, theaters, retail stores, and similar establishments,” as well as “greater protection for the right to vote” (Kennedy, 1963).

Emulating the Civil Rights Act of 1875, Kennedy's civil rights bill included provisions to ban discrimination as to public accommodations, and to enable the United States Attorney General to join in lawsuits against state governments that operated segregated school systems, among other provisions (Johnson, 1963, cited by Caro, 1982).

The assassination of President John F. Kennedy in late November 1963 changed the political situation. The new president, Lyndon B. Johnson, was a former teacher who had witnessed the effects of poverty on his students. President Johnson believed that equal access to education was vital to a child's ability to lead a productive life (Jeffrey, 1978). He utilized his experience in legislative politics and the power of his presidential office to support the bill. In his first address to Congress, on November 27, 1963, Johnson told the legislators, “No memorial oration or eulogy could more eloquently honor President Kennedy's memory than the earliest possible passage of the civil rights bill for which he fought so long” (Johnson, 1963, cited by Caro, 1982). Upon the return of Congress from its winter recess it became apparent that public opinion in the North favored the bill and the petition would acquire the necessary signatures. To prevent

humiliation of others that would result from the success of the petition, Chairman Smith allowed the bill to pass through the Rules Committee. The bill was brought to a vote in the House of Representatives on February 10, 1964, passed by a vote of 290 to 130, and sent to the Senate (Graham, 1990).

The Elementary and Secondary Education Act (ESEA), a United States federal statute enacted on April 11, 1965 as part of President Johnson's "War on Poverty," was at that time the most expansive federal educational bill ever. The Act is an extensive statute that funds primary and secondary education, while explicitly forbidding the establishment of a national curriculum (Bailey & Mosher, 1968). The law became the educational centerpiece of Johnson's legislative agenda, the "Great Society," and in particular his "War on Poverty" programs. The ESEA was designed to address the problem of inequality in education. The Act authorized the funding for professional development, instructional materials, resources to support educational programs, and parental involvement. The Act was originally authorized through 1970, but it has been reauthorized every five years since its enactment. Recent reauthorizations of the Act include Educational Consolidation and Improvement Act of 1981, the Improving America's Schools Act (IASA) of 1994, and No Child Left Behind Act of 2001 (Johnson, 1964, cited by Caro, 1982).

The law consists of five titles, pursuant to which the federal government provides funding to 90% of the nation's public and parochial schools. The first and most important is Title I, which provides funding and guidelines for educating "educationally disadvantaged" children. Congress budgeted more than 80% of the monies originally appropriated under the ESEA for Title I programs; in 2002, the federal government

allocated over \$8 billion to fund Title I programs. These programs are intended to meet the special educational needs of “educationally deprived” children and school districts with high concentrations of such students, who typically are from poor families. Title II provides money to purchase library materials and audio/visual equipment. Congress incorporated this provision into the original law in response to concerns that the federal government would regulate the content of materials purchased with Title II funds. Title III provides funding for programs designed to meet the educational needs of students “at risk” of school failure, including after-school, radio and television, counseling, and foreign language programs. Title IV provides funding for college and university research on education, and Title V provides funding to individual state departments of education. This piece of legislation constituted the most important educational component of the “War on Poverty” launched by President Johnson (Bailey & Mosher, 1968).

Following the enactment of the bill, President Johnson stated that Congress, which had been trying to pass a school bill for all the nation’s children since 1870, had finally taken the most significant step of this century to provide help for all school children. He argued that the school bill was wide-reaching, because “it will offer new hope to tens of thousands of youngsters who need attention before they ever enroll in the first grade, and it would assist five million children of poor families overcome their greatest barrier to progress: poverty” (Johnson, 1964, cited by Caro, 1982). Johnson asserted, “There was no other single piece of legislation that could help so many for so little cost: for every one of the billion dollars that we spend on this program, will come back tenfold as the school dropout rates decline” (Graham, 1990). It encouraged young people to stay in school and graduate.

The term ELL, used for English Language Learners, is a new singular title given to several unique groups. Bank Street College (n.d.) identified ELL as the new label for students whose second language is English. Previous labels included LEP for students with limited English proficiency, ESL for students whom English was a second language, and SLL for students whom English was their second language.

Limited English Proficiency was defined in the Elementary and Secondary Education Act of 1965 as follows:

An individual, means an individual (A) who is aged 3 through 21; (B) who is enrolled or preparing to enroll in an elementary school or secondary school; (C)(i) who was not born in the United States or whose native language is a language other than English; (ii)(I) who is a Native American or Alaska Native, or a native resident of the outlying areas; and (II) who comes from an environment where a language other than English has had a significant impact on the individual's level of English language proficiency; or (iii) who is migratory, whose native language is a language other than English, and who comes from an environment where a language other than English is dominant; and (D) whose difficulties in speaking, reading, writing, or understanding the English language may be sufficient to deny the individual (i) the ability to meet the State's proficient level of achievement on State assessments described in section 1111(b)(3); (ii) the ability to successfully achieve in classrooms where the language of instruction is English; or (iii) the opportunity to participate fully in society (Section 9101(25)).

This shift in language to ELL represents a more accurate reflection of the process of language acquisition because the students to whom this label applies are in various stages and processes of acquiring English skills. Peregoy and Boyle (2005) provided a more detailed description of students who may currently fall under the ELL umbrella/label. They say that ELL students may be the children of immigrants coming to the United States looking for a better life, some of them looking to escape war and/or political unrest in their native countries, and children who have been born here, such as Native Americans, whose is "roots in American soil go back for countless generations"

(p. 2). Regardless of when, why, or how these students arrived in American public schools, their commonality is that all speak a primary language other than English in the home and are required to learn and show proficiency in academic areas (most notably reading and math) in and through the English language.

In 1974, the United States Supreme Court ruled in *Lau v. Nichols* that failure to provide appropriate educational support for students with limited English proficiency violates students' rights. The need to provide and monitor services and educational progress of ELL students has been recognized continually by the courts and by legislation (e.g., NCLB Act of 2001).

The federal NCLB Act of 2001 not only requires schools, districts, and states to identify and track ELL students, it also mandates that ELL students be reported as a unique subpopulation for determination of AYP. However, the NCLB Act does not specifically define what constitutes ELL. Instead, the identification of ELL students is a process left to the individual states.

### **Identification of English Language Learners**

Goldenberg and Rutherford-Quach (2010) studied the identification of ELL students nationwide and found that while the process varies from state to state, it tends to include two steps. The first step involves some initial report, referral, or indication that a student might have limited English proficiency. Step 2 involves the administering of an English language proficiency test to make an identification of the student's placement.

States continue to use a "Home Language Survey" as the primary means of identifying a potential case of limited English proficiency. Kindler (2002) reported that nearly 45 states used survey instruments as an identification tool for determining limited

English proficiency. More recently, *Education Week* reported that currently 49 of the 51 states (including the District of Columbia) use a home language survey in the referral process (“Identifying English-language Learners,” 2009). However, even though home language surveys are typically the first measure of a potential English proficiency problem, they are fraught with controversy. The first problem is the simple nature of the surveys. That is, most just ask for information about languages spoken in the home and perhaps one or two other language-related questions. This caused Abedi (2008) to question their reliability and validity, stating that there is no correlation between parents’ answers on these surveys and students’ measured proficiency levels. Second, Littlejohn (1998) argued that the use of these surveys over-identifies students in the ELL category because not all students who have a home language other than English are limited in English proficiency.

After an initial referral of a potential English proficiency problem, all states, plus the District of Columbia, determined ELL status by giving students an English proficiency assessment. Again, there are no universal or national criteria for these assessments; rather, states have the right to create their own.

As discussed in Chapter 1, in 2004 the state of Arizona commissioned the development of the Stanford English Language Proficiency (SELP) test, which was adopted by the Arizona Department of Education (ADE) for statewide use. It was implemented in its original form for two years. SELP was then revised, renamed the AriZona English Language Learner Assessment (AZELLA), and adopted by the ADE for statewide use in fall 2006. At this time the Primary Home Language Other Than English (PHLOTE) survey was also developed and completed by parents. PHLOTE students were



administered the AZELLA to determine the level of their English language proficiency and their correct placement in classes (Arizona Department of Education A.R.S. §15-756.A, 2010).

According to the ADE, “Proficiency Level” means the level of English language proficiency of a PHLOTE student as determined by the AZELLA. The AZELLA proficiency levels are (a) Pre-Emergent, (b) Emergent, (c) Basic, (d) Intermediate, and (e) Proficient. A PHLOTE student whose composite AZELLA score is Proficient is not classified as ELL and is not placed in a Sheltered English Instruction (SEI) Classroom. SEI Classroom entry or exit are determined solely by scores on the AZELLA. Students whose AZELLA composite proficiency level scores are Pre-Emergent, Emergent, Basic, or Intermediate are grouped in SEI Classrooms. New ELLs take the AZELLA at least twice during their first school year in an Arizona school, once at the beginning of the year, or upon initial entry to school, and once at the end of the school year. Continuing ELLs are reassessed with the AZELLA at the end of each school year. English language learners are given the opportunity to take the AZELLA at mid-point in the academic year to measure progress toward English language proficiency. No student takes the AZELLA more than three times in a school year (Arizona Department of Education A.R.S. §15-756.A, 2010).

## **Curriculum, Instruction, and Assessment**

### **Curriculum**

Once students are classified as ELLs, federal law requires that educational programs provide them with two components: access to the core curriculum and opportunities for English language development. Federal law makes no determination on

how schools and/or districts are to meet these two requirements. Rather, state educational agencies and state laws govern program and curricular implementation. Historically, since LEP/ELL students were typically foreign-born residents of certain localities who spoke the same first language, services were provided under the aegis of “bilingual education.”

Lessow-Hurley (2000) discussed dual or bilingual education at length, and concluded that all forms of bilingual education focus on teaching and improving English, and on providing access to the core curriculum through the home language, while learning English. Within bilingual education, the most common types of programs are transitional bilingual, maintenance bilingual, immersion, two-way immersion, and newcomer programs.

Peregoy and Boyle (2005) reported that bilingual education programs serve only a small percentage of ELL students. The vast majority of these students receive services through English language instructional programs,” a shift that has mirrored shifts in population. Previously, ELL students in a school or district tended to be from the same place and spoke the same language; now, however, schools and classrooms contain students from multiple locations who speak a multitude of languages. The four most common types of ELL instructional programs are Sheltered English, also called Specially Designed Academic Instruction in English (SDAIE); ESL Pullout; English Language Development (ELD); and Structured English Immersion.

*Education Week* reported on the frequency and type of programs offered by states. The number of states (plus the District of Columbia) that offered the specific programs were Content-based ESL (43), Pull-out ESL (42), Sheltered English Instruction (39),

Structured English Instruction (32), dual language (31), transitional bilingual (28), two-way immersion (23), specially-designed academic instruction in English (18), heritage language (16), developmental bilingual (15), and other (29; *Education Week*, 2009).

In SEI/SDAIE programs, subject matter is taught entirely in English, while the instructional approach, which includes specialized techniques, is designed to foster second language acquisition. With ESL pullout programs, students receive the majority of their instruction in English but are “pulled out” of the regular class to receive help from an ESL teacher or assistant. ELD programs are very similar to SDAIE programs in that students receive all of their instruction in English from teachers with special training in second language acquisition skills. Finally, in structured English Immersion, sheltering techniques are used to make the English-only content understandable.

In contrast, since 2008 Arizona ELL students are required to attend four hours of English language development (ELD) classes per day. Additional requirements of the ELD classes are that the students be taught exclusively with materials written in English, be grouped according to scores on the AZELLA, and that the teachers must be highly qualified in English (Haskins, 2010).

### **Instruction**

The first requirement in terms of instruction for ELL students under NCLB is that they have access to the core curriculum. In general, all states have adopted standards-based curriculum and focus instruction on standards within core subjects. Laturneau (2003) detailed the three components of standards-based instruction: (a) the content standards describe what students should know and be able to do; (b) benchmarks within the standards specify expected knowledge and skills for each standard at different grade

levels; and (c) performance and/or progress indicators that describe how students will show that they have met the standard.

The second requirement is that ELL students have opportunities to develop English language skills. The different types of opportunities currently in use were discussed above in the section on curriculum. The SEI proposed for use as a curricular framework in Arizona also contains and recommends particular instructional strategies. The strategic core of SEI is for teachers to modify their language, making instructional talk more understandable by speaking clearly, repeating main ideas and key points, and defining needed vocabulary within context. Another important component is to combine the verbal with nonverbal communications, such as gestures, graphs, pictures, and objects.

Peregoy and Boyle (2005) provided information on other high-yield ELL instructional strategies including, group work, thematic instruction, and scaffolding. Many of these strategies are also included in the SEI approach. In summary, for ELL students to achieve greater and deeper understanding and retention of material, instruction must combine comprehensible input with social interaction opportunities to enable ELL students to process information verbally and nonverbally. Gibbs (1994) also stated that social interaction and positive relationships help promote success among ELL and all students.

Table 4 displays ADE requirements for instructional time in all SEI classrooms.

Table 4

*Overview of ELL Instructional Time Program in Arizona*

Time allocations	Conversation	Grammar	Reading	Vocabulary	Prewriting/ writing
Pre-Emergent and Emergent	45 Minutes	60 Minutes	60 Minutes	60 Minutes	15 Minutes
Basic	30 Minutes	60 Minutes	60 Minutes	60 Minutes	30 Minutes
Intermediate	15 Minutes	60 Minutes	60 Minutes	60 Minutes	45 Minutes

*Note:* ADE website [www.ade.state.as.us](http://www.ade.state.as.us); retrieved October 10, 2010.

Students who exit the program (by testing proficient on the AZELLA) are monitored for two years and tested annually using the AZELLA. Students may be placed back in the ELL program based on AZELLA proficiency scores earned during the two-year monitoring cycle.

ADE also mandated that these specific policies be followed in SEI classrooms: (a) instruction and materials are in English; (b) language ability is used to determine grouping in the SEI setting; (c) goal is for students to become proficient in one year; (d) four hours of English language development instruction is driven by ELL standards; (e) an hour for the purpose of ELL means a “normal class period” to facilitate class scheduling on an hourly cycle; and (f) research-based models must be used.

Schools with these policies in place will also have an SEI classroom program with the following components in place, which includes the required four hours of daily English language instruction: (a) phonology–pronunciation and the sound system of English; (b) morphology–internal structure and forms of words; (c) syntax–rules of English word order; (d) lexicon–vocabulary; (e) semantics–word meaning and how to use

English in different contexts; and (f) listening, speaking, reading, and writing aligned with English Language Proficient Standards.

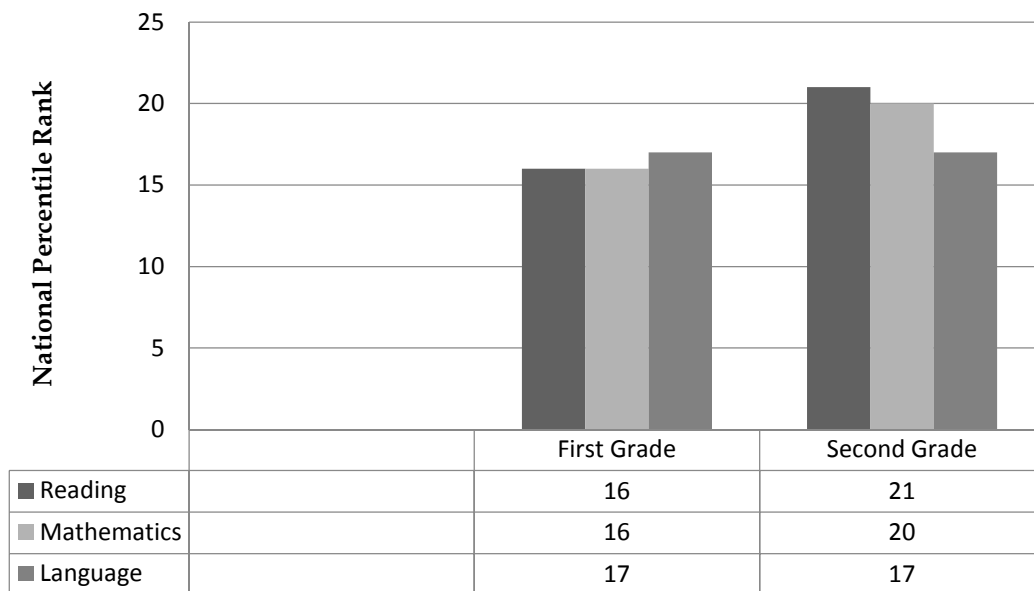
### **Assessment**

Assessment refers to any evaluation of student learning, progress, achievement, and/or development. With regard to ELL students, two very distinct assessment determinations occur every year, both mandated by NCLB. The first required assessment measures ELL students' progress in English language development. The second requires a reporting of how ELL students progress in the core curriculum, defined as reading and mathematics (some states also require and publish results for science). The primary goal of the first requirement is to have students reach proficiency in English, although general progress is also measured and reported. Every ELL student is assessed yearly with the same instrument that originally indicated limited English proficiency. In Arizona, ELL students must take the AZELLA yearly. NCLB requires states to report student progress in English language development progress each year.

A few years ago *Education Week* reported the most up-to-date national information compiled by the United States Department of Education. The results for 2006-07 indicated that of the almost 4.5 million students classified as ELL, only 12.5% tested proficient in English at the end of the year. In Arizona, only 10.7% of the ELL population ( $N = 167,679$ ) reached proficiency levels. The same report also provided information on the extent of student progress. Nationally, 34.4% of all ELL students made progress toward English proficiency. The result in Arizona was 47.8% of the ELL students were moving toward language proficiency (*Education Week*, 2009).

The second reporting requirement answers the question of how ELL students fare in the core content areas of reading and mathematics. All individual students in Grades 3-8 and 10 are required to take a yearly state assessment to measure their proficiency in reading and mathematics. The results on this test determine a school's AYP status and lie at the heart of NCLB accountability requirements.

In Arizona, all students in Grades 3-8 and 10 take the SAT 10, which measures performance in reading, language, and mathematics. Statewide performance data in Grades 1 and 2 comparing ELL students to ALL students for 2009 and 2010 are displayed in Figure 2.



*Figure 2.* 2010 Stanford 10 Grade 1 & 2 reading, mathematics, and language. The National Percentile Ranks indicate the relative standing of a student in comparison with other students in the same grade in the norm (reference) group who took the test at a comparable time. Percentile ranks range from a low of 1 to a high of 99, with 50 as the median performance for the grade. The percentile rank corresponding to a given score indicates the percentage of students in the same grade obtaining scores less than these scores.

The school district that was the focus of the present study also used what is called NorthWest Evaluation Assessment (NWEA), which measures performance in reading,

language arts, science, and mathematics. Statewide performance data comparing ELL students to ALL students in Grades 1 and 2 across the country are displayed in Table 5.

Table 5

*NWEA Results for Arizona Grades 1 and 2 in 2010 (Mathematics Status Norms (RIT Values))*

Grade	Beginning of year Median	Beginning of year Mean	Middle of year Median	Middle of year Mean	End of year Median	End of year Mean
1	164	163.4	171	169.9	178	176.7
2	179	179.5	186	186.5	191	190.8

NWEA is a not-for-profit organization committed to helping school districts throughout the nation improve learning for all students. NWEA partners with more than 2,200 school districts that serve more than 3 million students. As a result of NWEA tests, educators can make informed decisions about how to promote their students' academic growth. The NWEA computerized adaptive tests are called Measure of Academic Progress (MAP). For each individual taking a MAP test, the difficulty of each question is based on how well a student answers all the previous questions. As the student answers correctly, questions become more difficult. If the student answers incorrectly, the questions become easier. In an optimal norm-referenced test, collectively students answer approximately half the items correctly and half incorrectly. The final score is an estimate of the student's achievement level relative to national norms (Cronin & Dahlin, 2007).

Tests developed by NWEA use a scale called RIT to measure student achievement and growth. RIT stands for Rasch UnIT, a measurement scale developed to simplify the interpretation of test scores. The RIT score relates directly to the curriculum



scale in each subject area. It is an equal-interval scale, like feet and inches, so scores can be added together to calculate accurate class or school averages. RIT scores range from about 140 to 300. Students typically start at the 140 to 190 level in the third grade and progress to the 240 to 300 level by high school. RIT scores make it possible to follow a student's educational growth from year to year. Although the tests are not timed, it usually takes students about one hour to complete each of the four tests in reading, language, and math (Cronin & Dahlin, 2007).

Districts have the option of testing their students up to four times per year. Typically, students are tested at the beginning, middle, and end of the school year. NWEA assessments are designed to target a student's academic performance in mathematics, reading, language usage, and science. The tests are tailored to an individual's current achievement level. This gives each student a fair opportunity to show what he or she knows and can do. If a school uses MAP, the computer adjusts the difficulty of the questions so that each student takes a unique test. NWEA assessments are used to measure a student's progress or growth in school. Parents may have a chart to record a child's height at certain times, such as on birthdays, from one year to the next. NWEA assessments do something similar, except they measure a student's growth in mathematics, reading, language usage, and science skills.

NWEA tests are important to teachers because they keep track of progress and growth in basic skills. NWEA tests let teachers know a student's strengths and whether help is needed in any specific areas. Teachers use this information to help them guide instruction in the classroom.

The TerraNova was another test that was administered to students from kindergarten through grade 12 throughout much of the United States to measure student capabilities in reading, language arts, math, science, and social studies. These classic fill-in-the-bubble tests compare each student's scores to national norms. At the time of this study the TerraNova test was being administered until the SAT 10 replaced it.

The TerraNova tests are used by many U.S. Departments of Defense Dependents schools. The state of California uses the test as part of the CAT/6 or California Achievement Tests, 6th edition, the statewide testing program. The CAT series of tests was available before many other states began developing their own standards-based tests as part of an overall testing movement in the United States (Ferrara, 2010).

The TerraNova test takes an hour to complete and is usually administered over one to two days (depending on the grade level). The questions are usually on the same level as other tests; however, the tests for Grade 5 and above are difficult and utilize short answer response modes. Some of the tests are a bit more difficult, depending on grade level and school types (usually more difficult for private schools).

The Terra Nova tests are administered to provide an approximate percentile score range, which is how results are reported to teachers. The test is taken several times throughout the school year. Correct interpretations of the TerraNova test scores provide ways to determine what help, if any, a student needs to improve his or her academic achievement (Ferrara, 2010).

### **Achievement Gap**

Christie (2002) provided a detailed definition of what is called the “achievement gap” in education. It can be defined as a significant performance difference on an area (or

areas) of a state test between any of various groups of students. Student groups can include male and female students, students with and without disabilities, students with and without proficiency in English, minority and nonminority students, and students who are eligible for free and reduced-price lunch and those who are not. For AYP reporting purposes, students without English proficiency are called ELL, and students eligible for free and reduced-price lunch are called Economically Disadvantaged.

According to Fry (2008), prior analysis of assessment data uniformly indicates that ELL students are much more likely than non-ELL students to score below proficiency levels in both reading and mathematics. McBride's (2008) report concurred with Fry's findings and stated further that ELL students are among the lowest scoring on both national and state assessments. Additionally, she found that from 2005 through 2007 the achievement gap increased between non-ELL and ELL students on the NAEP examination.

Research in the field of science education has focused on inquiry (Amaral, Garrison, & Klentschy, 2002; Cuevas, Lee, Hart, & Deaktor, 2005; Fradd & Lee, 1999), professional development for teachers (Buck, Mast, Ehlers, & Franklin, 2005; Hart & Lee, 2003), and lesson adaptations and accommodations (Rice, Pappamihel, & Lake, 2004). Most recently there has been more professional development given to teachers with more opportunities to use different types of strategies and accommodations with their students.

The differences between math and the other core subjects (i.e., English, social studies, and science) is that math has its own unique language and symbols. Halliday (1978) was the first to coin the term *mathematics register*. He further defined registry as

“a set of meanings that is appropriate to a particular function of language, together with the words and structures which express these meanings” (p. 195). Schleppegrell (2007) added that “learning the language of a new discipline is part of the learning of the discipline; in fact, the language and the learning cannot be separated” (p. 140). He stated further that there are three distinct linguistic challenges associated with math: (a) multi-semiotic formations, (b) dense noun phrases that participate in relational processes, and (c) precise meanings of conjunctions and implicit logical relationships that link mathematic elements. His conclusion is that “the linguistic challenges of math need to be addressed for students to be able to construct knowledge about math in ways that will ensure their success” (p. 156).

Many researchers have concluded that the language is a barrier for many children, and that math language differs enough from everyday language that it presents challenges for all groups of students, especially ELL students (Adams, 2003; Pimm, 1987; Spanos, Rhodes, Dale, & Crandall, 1988). Buchanan and Helman (1997) recommended that teachers not only teach the vocabulary of math, but explain the nuances of the language. For example, when teaching *greater*, a teacher might also have to explain the meaning of the suffix *er*. Tevebaugh (1998) showed that ELL students would be more successful in math with extra math language instruction. Sfard, Nesher, Streefland, Cobb, and Mason (1998) also recommended that teachers verbally explain the meaning of math symbols to facilitate better understanding, and suggested that focusing on the linguistic features could help clarify the technical meanings. Other researchers have also pointed out that explanations of meanings can help students succeed in math (O’Hallaran, 2000).

Leung, Low, and Sweller (1997) found that until students gain experience and facility in solving problems, the teacher's verbal explanations are the most important component of instruction. Moschkovich (1999) concluded that to increase ELL students' language proficiency and achievement in math, students need to participate both orally and in writing by "explaining solution processes, describing conjectures, providing conclusions and presenting arguments" (p. 11). Other studies have clearly pointed to the significance of reading to overall math performance and achievement (Helwig, Rozeck-Tedesco, Tindal, Heath, & Almond, 1999; Lager, 2006).

Another aspect of learning math is geared to the types of classes students take throughout their academic years. Lager (2004) wrote, "The more advanced math becomes the more language-dependent it is" (p. 1). Cardenas, Robledo, and Waggoner (1988) reported that the highest correlation with staying in school is enrollment in advanced math classes, while Wang and Goldschmidt (1999) reported that students who take elective math classes have the highest overall academic growth rates.

Two studies published in 1988 showed that low math achievement scores of ELL students were a function of language, and that the scores could be improved by increasing students' language comprehension and by modifying the language of the assessment items (Cocking & Chipman, 1988; Mestre, 1988). Staub and Reusser (1995) supported these recommendations and showed that the wording of math problems has a major influence on comprehension and students' ability to solve problems. In a highly publicized and notable follow-up study, Abedi and Lord (2001) found that modified wording of math items on the National Assessment of Educational Progress resulted in higher scores for ELL students. The argument continues to be made that high-stakes

assessments are inappropriate for ELL students due to the ways the tests are constructed and worded (Solorzano, 2008).

Although researchers have identified many obstacles and barriers encountered by ELL students, in a less-publicized study Abedi, Courtney, Leon, Kao, and Azzam (2006) found that ELL students' math achievement was significantly related to three factors: (a) the students' report of content coverage, (b) the teacher's level of content knowledge, and (c) students' math ability and prior classes taken. Nationally, the mathematics achievement level for ELL students is at or near the bottom of the norms. Moreover, to date no research has demonstrated that specific intervention programs or strategies could be implemented to help improve ELL students' math performances.

## CHAPTER 3

### METHODS

#### **Setting for the Study: The Navajo Nation**

The Navajo Nation (Navajo: *Naabeehó Bináhásdzo*) is a semi-autonomous Native American-governed territory covering 26,000 square miles (67,340 km<sup>2</sup>), occupying all of northeastern Arizona, the southeastern portion of Utah, and much of northwestern New Mexico. It is the largest land area assigned primarily to a Native American jurisdiction within the United States. In Navajo, the geographic entities with its legally defined borders are known as “*Naabeehó Bináhásdzo*.” This contrasts with “*Diné Bikéyah*” and “*Naabeehó Bikéyah*” for the general idea of “*Navajoland*.” More importantly, neither of these designations should be confused with “*Dinétaah*,” the term used for the traditional homeland of the Navajo people (The Long Walk). This homeland is situated in the areas between the mountains called San Francisco Peaks, Hesperus Mountain, Blanca Peak, and Mount Taylor, which the Navajo people consider their four sacred mountains (Wilkins, 1999).

After the Long Walk and the Navajos' return from their imprisonment in Bosque Redondo, the Navajo Indian Reservation was established according to the Treaty of 1868. The borders were defined as the 37th parallel northern latitude in the north; the southern border as a line running through Fort Defiance; the eastern border as a line running through Fort Lyon; and in the west as longitude 109°30. Though the treaty provided for 10,000 square miles in the then New Mexico Territory, the actual size of the territory was established at only 3,328,302 acres, slightly more than half the size specified in the treaty (5,200.5 square miles). However, because there were no physical boundaries or signposts

placed to mark the Navajo Reservation, many Navajos ignored these formal official boundaries and returned to where they had lived prior to captivity (Wilkins, 1999). After the Navajo Nation treaty of 1868, the first expansion of the territory occurred on October 28, 1878, when President Rutherford B. Hayes signed an executive order that moved the western boundary 20 miles further west in Arizona. More additions followed throughout the late 19th and early 20th centuries. Most of these additions originated in executive orders, some of which were confirmed by acts of Congress, and all of which contributed to making the Navajo Reservation by far the largest Indian reservation in the United States (Wilkins, 1999). See Figure 3 for a map of the reservation.

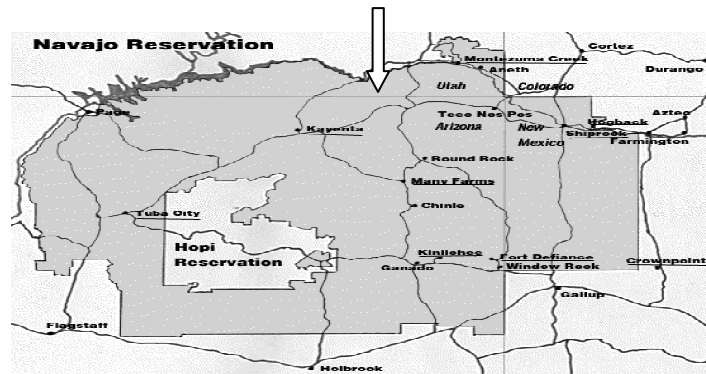


Figure 3. Map of the Navajo Reservation

Adjacent to or near the Navajo Reservation are the Southern Ute of Colorado and the Ute Mountain Ute Tribe of Colorado, Utah, and New Mexico, both to the north; the Jicarilla Apache to the east; and other tribes to the west and south. The Navajo Nation's territory surrounds the Hopi Indian Reservation. A conflict over shared lands emerged in the 1980s, when the United States Department of the Interior attempted to relocate Diné families living in the Navajo/Hopi Joint Use Area. The conflict was resolved, or at least



postponed, by the awarding of a 75-year lease to Navajos who refused to leave the former shared lands.

Situated within the Navajo Nation are Canyon de Chelly National Monument, Monument Valley National Monument, Rainbow Bridge National Monument, and the Shiprock landmark. The eastern portion of the reservation, in New Mexico, is popularly called the Checkerboard because Navajo lands are mingled with fee lands, owned by Navajos and non-Navajos, and federal and state lands under various jurisdictions. Furthermore, three large non-contiguous sections located entirely in the state of New Mexico are also under Navajo jurisdiction: the Ramah Navajo Indian Reservation, the Alamo Navajo Indian Reservation, and the Tohajiilee Indian Reservation. There is no private ownership of Tribal Trust lands; instead, all Tribal Trust land is owned in common and administered by the Navajo Nation government. By contrast Bureau of Indian Affairs (BIA) Indian Allotment lands are privately owned by the heirs and generations of the original BIA Indians to whom the lands were issued. With Tribal Trust lands, leases are made both to customary land users (for home sites, grazing, and other uses) and organizations, which may include BIA and other federal agencies, churches, and other religious organizations, as well as private or commercial businesses (Triefeldt, 2007).

The Navajo Nation is divided into five agencies, with the seat of government located in the capital of the Navajo Nation in Window Rock, Arizona. These agencies are similar to provincial entities and match the five BIA agencies. These five agencies within the Navajo Indian Reservation are Chinle Agency, Eastern Navajo Agency, Western Navajo Agency, Fort Defiance Agency, and Shiprock Agency. The BIA agencies provide

various technical services under the direction of the BIA's Navajo Area Office in Gallup, New Mexico. Agencies are further divided into chapters, analogous to counties, as the smallest political unit.

The Navajo Nation is governed by a president, with elections held every four years. Wage employment opportunities, public schools, hospitals, and public utilities have increasingly brought the Navajo people in larger numbers to urban centers on the reservation. A strong sense of tribal identity has kept Navajo culture and social cohesiveness intact, despite the many changes of the last century.

The Navajo Nation works to provide new business opportunities and partnerships with individuals, including small business owners, large commercial/industrial companies, and tourism agencies and companies. To become more efficient and accessible, the Navajo Nation is working to upgrade and implement its programs to benefit these burgeoning business relationships (Wilkins, 1999).

Currently, the Navajo Housing Authority (NHA), the tribally designated housing entity for the Navajo Nation, has begun construction on new houses using new materials on the Navajo Nation. These materials are more cost effective and fire resistant in the four-season weather environment of the reservation. There is also the option for many families to build scattered site-homes based on their traditional home site leases.

*Hooghan* means the home for Navajos and the center of learning, and the traditional style of home in Navajo is the *hogan*. Most modern housing in the Navajo Nation consists of detached single-family houses, both site-constructed and mobile homes. Most houses in the Navajo Nation were built in the 1960s, 1970s, or 1980s, although there are older houses (Iverson & Roessel, 2002).

Most single-family houses are in rural styles and constructed of wood. Because many houses do not have access to natural gas or electricity, wood or propane is used for heating and cooking. Due to the reservation's remote geographic location, many structures do not have telephone or public utility services, and many lack complete kitchen and plumbing facilities. However, infrastructure development has grown significantly through the years, affording Navajo families with more modern conveniences, such as satellite television and even wireless access in some communities. The government-subsidized telephone program has brought even the most remote locations of the reservation into contact with the rest of the Navajo Nation and world.

Roads on the reservation vary in condition. Most federally operated United States highways are in good condition year-round and are suitable for vehicles of any size and type. However, roads in many rural areas and small villages are unpaved. In the central parts of the Navajo Nation roads are often poorly maintained and are sometimes in nearly unusable condition after heavy rains. School buses use these roads to transport students more than 50 miles each way to attend school. These students leave very early in the morning and arrive back at home late in the evenings. In general, except for the most remote regions, road conditions in the Navajo Nation are satisfactory for routine use.

A major problem faced by the Navajo Nation is a very high drop-out rate among high school students. Indeed, historically the Navajo Nation resisted compulsory education, including boarding schools, such as those imposed by United States Cavalry General Richard Henry Pratt in the late 19<sup>th</sup> century. However, the retention of students in schools and in education in general are high priorities today. Over 150 public, private, and BIA schools serve students from kindergarten through high school on the reservation.

There is also a local Head Start, the only educational program operated by the Navajo Nation government. Post-secondary education and vocational training are available on and off the reservation (Iverson & Roessel, 2002).

It is the educational mission of the Navajo Nation to promote and foster lifelong learning for the Navajo people, and to protect the cultural integrity and sovereignty of the Navajo Nation. The 11-member Navajo Nation Board of Education is charged with overseeing the operations of schools in the Navajo Nation, which includes exercising regulatory functions and duties over the nation's education programs. The board was established by the Navajo Nation Education Code Title 10, enacted in July 2005 by the Navajo Nation Council. The board acts to promote the goals of the Navajo Sovereignty Education Act of 2005, which includes the establishment and management of a Navajo Nation Department of Diné Education. The purpose of the department is to affirm the commitment of the Navajo Nation to the education of the Navajo people, to repeal obsolete language, and to update and reorganize the existing language of Titles 2 and 10 of the Navajo Nation Code.

The Navajo Preparatory School is the only Navajo-sanctioned college preparatory school for Native Americans in New Mexico. Its goals are to offer students a challenging, innovative curriculum in science, math, computers, and other traditional academic subjects, as well as to help students gain a deep appreciation of the Navajo language, culture, and history. The Navajo Preparatory School is located in Farmington, New Mexico, a few miles outside the Navajo Reservation (Wilkins, 1999).

The Navajo Nation also operates Diné College, a two-year community college with a main campus in Tsaile, Apache County, Arizona and seven other campuses on the

reservation, including one in the town where the present study was conducted. The total current enrollment at Dine' College's seven campuses is 1,830 students, 210 of whom are degree-seeking students planning to transfer to four-year institutions (Wilkins, 1999).

### **Community/Demographics**

The community in which the study took place is a census-designated place (CDP) that is part of the Navajo Nation. The incorporated town of Kayenta is located in Navajo County, in the northeastern part of Arizona. Kayenta is located in the center of five small towns and is one of the largest tourist attractions on the Navajo Reservation. It has three hotels/motels that service tourists who visit the Monument Valley National Monument, Canyon De Chelly National Monument, Navajo National Monument, Rainbow Bridge, and Antelope Canyon.

The 2000 United States Census reported a population of 4,922 people and 1,245 households in the Kayenta area. The racial makeup of the CDP was 93% Native Americans, 6% White, .93% Hispanic or Latino, .20% Black or African American, 0.12% Asian, 0.04% Pacific Islander, and .16% other (Census Bureau, 2000).

Some 59% of the 1,245 households included children under the age of 18 living in the home, 51% were married couples living together, 26% had a female householder with no husband present, and 17% were non-families. Some 15% of all households were made up of lone individuals, and 2% had someone living alone who was 65 years of age or older. The median household size was 3.95 and the median family size was 4.39 (Census Bureau, 2000).

The age dispersion in the CDP was wide: 44% of residents under the age of 18, 10% from 18 to 24, 26% from 25 to 44, 17% from 45 to 64, and 3% 65 or older. The

median age was 22. For every 100 females there were 92 males. For every 100 females 18 and over, there were 83 males (Census Bureau, 2000).

According to the 2000 census, the median income for a household on the Navajo Reservation was \$31,707, and the median income for a family was \$32,500. The median income for males was \$40,804, versus \$21,912 for females. The per capita income for the Navajo Nation was \$9,421. About 30% of families and 34% of the population were below the federal poverty level, including 39% of those under the age of 18 and 37% of those 65 or over (Census Bureau, 2000).

Job opportunities in and around the community were very limited. As a result, according to the Census Bureau 34% of children in Navajo County lived below poverty level. Local people who are able to find work were employed by the coal company, the Navajo Tribal Utility Authority, the local store of the state-wide Bashas' grocery chain, local schools, the Indian Health Services, and an assortment of local businesses and government agencies. There is also temporary and seasonal work available in the summer, jobs that cater to the thousands of tourists who pass through the community. These conditions have changed little since the time of the 2000 census.

In addition to Dine' College, the community has several other satellite college campuses for people who want to further their education. This gives people in the community opportunities to pursue their education. However, upon graduation from high school most young people must leave their families on the reservation to further their education or to find employment elsewhere.

## **Main Purposes and Research Questions**

The main purpose of the NCLB Act of 2001 was to improve the quality of education for all students in the United States. In addition to mandates aimed toward raising student achievement, particularly in reading and math, came mandates requiring greater accountability by states and school districts. These accountability mandates raised the bar for ELL students and held school districts and states accountable for improving the education of ELL students. Arizona public schools, like schools in all states, have struggled to meet this mandate. The purpose of the present study was to investigate the effects of a set of curriculum-based measures (CBMs) on math achievement among ALL students, with an emphasis on ELL students in the target school.

This study addressed the following research questions:

1. What are the effects of a set of CBMs on the math achievement of ALL students?
2. What are the effects of the CBMs on the math achievement of ELL students?

## **Sample**

The sample of students for this study was drawn from a public school in Kayenta, Arizona, which is in the Navajo Nation. The physical foundation for the school was laid in 1940. At that time the public school served 26 students and was located in a one-room schoolhouse near the local trading post. From that one-room school evolved a school district comprised of a primary school (pre-k- through Grade 2), elementary school (Grades 3-5), middle school (Grades 6-8), and high school (Grades 9-12).

At the time of the study, school year 2010-2011, the primary school served 425 students drawn from the immediate community and surrounding areas. More than 95% of the student body was Native American and 85% of students received free or reduced

price lunches. The school bused in more than one-half of the students every day, some from the five small towns located nearby, but others from outside the community. The school served breakfast and lunch daily.

### **Research Design**

The present study employed an experimental design of experimental and control groups. Two analysis of covariance (ANCOVA) tests were applied, one for first-grade data and one for second-grade data. The research design used in this study was aligned to the planned variation model proposed by Yeh (2000). One strength the design holds is that it allows the testing of additional hypotheses along with the main treatment effect. Yeh called this type of study theory-based evaluation. This overall design can address whether and how well the intervention worked, who it benefitted, and perhaps the degree to which replication is possible. However, one of the potential problems of this type of design is the possibility of confounding treatment effects (Orr, 1999).

More specifically, this experimental design consisted of one experimental group and one control group for Grade 1 and one experimental group and one control group for Grade 2, all intact classes of ELL students at the pre-k through Grade 2 elementary school in Kayenta, Arizona. The term ELL, as used here, indicates a person who is in the process of acquiring English and has a first language other than English. As explained in Chapter 2, other terms commonly found in the literature include language minority students, limited English proficient (LEP), English as a second language (ESL), and culturally and linguistically diverse (CLD). This study concentrated on four ELL classes consisting of a total of 61 students: 22 girls and 29 boys. Many of these students came



from the five small towns located just outside of Kayenta. A majority of the students come from families of low economic status.

The school had 35 certified teachers. There were two ELL teachers in the first grade and seven non-ELL teachers for the first grade. For the second grade there were also two ELL teachers and seven non-ELL teachers. The two ELL first-grade teachers in this study each had six years of teaching experience and had taught the school's Grade 1 ELL classes for three years. One was a Navajo from a different community and the other was an Anglo from the East Coast of the United States. One of the teachers held a master's degree in curriculum and instruction and the other held a bachelor's degree in elementary education. Both held Structure English Instruction (SEI) and early childhood endorsements. One had been teaching for eight years and the other for six years. The second-grade teachers both had bachelor's degrees in elementary education. These two teachers were both Navajo and had been teaching the ELL classes for three years. Neither teacher was from the community. Both held SEI and early childhood endorsements. One had been teaching for 12 years and the other for 15 years. All four teachers met the highly qualified (HQ) requirements for NCLB.

At the end of school year 2009-2010, all teachers in the school were asked if they were interested in becoming ELL teachers for the following school year, 2010-2011. Those who were interested submitted a request and their credentials were forwarded to the Human Resource Department for approval. Next, the ELL teachers were asked if they wanted to participate in a study involving the use of CBMs. Teachers were given just enough information about the study to enable them to decide whether they wanted to participate. Two first-grade and two second-grade teachers volunteered to participate in

the study. One teacher from each grade volunteered to teach the control groups, and one from each grade volunteered to teach the experimental groups.

During the summer of 2009, all ELL teachers were given intensive professional development concerning everything that dealt with ADE requirements for the ELL program. Teachers were also brought in for planning and preparation to ensure that the specific requirements were being met, and to make certain they understood their roles as ELL teachers. During the instruction portion of the present study the four participating teachers met once each month to review the program, lesson plans, and data, and to assist each other. This was similar to a support group as this was their first year of involvement with full ELL implementation.

### **Treatment**

In addition to all the resources from the new pilot math program, the experimental groups in this study were provided with an independently created weekly assessment called CBM. For the sake of the elementary students, the assessments were given the name Math Monsters. Individual questions for the CBMs were developed and identified by Arizona State Mathematics Standards. Each CBM had eight questions and a total of 10 possible points. Six of the questions were multiple choice and worth 1 point each, and two questions were constructed response-type questions and worth 2 points each (6 multiple choice @ 1 point and 2 constructed response @ 2 points = 10 total points). Each CBM test had at least one question from each of the Arizona State Mathematics Standards: (a) number sense and operations, (b) algebra, (c) geometry, (d) measurement, (e) and data and probability. Sample CBM tests for the first and second grades are located

in Appendices A and B, respectively. Neither students nor teachers were informed that the use of CBMs would be part of an educational research investigation.

The groups consisted of four ELL classes: two first-grade and two second-grade classes. The classification of ELL for this study matched the NCLB and AZELLA reporting categories: current, exit, and never. The label *current ELL* is used for students who have not met English proficiency according to AZELLA. The exit category represents students who have met proficiency on the AZELLA test. These students are then monitored for two years to make sure they do not test back into the ELL program. The provisions of NCLB state that a student who has met English proficiency standards still counts for the AYP reporting subgroup of ELL for the next two years. Each state department of education must complete an AYP analysis for all public schools and districts serving such schools. Arizona's definition of AYP is based primarily on reading and mathematics, and the results are based on yearly assessments in reading, writing, and mathematics via the AIMS, which is administered in Grades 3-8 and 10. The schools are held accountable for making AYP to ensure student achievement. To meet AYP, schools must disaggregate scores to show they have met AYP in each subgroup as specified by NCLB requirements, including the ELL subgroup. All students must be assessed, including the subgroup of ELL students. The ELL category of *never* indicates a student who has never been classified ELL or one who had achieved English proficiency standards for two consecutive years.

### **CBMs (Treatment)**

CBMs are tools for teachers to use to find out how students are progressing in basic academic areas such as math and reading. CBMs can be helpful to parents because

they provide current, week-by-week information on the progress their children are making. When teachers use CBMs, they find out how well their students are progressing in learning the content for the academic year. CBMs also monitor the success of the instruction students are receiving. When it is given and a student's performance does not meet expectations, the teacher can change the way of teaching that particular student to find the type and amount of instruction the student needs to make sufficient progress toward meeting the academic goals (Jim Wright, personal communication, [www.interventioncentral.org](http://www.interventioncentral.org), October 10, 2010).

When CBMs are used, each child is tested briefly each week. The tests generally last from one to five minutes. The teacher counts the number of correct and incorrect responses made in the time allotted to find the child's score. For example, in reading the child may be asked to read aloud for one minute. Each child's scores are recorded on a graph and compared to the expected performance on the content for that year. The graph allows the teacher to see quickly how the child's performance compares to expectations (Jim Wright, personal communication, [www.interventioncentral.org](http://www.interventioncentral.org), October 10, 2010). Figure 4 shows a hypothetical child's performance on a progressive graph that could be shared with parents.

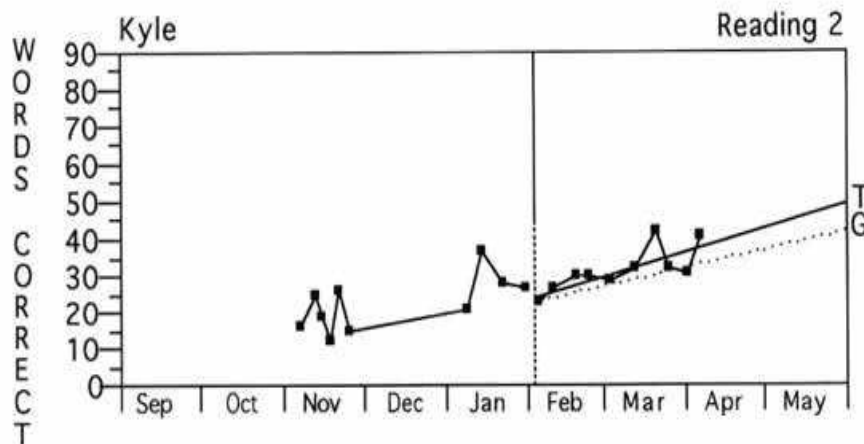


Figure 4. Example of child's graphed performance for progress monitoring

McLane (2011) further explained that teachers can change instruction in several ways. For example, he or she might increase instructional time, change a teaching technique or way of presenting the material, or change a grouping arrangement (for instance, individual instruction instead of small group instruction). After the change, the teacher can see from the weekly scores on the graph whether the change is helping the student. If not, the teacher can try another instructional strategy, and its success will be tracked through the weekly measurements.

With the CBM approach, the student is given brief, timed exercises to complete using materials drawn directly from the child's academic program. To date, teachers using CBMs have found powerful assessment tools for measuring mastery of basic skills as well as an efficient means of monitoring short and long-term student progress in key academic areas (Jim Wright, personal communication, [www.interventioncentral.org](http://www.interventioncentral.org), October 10, 2010).

## Other Tests

The school district in this study also used three tests: NWEA, TerraNova, and SAT 10. The NWEA measures performance in reading, language arts, science, and mathematics and reports the results in the form of RIT scores (see Chapter 2). Table 6 shows the math NWEA status for the first and second grade classes in this study, from the beginning, middle, and end of the school year.

Table 6

*NWEA Results for Arizona 2010 Mathematics Status Norms (RIT Values)*

Grade	Beginning of year	Beginning of year	Middle of year	Middle of year	End of year	End of year
	Median	Mean	Median	Mean	Median	Mean
1	164	163.4	171	169.9	178	176.7
2	179	179.5	186	186.5	191	190.8

Table 7 shows the NWEA RIT scores categories from lowest to highest.

Table 7

*NWEA RIT Scores for First and Second Grade*

Grade	Fall		Winter			Spring			
	LO	AV	HI	LO	AV	HI	LO	AV	HI
1	<157	157-170	>170	<164	164-177	>177	<171	171-184	>184
2	<173	173-184	>184	<180	180-192	>192	<184	184-197	>197

*Note.* Northwest Evaluation Assessment website [www.nwea.org](http://www.nwea.org); retrieved October 10, 2010

The NWEA tests were administered three times over the course of the year: fall (2010), winter (2011), and spring (2011). These tests are abbreviated henceforth in this document as RIT.

The TerraNova test is another assessment the district used because it was mandated by the state for Arizona schools. In 2009, the ADE replaced the TerraNova test with the SAT 10, a norm-referenced test that compares students according to national norms. SAT 10 results are reported in percentile rankings based on standardized scores, not in percentage of correct answers. The year of the present study, 2010-2011, was the first year the target school administered the SAT 10 to all K-2 students. The SAT 10 uses different categories of content for first and second grade levels (see Table 8).

Table 8

*SAT 10 First and Second Grade Mathematics Accountabilities*

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SAT 10 First Grade
<p>Mathematics Problem-Solving:</p> <ul style="list-style-type: none"> <li>➤ Number Sense and Operations–Demonstrate understanding of the meaning and use of numbers, the various representations of numbers, number systems, and the relationships between and among numbers. Demonstrate understanding of the meaning of operations, the relationship between operations, and the practical settings in which a specific operation or set of operations is appropriate.</li> <li>➤ Patterns, Relationship, and Algebra–Describe, complete, continue, and demonstrate understanding of patterns involving numbers, symbols, and geometric figures. Patterns with numbers include those found in lists, function tables, ratios and proportions, and matrices.</li> <li>➤ Demonstrate understanding of elementary algebraic principles as found in the relationships between mathematical situations and algebraic symbolism.</li> <li>➤ Data, Statistics, and Probability–Describe, interpret, and make predictions based on the analysis of data presented in a variety of ways, including graphs, plots, tables, and lists. Demonstrate understanding of basic probability concepts.</li> </ul>

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Table 8 continued on next page

Table 8 (continued)

*SAT 10 First and Second Grade Mathematics Accountabilities*

- 
- Geometry and Measurement–Demonstrate understanding of the characteristics and properties of plane and solid figures, coordinate geometry, and spatial reasoning. Demonstrate understanding of the meaning and use of various measurement systems, the tools of measurement, and the integral role of estimation in measurement.
  - Communication and Representation–Demonstrate an understanding of the symbols and terms utilized in mathematics, and correctly interpret alternative representations of numbers, expressions, and data.
  - Estimation–Apply estimation strategies in problem solving and determine the reasonableness of results.
  - Mathematical Connections–Demonstrate an understanding of the interrelatedness of mathematical concepts, procedures, and processes both among different mathematical topics and with other content areas.

Reasoning and Problem Solving–Demonstrate the ability to apply inductive, deductive, or spatial reasoning and to make valid inferences and draw valid conclusions. Demonstrate the ability to apply strategies to solve conventional and nonroutine problems.

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Mathematical Procedures:

- Number Facts
- Computation with Whole Numbers
- Computation in Context–Demonstrate the ability to solve everyday problems requiring addition and subtraction
- Computation with Symbolic Notation–Demonstrate the ability to solve addition and subtraction problems represented by the symbols and notation of arithmetic.

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SAT 10 Second Grade

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Mathematics Problem-Solving:

- Number Sense and Operations–Demonstrate understanding of the meaning and use of numbers, the various representations of numbers, number systems, and the relationships between and among numbers. Demonstrate understanding of the meaning of operations, the relationship between operations, and the practical settings in which a specific operation or set of operations is appropriate.

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Table 8 continued on next page



Table 8 (continued)

*SAT 10 First and Second Grade Mathematics Accountabilities*

- 
- Patterns, Relationship, and Algebra—Describe, complete, continue, and demonstrate understanding of patterns involving numbers, symbols, and geometric figures. Patterns with numbers include those found in lists, function tables, ratios and proportions, and matrices.
  - Demonstrate understanding of elementary algebraic principles as found in the relationships between mathematical situations and algebraic symbolism.
  - Data, Statistics, and Probability—Describe, interpret, and make predictions based on the analysis of data presented in a variety of ways, including graphs, plots, tables, and lists. Demonstrate understanding of basic probability concepts.
  - Geometry and Measurement—Demonstrate understanding of the characteristics and properties of plane and solid figures, coordinate geometry, and spatial reasoning. Demonstrate understanding of the meaning and use of various measurement systems, the tools of measurement, and the integral role of estimation in measurement.
  - Communication and Representation—Demonstrate an understanding of the symbols and terms utilized in mathematics, and correctly interpret alternative representations of numbers, expressions, and data.
  - Estimation—Apply estimation strategies in problem solving and determine the reasonableness of results.
  - Mathematical Connections—Demonstrate an understanding of the interrelatedness of mathematical concepts, procedures, and processes both among different mathematical topics and with other content areas.

Reasoning and Problem Solving—Demonstrate the ability to apply inductive, deductive, or spatial reasoning and to make valid inferences and draw valid conclusions.  
Demonstrate the ability to apply strategies to solve conventional and nonroutine problems.

---

Mathematical Procedures:

- Number Facts.
- Computation with Whole Numbers.
- Computation in Context—Demonstrate the ability to solve everyday problems requiring addition, subtraction, and multiplication.
- Computation with Symbolic Notation—Demonstrate the ability to solve addition, subtraction, and multiplication problems represented by the symbols and notation of arithmetic.

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*Note.* Adapted from Arizona Department of Education, retrieved October 10, 2010, from [www.ade.state.as.us](http://www.ade.state.as.us).

All test questions on the SAT 10 are in multiple choice format and reflect academic content commonly taught in schools throughout the United States. Figure 5 contains the SAT 10 scores for ELL and non-ELL students in Grades 1 and 2 in the school in question.

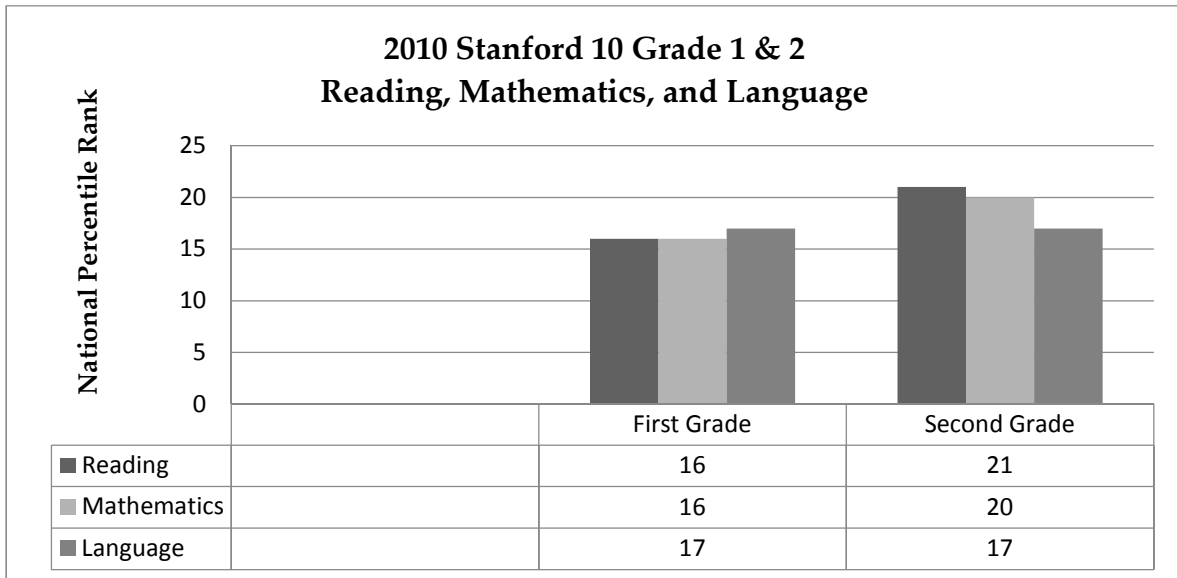


Figure 5. SAT 10 scores for first and second grades

The SAT 10 is mainly required for second-grade students, but the school in this study also administered the test in kindergarten and first-grade classes. The test is administered orally by teachers, and students are not provided a written copy of the test questions. Students have only the answer sheets, from which they choose answers to the questions, which are in multiple choice formats. For example, on the math test students are limited to the use of the strategies and clues they may have been taught to use for a certain math problem. This may skew the test results against the students doing well on the test. It could be considered a listening test rather than a true math test.

The SAT 10 assessments are given at the end of each school year. Consequently, teachers, parents, and students do not receive the results until late July. By this time, not much can be done for students because school is out for the summer. However, because the SAT 10 results are used to inform parents, teachers, students, and the general public about student achievement, scaled scores must be related to the Arizona State Mathematics Standards in a comprehensible way. To accomplish this goal, the ADE developed a four-level classification or performance system. The four levels are Falls Far Below, Approaches, Meets, and Exceeds (FAME scale) performance categories. The multiple assessments document a student’s achievement at every stage of the instruction/assessment cycle, as illustrated in the model depicted in Figure 6.

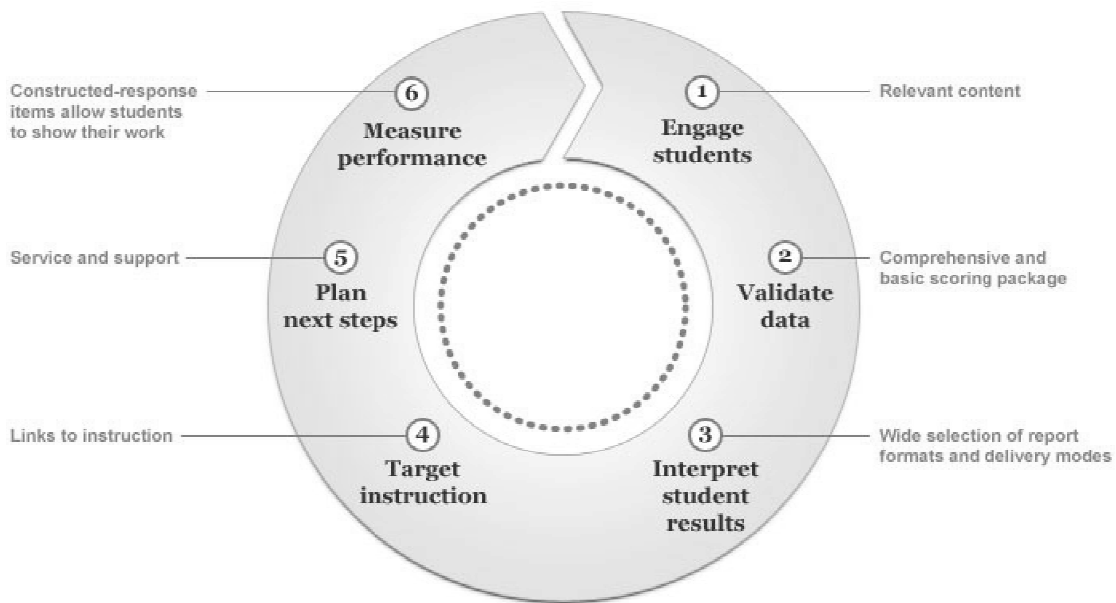


Figure 6. A model for meeting student achievement standards. Adapted from *Performance Assessment for the Next Generation of State Assessment*, by J. Ferrara, 2010, *Educational Researcher*, 28, 14-20.

A major responsibility of schools is to teach children the academic skills they will eventually need to take their place as responsible members of society. However, schools not only teach crucial academic skills, they are also required to measure individual students' acquisition and mastery of these skills. According to prevailing doctrine, the measurement of a student's school abilities is as important as the teaching of knowledge and skills. After all, only by carefully testing what a child has learned can the instructor draw conclusions about whether that student is ready to advance to more difficult material (Deno, 2003).

A more general definition of test validity answers the question, "Does the test measure what it is intended to measure?" May, Perez-Johnson, Haimson, Satter, and Gleason (2009) defined test validity as "the degree to which the state assessment adequately measures the outcomes targeted by the intervention" (p. 5). The technical manual from the ADE ensures that the items are aligned with the Arizona State Standards, so by that definition the SAT 10 is a valid assessment instrument. However, teachers have reported that students who are unable to listen and read effectively will be hampered in their performance on the test.

Collins (1992) was a pioneer in the work on designed experiments in education, where the focus was on investigating how different learning environment designs affect dependent variables in teaching and learning. In discussing methods and designs, Collins, Joseph, and Bielaczyc (2004) argued that designs can be more or less specific, but can never be completely specified and that results can "vary widely depending on things like, participants' needs, interests, abilities, interpretations, interactions, and goals" (p. 17). They also stated that because educational experiments are carried out in the messy

situations of actual classrooms, “there are many variables that affect the success of the design, and many of these variables cannot be controlled” (p. 19).

In the past, routine classroom testing has often involved the use of commercially prepared tests, but these tests also have significant limitations. However, an alternative approach to academic assessment has recently become available that allows teachers to closely monitor the rate of student progress. Teachers have found this approach to be time consuming, but necessary to ensure student achievement. Educational researchers have devised a simple, statistically reliable, practical means of measuring students’ skills in basic subject areas such as reading, writing, and mathematics.

### **Data Analysis**

This study compared students’ math achievement scores on the SAT 10 to determine whether there were significant differences in achievement scores between students in an experimental group who used weekly CBMs and those in a control group who did not. The post-treatment scores for each group were compared to determine whether significant differences existed as a result of the treatment. Data gathered from this research process were collected and entered into a statistics software package: Statistical Package for the Social Sciences (SPSS--20). SPSS was used for all statistical analyses and the significance was set at the .05 level for all inferential tests.

Near the end of the 2010-2011 academic year, all first- and second-grade students in the target school were assessed using the SAT 10. This is the test used for NCLB and AYP reporting, so data were taken from the regular assessment given by the school district. Data for each of the two grade levels were kept and analyzed separately. After administration of the test, the school decided to implement the CBMs. One class in each

grade was designated the experimental group and received the CBM training. The other class in each grade received the regular curriculum and were designated the control groups, again, one for each grade. Therefore, there was no randomization of subjects or treatment in this study. The ELL teachers volunteered to be either a control or experimental groups. Neither students nor teachers were aware of being part in this educational research investigation. However, the implementation of the CBMs was mandated for one first-grade class and one second-grade class during that school year (2010-2011).

The NWEA RIT tests were administered near the beginning of the same year (2010-2011), and again in January 2011, at mid-year. The scores from both administrations of the RIT were analyzed in various ways for all classes in this study (two each for Grades 1 and 2). Among other things, scores from each administration in each grade were correlated with the SAT 10 scores in each respective grade to help determine a possible covariate for each grade for use in the analysis of covariance (ANCOVA) analyses. Use of baseline measures has been shown to increase statistical power when they are used as covariates in impact analyses (Bloom, Richburg-Hayes, & Black, 2007; Shandish, Cook, & Campbell, 2002).

Fortunately, many of the students in the ELL program are enrolled full time throughout the school year. This is one group that seldom leaves the school and usually has perfect attendance. Under NCLB and ADE a full academic school year consists of 180 school days. All teachers and students followed the normal assignment process and procedures as they had in previous years.

Table 9 contains data on the number of students, broken down by gender, in the four classes used in this study: one experimental group and one control group each for Grades 1 and 2. Altogether there were 22 female and 29 male subjects in the four groups.

Table 9

*Subject Demographics*

Grade	Group	# Females	# Males	Total
Grade 1	Experimental	3	10	13
Grade 1	Control	5	9	14
Grade 2	Experimental	9	10	19
Grade 2	Control	5	10	15

**Research Questions**

This study addressed the following primary and secondary research questions.

The primary question asked,

1. What are the effects of CBM's on the math achievement of ELL students?

The secondary question asked,

2. What are the effects of CBM's on the math achievement of on male and female ELL students?

**Hypotheses**

The following hypotheses were used to test the primary and secondary research questions posed in this study. Parallel sets of identical hypotheses were employed for Grades 1 and 2. Parallel two-way ANCOVAs were used to test the hypotheses, one for

each grade. For each ANCOVA the SAT 10 math scores served as the dependent variable. The independent variables were treatment (experimental CBMs and control), and gender of the students (males and females).

- Ho 1 There will be no statistically significant main effect difference in math scores on the SAT 10 between the experimental and control groups ( $p < .05$ ). These hypotheses were tested with a pair of analysis of covariance tests (one each for Grades 1 and 2).
- Ho 2 There will be no statistically significant main effect difference in math scores on the SAT 10 between male and female subjects ( $p < .05$ ). These hypotheses were tested with a pair of analysis of covariance tests (one each for Grades 1 and 2)
- Ho 3 There will be no statistically significant interaction between the two main effects of treatment and gender ( $p < .05$ ). These hypotheses were tested with a pair of analysis of covariance tests (one each for Grades 1 and 2).



## CHAPTER 4

### RESULTS

The purpose of this study was to determine the effects of curriculum-based measures (CBM's) on elementary students' math achievement. The main focus of the study was on the effects of the CBM's on the achievement of ELL students. As indicated in Chapter 2, there is no research published on the effects of intervention programs or strategies directed toward the improvement of math achievement on the part of ELL students.

#### **Grade 1**

The means and standard deviations for the NWEA RIT (first administration) and SAT 10 for the two Grade 1 treatment groups (control and experimental) are displayed in Table 10. The mean for the experimental group was higher than the mean for the control group on the NWEA RIT (first administration), but not significantly so [ANOVA  $F(1,27) = 1.966, p > .05, \text{partial } \eta^2 = .070$ ]. Similarly, the experimental group mean was slightly, but not significantly, higher than the control group mean on the math portion of the SAT 10 [ANOVA  $F(1,27) = .067, p > .05, \text{partial } \eta^2 = .003$ ]. Both treatment groups demonstrated homogeneity of variance on the NWEA RIT and SAT 10 tests (Levene's  $F = 1.127, p > .05$ ; Levene's  $F = .058, p > .05$ , respectively).

Table 10

*Means and Standard Deviations for the NWEA RIT Math (First Administration) and SAT 10 Math by Treatment Group: Grade 1*

Group	<i>n</i>	RIT Math		SAT 10 Math	
		M	SD	M	SD
Experimental	12	152.330	8.690	509.670	20.956
Control	16	146.310	12.805	507.500	22.724

There was a strong, statistically significant correlation (Pearson) between the two administrations of the NWEA RIT (beginning and mid-year) ( $r = .863$ ,  $df = 26$ ,  $p < .0001$ ) for Grade 1. Correlations between the beginning and mid-year administrations of the RIT (math) and the SAT 10 (math) were moderate and significant ( $r = .586$ ,  $p < .001$  and  $r = .570$ ,  $p < .002$ , respectively). These correlations were sufficiently high to enable the RIT to serve as a covariate with the SAT 10 in the analysis of covariance model (ANCOVA). The earlier NWEA RIT administration was employed as a covariate because it corresponded more closely chronologically to the onset of the treatment program (CBMs).

NWEA RIT math scores (beginning of year–first administration) were entered into the model as the covariate and the SAT 10 math scores were entered as the dependent variable. The independent variable was the treatment group (experimental and control). The results, shown in Table 11, reveal no significant difference between the adjusted (estimated marginal) means for the two groups on the math portion of the SAT 10. These results are reinforced by the small difference in group means reflected by the partial eta squared.

Table 11

*Analysis of Covariance for Grade 1 Subjects by Treatment Group: SAT 10 Math and (Covariate) NWEA RIT*

Source	SS	df	MS	F	p	$\eta^2$
Corrected Model	4480.986	2	2240.493	6.891	.004	.355
Intercept	16475.559	1	16475.559	50.645	.000	.670
RIT (Covariate)	4488.796	1	4488.796	13.684	.001	.354
Treatment	149.012	1	149.012	.458	.505	.018
Error	8127.8711	25				

*Note: NWEA RIT math portion, first (beginning-of-year) administration*

The small  $n$ 's and resulting small cell sizes prohibited the addition of other independent variables to the ANCOVA model. Therefore, separate comparisons were made of differences between male and female Grade 1 subjects (combined groups) on the NWEA RIT math scores (first administration) and SAT math scores. Means and standard deviations for males and females in Grade 1 are displayed in Table 12.

Table 12

*Means and Standard Deviations for the NWEA RIT Math (First Administration) and SAT 10 Math by Gender: Grade 1*

Group	n	RIT Math		SAT 10 Math	
		M	SD	M	SD
Males	17	148.890	11.448	507.060	23.443
Females	11	149.180	12.197	510.550	19.335

As shown in Table 13, females scored slightly higher on the RIT than the males, but not significantly so [ANOVA  $F(1,27) = .011, p > .05, \eta^2 = .000$ ]. A similar

comparison was made for the SAT 10 math scores. The result was also a non-significant difference between the male and female subjects [ANOVA  $F(1,27) = .168, p > .05, \eta^2 = .006$ ]. Both gender groups demonstrated homogeneity of variance on the NWEA RIT and SAT 10 tests (Levene's  $F = .066, p > .05$ ; Levene's  $F = .389, p > .05$ , respectively).

Finally, an ANCOVA was employed to estimate the effects of gender for the combined two Grade 1 groups on the dependent variable of SAT 10 math scores, using the first administration (beginning of year) NWEA RIT math scores as the covariate. The results of this ANCOVA test, as displayed in Table 13, shows there was no significant difference between adjusted group means on the SAT 10 math scores. Again, the partial eta squared was small.

Table 13

*Analysis of Covariance for Grade 1 Subjects by Gender: SAT 10 Math and (Covariate) NWEA RIT (Math)*

Source	SS	df	MS	F	p	$\eta^2$
Corrected Model	4390.515	2	2195.258	6.678	.005	.348
Intercept	18800.080	1	18800.080	57.189	.000	.696
RIT (Covariate)	4309.327	1	4309.327	13.109	.001	.344
Gender	58.542	1	58.542	.178	.677	.007
Error	8218.334	25	328.734			

*Note: NWEA RIT math portion, first (beginning of year) administration*

## Grade 2

The means and standard deviations for the NWEA RIT (first administration) and SAT 10 for the two Grade 2 groups (control and experimental) are displayed in Table 14.

The mean for the experimental group was slightly higher than the mean for the control group on the NWEA RIT (first administration), but not significantly so [ANOVA  $F(1,28) = .135, p > .05, \text{partial } \eta^2 = .005$ ]. For the math portion of the SAT 10, the experimental group mean was somewhat lower than the control group mean, but not significantly so [ANOVA  $F(1,28) = 3.097, p > .05, \text{partial } \eta^2 = .100$ ]. There was a lack of homogeneity of variance between groups on the NWEA RIT math scores (Levene's  $F = 6.592, p < .016$ ), but not on the SAT 10 math scores (Levene's  $F = .003, p > .05$ ).

Table 14

*Means and Standard Deviations for the NWEA RIT Math (First Administration) and SAT 10 Math by Treatment Group: Grade 2*

Group	<i>n</i>	RIT Math		SAT 10 Math	
		M	SD	M	SD
Experimental	17	172.47	12.665	528.88	33.886
Control	13	171.08	5.722	550.92	34.136

There was a strong, statistically significant correlation (Pearson) between the two administrations of the NWEA RIT (beginning and mid-year): ( $r = .853, df = 28, p < .0001$ ) for Grade 2. The correlation between the beginning-of-the-year administration of the NWEA RIT (math) and the SAT 10 (math) was moderate but not statistically significant ( $r = .360, p > .05$ ). Conversely, the correlation between the mid-year administration of the NWEA RIT (math) and the STA 10 (math) was somewhat higher and statistically significant ( $r = .413, p < .02$ ). Though the correlation between the earlier NWEA RIT administration and the SAT 10 was not large enough to be statistically significant ( $p .051$ ), it was large enough to support its use as a covariate in the ANCOVA

model. That administration also corresponded more closely chronologically to the onset of the treatment program (CBMs) than did the second administration.

NWEA RIT math scores (first administration) were entered into the model as the covariate and the SAT 10 math scores were entered as the dependent variable. The independent variable was the treatment group (experimental and control). The results, as shown in Table 15, reveal no significant difference between the adjusted (estimated marginal) means for the two groups on the math portion of the SAT 10. However, the difference between the group (adjusted) means neared significance, and came slightly closer to reaching the designated significance level after adjustment via the covariate than before the adjustment. This difference is reflected in the moderate size of the partial eta squared.

Table 15

*Analysis of Covariance for Grade 1 Subjects by Treatment Group: SAT 10 Math and (Covariate) NWEA RIT*

Source	SS	df	MS	F	p	$\eta^2$
Corrected Model	8851.341	2	4425.671	4.412	.022	.246
Intercept	9643.033	1	9643.033	9.614	.004	.263
RIT (Covariate	5272.034	1	4188.034	4.175	.051	.134
Treatment	4188.034	1	4188.034	4.175	.051	.134
Error	27082.025	27	328.734			

*Note: NWEA RIT math portion, first (beginning of year) administration*

As in the Grade 1 analysis, small *n*'s and resulting small cell sizes prohibited the addition of other independent variables to the ANCOVA models. Therefore, a separate

comparison was made of differences between male and female Grade 2 subjects (combined groups) on the NWEA RIT math scores (first administration) and SAT math scores. Means and standard deviations for males and females in Grade 2 are displayed in Table 16.

Table 16

*Means and Standard Deviations for the NWEA RIT Math (First Administration) and SAT 10 Math by Gender: Grade 2*

Group	<i>n</i>	RIT Math		SAT 10 Math	
		M	SD	M	SD
Males	19	173.84	9.069	543.530	42.105
Females	11	168.45	11.361	529.640	16.366

As shown in Table 17, males scored somewhat higher on the NWEA RIT than the females, but not significantly so [ANOVA  $F(1,28) = 2.043, p > .05, \eta^2 = .068$ ]. A similar comparison was made for the SAT 10 math scores. Again, the result was a non-significant difference in favor of the male subjects [ANOVA  $F(1,28) = 1.088, p > .05, \eta^2 = .037$ ]. Both treatment groups demonstrated homogeneity of variance on the NWEA RIT and SAT 10 tests (Levene's  $F = .339, p > .05$ ; Levene's  $F = 2.903, p > .05$ , respectively).

Finally, an ANCOVA was employed to estimate the effects of gender for the combined two Grade 2 gender groups on the dependent variable of SAT 10 math scores, using the first administration NWEA RIT math scores as the covariate. The results of this ANCOVA test, as displayed in Table 17, were that there was no significant difference between adjusted gender group means on the SAT 10 math scores. Again, the partial eta squared was modest.

Table 17

*Analysis of Covariance for Grade 2 Subjects by Gender: SAT 10 Math and (Covariate) NWEA RIT (Math)*

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	$\eta^2$
Corrected Model	8851.341	2	4425.671	4.412	.022	.26
Intercept	4096.205	1	4096.205	4.257	.049	.136
RIT (Covariate)	6376.333	1	6376.333	6.627	.016	.197
Treatment	3831.562	1	3831.562	3.982	.556	.129
Error	25978.355	27	328.734			

*Note: NWEA RIT math portion, first (beginning of year) administration*



## CHAPTER 5

### SUMMARY, CONCLUSIONS, RECOMMENDATIONS

#### **Summary**

The purpose of this study was to investigate the effectiveness of curriculum-based measures (CBMs) on the achievement of first and second grade ELL students in the area of mathematics. The No Child Left Behind (NCLB) Act of 2001 was intended to lead to improvement in the overall quality of the United States educational system. Portions of the resulting programs placed emphasis on specific demographic groups, including those with specific educational needs such as special education students and students whose first language is not English, groups that have long lagged behind the general population. Unfortunately, however, despite increasing emphasis on assessment and accountability, the achievement gaps between these subpopulations and the general population of school students continues to widen.

Accordingly, this study was designed to address the following primary research questions: What are the effects of CBMs on the math achievement of ELL students? The secondary research question asked, What are the effects of CBMs on the math achievement of male and female ELL students?

The following hypotheses were used to test these primary and secondary research questions. Parallel sets of identical hypotheses were employed for Grades 1 and 2.

*Ho 1* There will be no statistically significant difference in math scores on the SAT 10 between the experimental and control groups ( $p < .05$ ) for Grade 1. There will be no statistically significant difference in math scores on the SAT 10 between the experimental and control groups ( $p < .05$ ) for Grade 2.

These hypotheses were tested with a pair of analysis of covariance tests (ANCOVA) for Grades 1 and 2. The SAT 10 math was the dependent variable and treatment group (experimental and control) was the independent variable. The NWEA RIT (first administration) was employed as the covariate. The null hypothesis of no significant difference was retained for both Grades 1 and 2.

*Ho 2* There will be no statistically significant difference in math scores on the SAT 10 between male and female subjects ( $p < .05$ ) for Grade 1. There will be no statistically significant difference in math scores on the SAT 10 between male and female subjects ( $p < .05$ ) for Grade 2.

These hypotheses were tested with a pair of analysis of covariance tests (ANCOVA) for Grades 1 and 2. The SAT 10 math was the dependent variable and gender (male and female) was the independent variable. The NWEA RIT (first administration) was employed as the covariate. The null hypotheses of no significant difference was retained for both Grades 1 and 2.

### **Conclusions**

This study showed no significant differences in math scores as a result of using CBMs, or between male and female subjects. These results, for treatment and gender, were obtained for both Grades 1 and 2. Unfortunately, the research design did not permit analyses of teacher effects or school effects.

Researchers, including Berends, Golding, Stein, and Cravens (2010), Hill, Rowan, and Ball (2005), Konstantopoulos (2009), Nye, Konstantopoulos, and Hedges (2004), Wayne and Youngs (2003), and Bickert (2011), to name a few, have found that teachers with math certification, degrees related to math, and advanced course work in math produce high school students who performed better in mathematics than students of

teachers without those qualifications. Hill, Rowan, and Ball (2005) found that teachers' math knowledge was significantly related to student math achievement gains in elementary school, even after controlling for other variables through the use of covariates. Their findings led to a recommendation that one way to improve students' math scores was to improve teachers' knowledge of mathematics. For example, one of the Grade 2 teachers in this study had a strong interest in math. She took courses to assist her with current strategies and learning styles to help improve math scores in her classroom. Konstantopoulos (2009) found ample evidence that differences in teacher effectiveness is even more pronounced in schools with high percentages of low socio-economic students than in schools with higher or more normal socio-economic status students. The results of this study supported those who argued that teachers, far more than programs or curricula, make the difference in student achievement, at least when other factors are controlled.

### **Recommendations**

Ethnicity and socio-economic status were not examined as variables in the present study because all students in the samples (Grade 1 and Grade 2) were of the same ethnicity and similar socio-economic backgrounds. Therefore, assessing the effectiveness of CBMs with students of varying ethnicities and socio-economic status is also recommended as a topic for future research.

Since the research literature indicates that teachers can have a significant effect on math achievement, and that their knowledge of math is very important, schools could develop surveys to help determine teachers' knowledge of mathematics. It might also be instructive to examine differences among teachers' attitudes toward math, their attitudes

toward the teaching of math, teachers' completed course work in math, the amount of planning time they devote to math, and the instructional time they devote to math in their classrooms. Armed with knowledge gained from the surveys, administrators could help teachers obtain what they need to succeed.

Offering what is needed will be a huge step for everyone, because teachers do not want to feel incompetent or that they have failed their students for whatever reasons. Surveys of teacher backgrounds, attitudes, strengths, weaknesses, practices, and perceived needs could be a good place to start. Studies that have shown the need for such information are discussed in Chapter 1.

In addition to teachers and administrators, parents who are concerned with math achievement would be advised to converse with teachers to find out about their attitudes towards math. They could also examine teachers' math results from previous years.

In summary, the curriculum-based measure examined in this study did not result in increases in elementary students' math achievement scores. It appears that other variables are responsible for the different achievement levels seen among school students. However, in this study measured achievement levels were relatively constant across both genders and the two grade levels examined.

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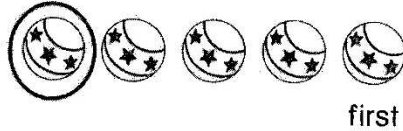
APPENDIX A

FIRST GRADE SAMPLE CBM TEST

Name: \_\_\_\_\_ Total Points (10): \_\_\_\_\_

Question 1 (Standard 2.0)

In which place is the circled ball?



- first
  - second
  - fourth
  - fifth
- 

Question 2 (Standard 3.0)

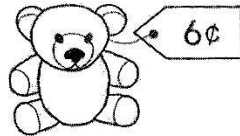
What is the name of this shape?



- hexagon
  - triangle
  - trapezoid
  - parallelogram
-

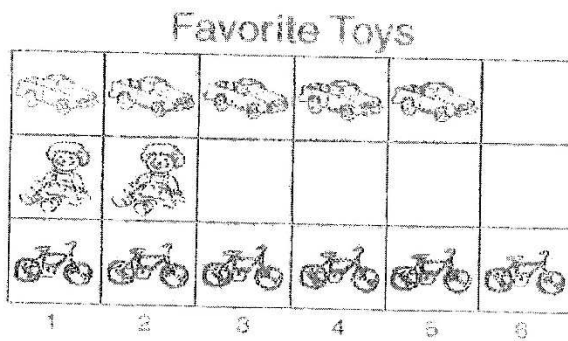
Question 3 (Standard 4.0)

Draw pennies to show the price.



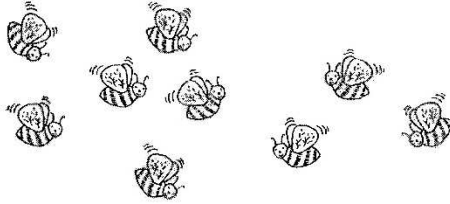
Question 4 (Standard 5.0)

Which toy was chosen by fewer than 5 children?



Question 5 (Standard 1.0)

Count the bees. Which number tells how many?



- five
- seven
- nine
- ten

---

Question 6 (Standard 1.0)

Which is a way to make 7?



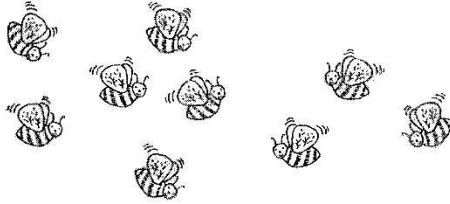
- $4 + 2$
- $6 + 2$
- $3 + 5$
- $4 + 3$

---

---

Question 5 (Standard 1.0)

Count the bees. Which number tells how many?



- five
- seven
- nine
- ten

---

Question 6 (Standard 1.0)

Which is a way to make 7?



- $4 + 2$
- $6 + 2$
- $3 + 5$
- $4 + 3$

---

---



Question 7 (Standard 1.0)

Skip count by 5's...

5, 10, 15, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, 35

Question 8 (CR:3 points) (Standard 1.0)

Use the chart. Start at and circle 21. Count forward by tens circling the numbers. What are the next two numbers after 41?

21, 31, 41, \_\_\_\_\_, \_\_\_\_\_,

21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

APPENDIX B  
SECOND GRADE SAMPLE CBM TEST

2<sup>nd</sup> Math Monsters 1

Name: \_\_\_\_\_ Total Points (10): \_\_\_\_\_

Question 1 (Standard 2.0)

Look for a counting pattern. Use the chart to help you. What are the missing numbers?

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

3, 6, 9, \_\_, \_\_, \_\_

- 9, 12, 15
- 12, 15, 18
- 18, 21, 24
- 24, 27, 30

Question 2 (Standard 3.0)

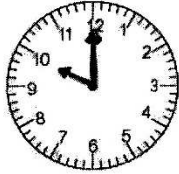
What is the name of this shape?



- hexagon
- triangle
- trapezoid
- parallelogram

Question 3 (Standard 4.0)

What time is it?



- 45 minutes after 10
  - 30 minutes after 10
  - 15 minutes after 10
  - 10 o'clock
- 
- 

Question 4 (Standard 5.0)

Use the data table. Maddie took a survey of her class. How many children chose the koala bear?

Bear	Data
Polar bear	x x x x x x x x x x
Koala bear	x x x x x x
Panda bear	x x x x x x x x

---

- 6
  - 7
  - 8
  - 10
-

Question 5 (Standard 1.0)

What is the sum?

$$\begin{array}{r} 57 \\ + 16 \\ \hline \end{array}$$

- 23
  - 41
  - 61
  - 73
- 

Question 6 (Standard 1.0)

What is the value of the underlined digit?      62

- 2
  - 12
  - 20
  - 26
- 

Question 7 (Standard 1.0)

Which shows an even number of happy faces?

- ☺ ☺ ☺ ☺
  - ☺ ☺ ☺ ☺ ☺ ☺
  - ☺ ☺ ☺ ☺ ☺ ☺ ☺
  - ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺
-

