5-2007

Teaching Probability and Statistics to English Language Learners in Grade Five.

Mary Jo Johnson Neal
East Tennessee State University

Teaching Probability and Statistics to English Language Learners

In Grade Five

A thesis

presented to

the faculty of the Department of Mathematics

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Masters of Science in Mathematical Sciences

---

by

Mary Jo Johnson Neal

May 2007

Dr. Edith Seier, Committee Chair

Dr. Robert M. Price, Jr.

Dr. Yali Liu

Keywords: Statistics, Probability, English Language Learner

ABSTRACT

Teaching Probability and Statistics to English Language Learners

In Grade Five

by

Mary Jo Johnson Neal

An increasing number of English Language Learners enrolling in the Washington County Virginia Public School System during the past several years prompted the idea of this thesis. These students are currently mainstreamed in the regular academic classroom. Adapting to their needs is a new challenge in education for teachers in Southwest Virginia. This thesis offers an opportunity for teachers to prepare for a multicultural classroom setting providing English Language Learners with learning strategies necessary to gain confidence in their mathematical ability and academic success in the areas of probability and statistics. Lesson plans have been specifically designed emphasizing teaching strategies, the role of an effective teacher, classroom environment, various cultures and relevant and authentic data.

DEDICATION

I lovingly dedicate this thesis to my precious family. To my husband, Lewis, thank you for encouraging me through each step of this process and assisting me with technical difficulties. To my daughter, Mary Lewis, your beautiful smile, loving heart and feisty spirit remind me to live each day to its fullest as you do! I only wish I had your stamina! To my mother and father, thank you for instilling in me a desire to always aim for higher goals, never settle for less than which I am capable and thank God each day for his wonderful blessings. Specifically to my mother, thank you for reminding me often to be kind to others and if I did not have something nice to say, not say anything at all! Specifically to my father, thank you for reminding me when I first began teaching twenty six years ago, that every child is someone's little angel! You two are awesome! To my brothers, thank you for understanding when I had to work on this thesis instead of keeping and entertaining your beautiful, precious children. Thank you Lord, for I am so blessed!

ACKNOWLEDGEMENTS

I would like to sincerely thank Dr. Edith Seier for her assistance during the writing and presentation of this thesis. Most specifically, I thank Dr. Seier for guiding me each step of the way and encouraging me to finish even when I was faced with personal trials.

I would also like to thank Dr. Anant Godbole who inspired me during the first class of the master's program. This inspiration led me to realizations about myself that ultimately enhanced my teaching performance and made me a better teacher today.

Thank you Brenda Withers, Amy Lawson and Mike Little for being wonderful team mates and friends. Working with you is an experience in itself! We make a great team!

A special thank you to the many students I have taught during the past twenty six years. My life has been enriched because of you. Each day, I wake up and am enthusiastic to go to work because of you! Each night, as I go to sleep, I remember the light that came on when you learned something new, or the funny thing you said, or the hug you gave me. I love each one of you!

CONTENTS

CHAPTER 1

INTRODUCTION

Minority Statistics

The United States Census Bureau released figures to the Associated Press indicating that the United States Hispanic population has surpassed 40 million as of June, 2005 meaning that one of every seven people in America is Hispanic. This number includes legal and illegal residents. The second largest minority population living in the United States is Asian. Both populations are increasing due to the high rate of immigration and a large number of births from each minority group. The majority of immigrants are in their twenties, bringing small children with them. (Associated Press) According to Audrey Singer, an immigrant and census specialist at the Brookings Institution, "Looking toward the future, we see a difference face of the United States population." In fact, the Census Bureau has projected that the number of minority groups in totality will roughly equal the white population by the year 2050. (Associated Press)

Changes in demographics affect not only society as a whole, but most critically the education of children. Children of minority groups are faced with the immediate challenges of learning a new language, performing academically, and adapting to a new culture while continuing to value their own culture. (Padron)

Research reveals in the late 80s and early 90s Hispanic students were three times more likely to drop out of school. Language minority students were one and half times more likely to drop out of high school in comparison to English monolingual students. Higher education among Hispanics rarely includes majors in engineering, biological sciences and physical sciences. (Clark, 1999)

English Language Learners (ELL) have tripled their numbers in Virginia Public Schools since 1992. These students now live in all eight regions of Virginia and speak a total of 118 different languages. Rapid growth of English Language Learners (ELL) has increased the need for teachers to understand and address their academic and socio-cultural needs. (VDOE, 2004)

No Child Left Behind

President George W. Bush began education reformation in October of 2001 by appointing an Advisory Commission to develop a plan closing the educational achievement gap for Hispanics living in America. The commission researched statistics and interviewed 1600 experts, parents, teacher, students, business and community leaders. They discovered that the American Education System is losing Hispanic students during their educational experience. The committee's research revealed:

- one out of three Hispanic students drops out of high school
- Only 10% of Hispanic students graduate from college
- Hispanic families hold high expectations for their children but they lack the knowledge to help them
- despite an increase in the Hispanic community, the federal government has inadequately coordinated programs to benefit them. (Presidential Advisory Committee, 2003)

As a result of these alarming statistics, the President's Advisory Committee recommended implementation of the No Child Left Behind Act. In addition, the committee recommended new and high expectations for these students along with reinforcement of a high-quality teaching profession skilled to address cultural diversity. Performance objectives of the No Child Left Behind Act requires the following of LEP students:

- become English proficient while striving for high academic standards in reading, language arts and mathematics; and
- participate in yearly assessments in reading, language arts and mathematics. (VDOE)

Encouraging minority students to strive for success in all areas will not only benefit these students, but the nation as a whole, more specifically the commonwealth of Virginia. Currently, the nation's economic base leans toward technology. Therefore, it is important for LEP students to become proficient in the areas of science and mathematics. Otherwise, their choice of careers will be limited. Study of mathematics and science will further aid students in their development intellectually and socially, allowing them to fully engage in a technological environment. (VDOE)

National Council of Teachers of Mathematics

Our society is increasingly culturally diverse, but with the increase of technology, we must ensure that all students, especially ELL, are provided with opportunities to master mathematics which are essential for social and economic success. The NCTM lists five goals for mathematical literacy. All students must do the following:

- value mathematics;
- become confident in their ability to perform mathematics;
- become mathematics problem solvers;

- learn to communicate mathematically; and
- learn to reason mathematically. (NCTM, 2000)

NCTM further adds "Cultural background and language must not be a barrier to full participation in mathematics programs preparing students for a full range of careers."

Virginia Standards of Learning

Beginning with the class of 2004, the Virginia Standards of Learning requires all students to pass the English reading skills test and the English writing skills test in order to graduate from high school with a standard diploma. Students must further earn four additional verified credits from performance on tests in subjects of their choosing. (VSOL)

Mathematics teachers can assist students in reaching these goals by providing a variety of classroom activities beginning at the elementary level. Students should have multiple opportunities involving the use of manipulatives, cooperatively working with peers, communicating mathematical ideas in every language and writing about mathematics in journals. (Adeeb) Most educators agree that mathematics is a language spoken in all cultures, albeit different languages and symbols, which provides opportunities for students to study and appreciate similarities and differences among all people. Such a diverse atmosphere can further promote problem solving, communication, logical reasoning and relationships. Teachers must make it a priority to build a child's confidence in their ability to "do" mathematics by encouraging them to ask questions, share answers and work cooperatively with others. Ideally, a multicultural setting should include:

- equal opportunities for all students;

- preparation for competent participation in a multicultural society;
- preparation of highly qualified teachers in a diverse classroom;
- end of oppression in all school settings;
- student-centered education; and
- reexamination of educational practices which affect all students. (Gorski)

The overall goal of education should be to facilitate and encourage all students to reach their maximum potential in the academic environment, ultimately preparing them to be social and active citizens of society. This goal can be accomplished through emphasis on social justice, equity in education and facilitation of a variety of educational experiences.

CHAPTER 2

CULTURAL CONTEXTS

Culture Based Disparity

Mathematics was invented in many different places in our world during different periods of time throughout history. Therefore, it is certain that mathematics is culturally influenced. While its theorems are universal, application, usage and instructional methods have been determined by cultural norms. Mathematics has been shaped and molded by the beliefs of various groups of people and their need for solving problems. Therefore, mathematics teachers are not simply delivering mathematical knowledge and skills, but are passing on values, habits and customs generated by a history of many cultures. (Bishop, 1994)

Students who are learning English as a Second Language (ESL) are influenced by the following factors:

- Age:

  Young students have little prior academic knowledge so they are learning new mathematical concepts while also learning the English language and academic vocabulary. Learning content and language simultaneously can be a daunting task. However, young students are more likely to speak English quickly and easily due to a more limited vocabulary. They are also less inhibited than older students and are not as likely to worry about what they sound like.

- Native language deficiency:

Students may have had limited access to education in their land. Some rural communities do not emphasize literacy. Political turmoil may have prevented students from attending school. These factors challenge English Language Learners (ELL) immensely as they limit prior knowledge with which to build upon entering schools in the United States.

- Family circumstances:

  English Language Learners (ELL) may have emotional and psychological stresses which affect their level of motivation and achievement. For instance, some families migrate to the United States to escape war or refugee camps. Others may be searching for employment or a better education for their children. Families may be split between their native country and the United States to be joined only when they can financially afford to move the remainder of the family. Obviously, these are stressful conditions for a child at any age. (VDOE, 2004)

Challenges

Some educators make the assumption that learning mathematics is the easiest academic subject for English Language Learners (ELL) because of the use of symbols. Sad to say, but some teachers actually believe there is only one correct way to find a solution to a mathematic problem. Both of these statements are far from being true. In fact, there are hundreds of different counting systems in the world, some using various representations of symbols. Cultural differences are also revealed in the way mathematics functions are performed. Algorithms are real objects created through an interaction of people, language and their culture. However, according to Perkins and Flores (2002):

> "Compared with differences in language and culture faced by students who are recent immigrants, the differences in mathematical notation and procedures seem to be minor. Nevertheless, immigrant students confront noticeable differences between the way that mathematical ideas are represented in their countries of origin and the manner that they are represented in the United States." (p. 346)

English Language Learners (ELL) encounter these challenges when learning mathematics:

- Cultural differences in the formation of numbers
- Use of commas and decimal points: For example, in some countries, periods are used instead of commas to separate multiples of a thousand, whereby, 1,200,000 would instead be written 1.200.000 Commas might be used as decimal point whereas 7.5 would be written as 7,5. This is the case in monetary terms as well. $15.00 might instead be written as $15,00.
- Different measurement systems: Most cultures use the metric system as their method of measure. Learning the United States customary system of measurement is difficult for many English Language Learners (ELL). They have trouble estimating units of length, capacity and weight, learning new equivalences which are not based on multiples of ten, and using fractions to describe measurement. Fractions are not used

in the metric system. For example, six inches equals half a foot, and one fourth of a pound equals four ounces, but five millimeters is not normally described as half a centimeter.

- Spiral approach to mathematics: In the United States, students learn math spirally with one concept building on the next. This is not so in all cultures. As a matter of fact curriculum in other countries may be limited primarily to calculations. Therefore, students may not learn much about geometry, probability and statistics during their elementary years.
- Unfamiliarity using manipulatives: In some cultures, teachers provide instruction during the majority of class time, afterward allowing students to work quietly on assignments at their desk for the remainder of class. These students might view manipulatives in the typical United States classroom as toys and not take the activity seriously.
- Rote memory and mental calculations: Different cultures learn by rote memory and perform algorithms by using mental computation. In the United States, it is customary for students to "show their work."
- Decimals versus fractions: Some cultures rely heavily on decimal representations of numbers with a minimal use of fractions.
- Translation of mathematic terms: Common math terms have several definitions. For example: when constructing a *table* to represent data; *table* also represents an object where you sit down to eat meals or may be a place a student does homework. A vocabulary word may also share its meaning with other mathematical terms. For example: Add, combine, sum, connect, in addition to, plus all mean to compute an

addition problem. This can be confusing for English Language Learners. In some cultures, words have only one meaning depending on the intonation or grunts.

- Mental math: Mental calculations are the norm in certain cultures. "Show your work" may prove to be difficult for English Language Learners because they must write steps of computation on paper.
- United States Dialects
- Participation: If English Language Learners are most familiar with listening to instruction, then sitting at a desk to perform computations, participation and working as a member of a cooperative group will be difficult. Some cultures also expect students to call answers aloud in class, while it is customary to raise your hand in a typical American classroom. English Language Learners (ELL) may be fearful of interacting within the regular classroom because of limited English and prior knowledge.
- Reading and writing orientation: While students in the United States read and write from left to right and front to back, other cultures do the opposite.
- Cultural norms: English Language Learners will quickly discover that certain behaviors are appropriate at school, while others are appropriate at home. (VDOE, 2004) For example: "A young Hispanic boy was being disciplined at home for something he had done. When his Mother finished scolding him, he looked at her and said, "Am I supposed to look at you (as teachers at school request) or look away from you (as a sign of respect)? I can't remember." English Language Learners are constantly pulled between two different cultures. (VDOE, 2004)

Ethnomathematics

Ethnomathematics is a term invented during the 1980s by a Brazilian Mathematician, Ubiratan D'Ambrosio. His definition states: "Ethnomathematics is the way different cultural groups mathematise (count, measure, relate, classify, and infer)." Gloria Gilmer of Mathematics Technology Incorporated prepared this definition of Ethnomathematics for a multicultural dictionary: "Ethnomathematics is the study of the mathematical practices of specific cultural groups in the course of dealing with their environmental problems and activities."

Ethnomathematics plays an important role in the teaching and learning of mathematics. By acknowledging the importance of their culture, students may then discover their full potential in mathematics. Furthermore, they will discover "how" students think and learn mathematics. In fact, algorithms are real objects that have been created through an interaction of people, language and culture in order to solve a problem. In fact, the same mathematics problem may ultimately be accomplished using a variety of algorithms. The relationship between mathematics, language and symbolism has an important role in the integration of diverse cultures. (Perkins, 2002)

Cultural Norms

English Language Learners (ELL) have more than likely experienced different linguistic, cultural and academic backgrounds than those offered in the United States. In fact, these prior experiences can affect their behavior, relationships with others and academic achievement. However, teachers who are specifically aware of these differences can help all students adjust to a multicultural setting. This can be accomplished by encouraging an appreciation and respect for all cultural norms within the classroom.

Cultural norms may include one or more of the following examples:

- Clothing styles

  Traditional native clothing may be worn at school or perhaps just at home. Women, for example, in certain cultures must cover their heads, arms and legs when they are in a public setting.

- Affection

  Girls hold hands with each other in some cultures. Knowing this can prevent teasing from other students.

- Communication

  Most people have a "personal space." In some cultures, people stand very closely next to or face to face with another person while conversing. In the United States, this can be regarded as an invasion of personal space.

- Eye contact

  Some ELL students may look down at their feet or simply look away when listening or speaking to a teacher or principal. This act according to their native culture is a sign of respect. Typically, in American schools, students are encouraged to make eye contact with teachers, principals and peers.

- Collaboration

  In many countries, students are not active participants in the classroom. In fact, they listen to a lecture and class work is completed independently, often, in silence. Instruction emphasizes rote learning. United States classrooms are

> normally quite the opposite involving the use of cooperative learning groups, manipulatives, experimentation, and higher order questioning techniques. It is then imperative that ELL students be introduced to these different methods of learning. In addition, remind students that rules also may be different during testing situations. (Kottler, 2002)

Cultural norms specifically within the Hispanic community reveal animated gestures and body language to more adequately communicate. Their eating habits consist of light meals for breakfast, and supper which is usually served late, with lunch being the main meal of the day. Upon learning this, it then made perfect sense to me that Hispanic students always complain about small portions served during lunchtime at school! Additionally, in a more social setting, Hispanics will accept food only after it has been offered two or three times. (Clutter)

Hispanics generally show respect for education and learning. During conversations, they tend to stand very close, even touching the person with whom they are speaking. Their social hubs tend to be churches and grocery stores where they meet, visit and share information. (Clutter)

Cultural norms specifically within the Vietnamese community reveal a rigid educational system. Their teachers typically use a standardized teaching style, and spend practically ninety-nine percent of the time teaching structured lessons followed by much practice with little emphasis on context. Students then experience learning through homework assignments. Emphasis is placed on rote memory and mental calculation. In fact, students are encouraged not to write everything down on paper. They use a different approach to solve addition, subtraction, multiplication and division problems. Asian students appear to perform well academically due to their hard work ethics and persistence. (Kottler, 2002)

Mathematical Knowledge

Mathematics consists of three components, namely, linguistic, conceptual and procedural. These components add further challenges for ELL students.

Knowledge of linguistics requires application of computational skills which provide solutions to problems relevant to real life situations. The subject of mathematics involves a specialized language, patterns and rules.

Helpful hints that can be used to assist ESL students in learning and understanding mathematics are:

- Vocabulary:

  Most mathematics terms are content specific and must be learned.

- Complex phrases:

  Phrases such as “least common multiple” will be impossible to find in a bilingual dictionary. Defining each word of the phrase may lead to an inaccurate definition. Students should rely on teachers, classmates and textbooks for these definitions.

- Unique mathematical meanings:

  Mathematics vocabulary is unique. Often, it has a completely different meaning than its typical English definition. For example: The word “cone” is a mathematical term that names a three dimensional geometric figure. Normally, however, we think of a double scoop of chocolate ice cream sitting atop an ice cream “cone”.

- Prepositions:

  In mathematics, prepositions often indicate use of an operation to solve a word problem. For example: in addition to being prepositions, the words “by” and “into” also indicate a division algorithm. Hence, $12 \div 3$ can be read as 12 divided “by” 3 or 3 goes “into” 12.

- Prefixes and suffixes:

  Learning the meanings of prefixes and suffixes will help ELL students with many mathematical words. For example: bi- means two, tri- means three, poly- means many, -gon means angle, hex- means six, etc.

- Vocabulary associated with operations:

  Many words are associated with operations. Knowing these words and phrases is essential in solving word problems. For example: vocabulary associated with addition includes add, plus, combine, sum, greater than, longer, increased by, and total of; vocabulary associated with subtraction includes less than, fewer than, decreased by, difference, subtract, minus, take away, from, and shorter; vocabulary associated with multiplication includes multiply, times, product, factor, twice, double, triple, and groups of; and vocabulary associated with division includes equal groups, divide, quotient, divided by, shared equally, over, into, and how many groups; and vocabulary associated with equal includes words like is, are, result and make. (VDOE, 2004)

Conceptual knowledge allows students to choose the operation, calculate the steps and ultimately, provide an answer or solution. Teachers must identify prior knowledge of ELL students in order to connect this knowledge to new concepts. If a student already has conceptual knowledge but does not possess essential English language development to explain the process, emphasis should be placed on learning “new” English words to more easily communicate the concept. If in retrospect, the student lacks conceptual knowledge, then the teacher must focus on the use of manipulatives, visuals and hands on activities to assist the student’s learning of the concept. (VDOE, 2004)

Procedural knowledge often presents frustration for ELL students simply because there exists different procedures and methods to perform computations. Nearly every culture seems to compute differently! Following is a list of helpful hints for assisting ELL students in the area of learning procedures:

- Read and write from the left to the right;
- Ask the teacher and/or classmates the preferred way of writing numbers and letters and also refer to textbooks;
- Use periods to name decimals and monetary amounts;
- Separate multiples of a thousand with commas indicating place value;
- Learn the U. S. Customary system of measurement but also remember the metric system, and;
- Learn different methods of computation inspired by a multicultural setting. (VDOE, 2004)

Although these three components of mathematics may cause much frustration and confusion to English Language Learners, teachers can come to their rescue. Teachers can better understand ELL academic performance in mathematics if they are aware of specific differences within the culture and teach accordingly. ELL students should be taught how to write in notebooks from left to right and front to back, in addition to completing homework and solving computations. Teachers should be flexible and accept different procedures used for computations even teaching different procedures to the entire class, involving the ELL. Encourage ELL to rely on and pair up with buddies and classmates who are proficient in the English language to solve problems and answer questions.

ELL Advantages

Despite the challenges ELL students encounter in a typical United States classroom, they possess significant advantages. Bilingual students, such as themselves, often see what unilingual students take for granted. They can make comparisons between educational systems of their native land and the United States which will lead to important questions and higher order thinking strategies. (Lee)

Mathematics has a unique language of its own. Unilingual students must learn the "new" mathematical definitions of a word in comparison to the nonmathematical meaning of which they already have knowledge. This may create confusion among students. However, bilingual students probably do not have this previous vocabulary knowledge which may allow them to more efficiently learn mathematics vocabulary. (Lee)

Students who are bilingual are generally more flexible in their thinking. They have the ability to switch perspectives easily and examine situations from a different point of view. Socially, bilingual children mature earlier. They tend to be more comfortable with diversity and have the ability to adapt socially. They also identify more with their own ethnic group. Cognitively, bilingual students exhibit higher divergent thinking and are socially sensitive in situations which require verbal interactions. Furthermore, they demonstrate the ability to function analytically and think more clearly. English Language Learners may stimulate enrichment for the entire school population by introducing a new and diverse culture and additional knowledge of their culture. (Lee)

Teachers should encourage ELLs to develop these advantages in mathematics. An effective way to accomplish this is by using manipulatives. Manipulatives become concrete objects students can use to consider further exploration. Teachers should also provide or design "real-life" math problems by using culturally relevant, authentic materials. The internet is a valuable and convenient resource for implementing this strategy. For example, menus from many different restaurants around the world can be used as resources for taking your favorite person to dinner on a budget, of course. Sam's Club offers vacation brochures, complete with destinations to many different areas in the world inclusive of costs and amenities. These are just a few examples. The list of possibilities is limitless and creativity involved in planning a lesson can further enhance a student's knowledge and lead to higher order thinking skills.

CHAPTER 3

TEACHING IN THE ELL ENVIRONMENT

The Effective Teacher

An effective teacher is essential for English language learners to be successful in an academic setting. Teachers have the responsibility of studying and understanding the cultures of all students and their environment. Teachers must eliminate any prejudices and examine their teaching styles, adopting different styles, if necessary, so every student can learn in the most optimal setting. An effective teacher should strive for an ongoing process of self examination and transformation. All students should receive an equal opportunity to achieve their greatest potential and encouraged to fully participate in a multicultural acceptable environment. (Gorski) Academics should be inclusively student centered with teachers taking an active role in reexamining educational practices and the effect they have on student learning. In addition, an effective teacher should actively discourage and terminate oppression not only within the classroom, but also within the total school environment. This affirmative action will ultimately produce students who are socially and critically active, aware, and accepting of their multicultural education setting. (Gorski)

Stages of English Language Learners

Students who are learning English as a second language, generally progress through five stages of acquisition. Learning English normally develops in predictable, sequential steps and with increased exposure English language learners progress through these stages. Following is a list of these stages correlating behaviors of students during each stage. A general understanding of the progression of language acquisition for students is revealed in each stage. It is important to note that all students are different and for various reasons may fluctuate among the stages depending on classroom and/or teacher demands and students' levels of participation. English language learners may also digress to an earlier stage when presented new and/or unfamiliar academic objectives or activities. (VDOE, 2004) Section 3.3 of this thesis identifies specific strategies teachers may use to assist students in each of these stages. Also important to note, a student's literacy skills in English are more easily acquired if the student already possesses literacy skills in their native language. Obviously, the more similar the two languages are, the easier it becomes for the student to transfer literacy skills.

Stage 1: Silent/Receptive Stage

Students remain in this beginning, "silent stage" of language acquisition up to six months with eventual use of five hundred (500) receptive words. As students adjust to a new environment and initial exposure to the English language, they will use many gestures such as nodding, pointing to objects, drawing and demonstrating to convey their message. They will answer "yes" or "no" to most questions, but are otherwise hesitant to speak. This hesitancy may arise from unfamiliarity of hearing their own voice speaking a different language. Perhaps they are afraid of using the wrong word or fear that other students will make fun of their accent or use of words. (VDOE, 2004)

Stage 2: Early Production Stage

This stage generally lasts from six months to one year with eventual use of one thousand (1000) receptive and active words. Students use short, repetitive language, focusing on key words and context clues. They generally produce only one or two word phrases. (VDOE, 2004)

Stage 3: Speech Emergence Stage

Students spend about one or two years at this stage eventually learning approximately three thousand (3000) active words. They progress by using simple sentences and participate using basic dialogue. (VDOE, 2004)

It is important to note that stages two and three are the levels at which students develop the oral skills needed for effective communication with teachers and peers.

Stage 4: Intermediate Fluency Stage

Two to three years at this level produces about six thousand (6000) active words. Students now have the ability to use more complex sentences and can ask questions. They are able to more accurately state their opinions and original thoughts. Furthermore, they can interact in more lengthy conversations. They are becoming more confident with their use of the English language and are much more fluent. At this stage, students are approaching grade level literacy. (VDOE, 2004)

Stage 5: Advanced Fluency Stage

Students generally reach this stage within five to seven years of beginning English acquisition and have knowledge of content area vocabulary. They have acquired the ability to converse fluently in addition to arguing and defending academic points. They understand level appropriate classroom activities and can write organized essays. Grade level appropriate textbooks can now be easily read and understood. At this stage, students are able to produce and understand language as well as native English speakers. Obviously, students at this stage have reached their peak of confidence. (VDOE, 2004)

There are several factors that influence the pace a student moves through each stage of language acquisition. The age of a student is one of these factors. While an older student probably possesses more prior knowledge and skills learned in the native language whereas younger students will exhibit limited prior experiences. Students who have prior knowledge and concepts simply need to learn English vocabulary necessary to transfer previously acquired knowledge. Young students on the other hand must learn a new language in addition to learning new concepts and skills. However, older students may feel more uncomfortable in front of peers because they fear making mistakes and therefore, may not take necessary risks. Younger students seem to be less inhibited in this area. It may take a longer period of time for older students in middle school and high school to learn because their courses are more demanding academically than those in elementary school. Native like pronunciation is more achievable for younger children. (VDOE, 2004)

Some ELL may come to the United States with only the experience of limited or interrupted education. This lack of education may be due to political turmoil where education is interrupted or perhaps minor emphasis is placed on education in the native country. ELL may come from rural communities which place limited value on education. So, in addition to learning English, students have the additional challenge of learning behaviors and expectations appropriate at school. (VDOE, 2004)

Another factor that may influence English efficiency involves family and home circumstances which may have caused the family to move to the United States. These reasons may affect the emotional and psychological mindset of students thus creating burden and stress which may ultimately affect their level of motivation and academic achievement. Obviously, a family seeking employment opportunities, reuniting with family members or desiring a better education creates fewer burdens than a family who has been forced to leave its native country due to political unrest or fear of going to refugee camps. (VDOE, 2004)

Learning Strategies

English language learners can learn content areas more effectively by acquiring knowledge of a variety of learning strategies. Depending on the age of a student, they may already naturally possess these strategies. If not, it will be necessary to implicitly teach the strategies.

Metacognitive strategies help students monitor their thinking skills and level of understanding. These strategies involve previewing section headings and bold words of a text. Students need to know how to organize an assignment and use a variety of materials. Focus is placed on key words of verbal and written language. Comprehension should be checked orally and in written formation. Ultimately, students judge how well they performed a task. (Kottler, 2002)

Cognitive strategies help students organize information. This can be accomplished by using resources such as dictionaries, encyclopedias, textbook glossaries and word walls. Students should relate new information to prior knowledge and experiences. Reviewing main ideas assists students in summarizing information. An excellent strategy in this area involves reviewing or practicing a new skill many times over and over again. (Kottler, 2002)

Social affective strategies help students interact with their peers in addition to helping them control emotions. Students should ask for clarification, rephrasing or additional information if a task or directions are not completely understood. Mental techniques such as self-talk can reduce anxiety and boost confidence in an assignment. Students can further learn cooperation skills by working in cooperative learning groups with peers to discover solutions to problems. (Kottler, 2002)

Classroom Environment

Effective teachers establish a multicultural classroom atmosphere that is accepting of diversity, decreases competitive activities and encourages participation from each and every student. These teachers value each student's prior experiences and develop mathematical activities around them. Since students spend as much, if not more time with teachers than parents, teachers play an important role in their lives. Influential teachers are sensitive to individual needs and aptitudes, provide motivation and have high expectations of all students. (Thompson, 2000)

Students learn more in a classroom which makes them feel safe, secure and comfortable with reduced levels of anxiety. Teachers can provide this positive environment by fostering an atmosphere of mutual respect among students and their teachers. Differences are considered assets. Various cultures and different ways of learning and communicating are readily accepted. A comfortable classroom encourages participation and taking risks without fear of being embarrassed or ridiculed. Encouraging active involvement motivates and engages students which essentially help them recall and retain information. Cooperative learning in peer groups allows a more relaxed atmosphere. Not only do students work with each other to solve problems, but they also discuss relevant information and interact socially. (Kottler, 2002) In all settings, teachers should smile often, use a pleasant tone of voice, gestures, and facial expressions, and modify their speech in order to help ELL further comprehend and feel comfortable in the classroom.

Classroom procedures and routines help orient ELL students to classroom expectations and further aid in the development of English acquisition. (Kottler, 2002) This can be accomplished by posting procedures, schedules, rules and expectations within the classroom. Teachers should use predictable signals and routine procedures to get students' attention, make transitions and complete tasks.

Learning about a student's native culture in relation to eye contact, personal space and prior schooling can help teachers make students feel more comfortable. Getting to know a student, speaking with the ESL specialist and students' parents in addition to observing students in class can further contribute to a risk free environment. English language learners should be seated near the front of the room and beside a student who is friendly and would serve as a good role model. (VDOE, 2004) Students will adjust more easily to a new school environment if they are paired with a "buddy" or two, one being from the same native country and the other a good student of the English language. (Kottler, 2002)

Teachers can further enhance classroom atmosphere and develop pride in different cultures by inviting bilingual parents to perform cultural demonstrations during school. (Haynes) Also encourage ELL students to share native language with their classmates. Place labels with native vocabulary on walls above objects such as flag, pencil sharpener, desk, chair, trashcan, door, window, floor, chalkboard, etc. (Haynes) This not only makes ELL comfortable in their surrounds but encourages American students to learn a second language.

Finally, decorate the classroom with posters of different countries and places in the United States. (Kottler, 2002) Encourage students to share their experiences. Ask students to choose the poster of a place they would like to live or visit and explain their choices. Journals can also provide a source for students to communicate in a non-threatening environment.

In essence, the more comfortable a student feels in their school setting, the more willing and able they will be to work and learn. This type of atmosphere provides an atmosphere where all students excel.

Instructional Strategies

Classroom teachers can ensure overall academic success for English language learners while also increasing their proficiency in English simply by implementing research based instructional strategies designed specifically for them. Research has proven that these students acquire language more quickly when actively involved in content area instruction. (Adeeb) Mathematics instruction can further promote English fluency when used simultaneously with bilingual instructional methods giving students the ability to communicate their answers and justify the reason. Teachers must modify instruction to meet all students' diverse linguistic and cultural needs. This can be accomplished by giving special attention to the following ideas.

1. Get to know English language learners.

First and foremost, teachers should get to know their English language learners. (Kottler, 2002) Good teaching involves caring, nurturing, and developing minds and talents. As teachers begin to know their students, students will also begin to know their teachers through communication of similarities and differences. Knowing you as a teacher and a person will make students more comfortable in the classroom thus providing a more effective environment for learning. "Getting to know you" activities are priceless in achieving this objective. I have included two that I have used in my classroom with much success. These are fun, non-threatening activities which are effective ways for students to get to know each other also.

"Getting to Know You" Activities

Activity #1

Check out the book Chrysanthemum by Kevin Henkes from your school library. Before reading the book, ask students what they know about the name Chrysanthemum. Some might know it is a type of flower. A student might count the letters in the name because it is a very long name. Someone might admit it would be a difficult name for a student in kindergarten to learn to spell. Read the book aloud to students. Discuss how Chrysanthemum's parents named her and ask students if they know how they were named. Share the story of how you got your own name. For example, my first name is Mary Jo. My mother's name is Mary Ann and my father's name is Joe. My parents decided to name me by giving me part of their names, hence the name, Mary Jo. I love my name because it is different and not many people share this name. Encourage students to go home and discuss how they were named with their parents. The following day ask students to write a paragraph telling where their name came from and what their name means. Use computers to research names and find the origin of different names. If you have a multicultural classroom, you and your students will learn much about names and different cultures. This exercise will promote respect, individuality, cultural diversity and sharing. Further sharing may involve discussing each other's nicknames (if they are not embarrassing). Ask students what they would like to name their children one day.

Activity #2

Purchase several large rolls of white bulletin board paper or white table cloth paper or bolts of newsprint from a newspaper office. Unroll paper and ask students to lie down on the paper one at a time. Trace around the outline of their bodies. Roll it up for them to take home and "dress." Students should dress their bodies using crayons or markers to color shirts, skirts, pants, shoes, hair, etc. Ask them to return their dressed bodies the following day. Cut out each body. Write the following sentences on "cloud-like shapes" for students to answer, cut out and then glue onto their bodies.

____________ always makes me smile.

____________ makes me strong.

Best friends are people who____.

I was born in ___________.

My favorite subject to study is __________ because____________________________________.

I really do not like __________ because____.

In my heart, I am sure that ___________.

Thumbs up! I am happiest when____.

My favorite food is ____.

My favorite television show is ______________________________________.

My favorite sport is ______________ because____.

I wish my feet could take me to _______________________ because______________________.

Ask students to complete each cloud and glue it somewhere on their body. Give every student a large red heart to glue to that place on their body. Hang all the bodies in the hallway for everyone to admire and read about each person in your classroom!

2. Explain and implement routines and procedures:

Classroom management procedures allow optimal participation of all students which in turn produces an environment conducive to learning. (VDOE, 2004) This can be accomplished through establishment of procedures for asking questions, going to the restroom, sharpening pencils, working with a buddy, etc. and should be visibly placed on a bulletin board for students to review. Provide preferential seating for ELL near yourself and a "buddy" who should be helpful, friendly and a good role model. Assignments, worksheets, tests and activities should be prepared using consistent formats with printed legible writing. Provide oral and written directions and assignments to students. Ask and answer questions about assignments. Allow ELL an adequate amount of "wait" time to respond to a question or situation, even encouraging them to discuss their answer with a buddy before saying it aloud. Picture dictionaries and bilingual dictionaries also provide an excellent resource and should be housed in a specific area for use in the classroom. Now that you better know your students and have tackled the task of classroom management, the English language learner should be marginally at ease and ready to learn.

3. Develop vocabulary daily.

Integrate language and content by developing mathematics vocabulary daily. (VDOE, 2004) In addition, teach strategies to students so they can learn and remember the new vocabulary. Identify and teach specific vocabulary that must be understood for the lesson and activity. Place vocabulary words with meanings and/or pictures on a "word wall" and give students a spiral index card notebook where they can write words each day. If fluent in their native language ask students to write native words below English words. Show "tricks" for remembering vocabulary. For example: a little chant that helps students remember the difference between multiples and factors: <u>m</u>ultiples are <u>m</u>any, <u>f</u>actors are <u>f</u>ew. Not only is it a catchy little chant, but the m's and f's match up nicely. Central tendency vocabulary includes mean, mode and median. Students tend to confuse mode and median. I share this with students:

both mode / most begin with “mo” and both have exactly four letters. Mode means the number in a set that is listed the most times; both median / middle begin with m and have a d as the third letter and both words are six letters long. Median means the number in the middle of a set of numbers when the numbers are placed in order from least to greatest. Also use word walls to display the four operations and list words that can have the same meaning. For example: addition-sum, equal, combine, altogether, both, in all, total, add, plus.

4. Target key words.

Vocabulary is most effective when teachers target key words that are most critical for understanding a concept. (VDOE, 2004) Present new vocabulary words using visuals, gestures, definitions and comparisons. Using vocabulary as a curriculum anchor will enable ELL to achieve success. The prime way to accomplish this is by introducing only a few words at a time that convey key concepts. These words should be relevant and beneficial to the concept revealing meaning. In addition, vocabulary should be reviewed daily and used in various situations to promote understanding. English language learners should practice saying the new word aloud, repeating it several times. Perhaps typing the word using many different fonts or writing the word in crayon can add to the visual effect. I have even used shaving cream on desks for students to write vocabulary words. After learning ten or fifteen new vocabulary words, ask students to create a crossword puzzle using a computer, printer and the following website: puzzlemaker.school.discovery.com/. Students love making these puzzles and they will learn words more quickly by typing in vocabulary and the definition of each word. When a final puzzle is printed, they can solve the puzzle!

5. Verbalize vocabulary often.

Use appropriate vocabulary while solving problems on the board, overhead projector or Smart Board. (VDOE, 2004) Put students in small groups to solve problems, discussing strategies and possible solutions encouraging the use of vocabulary. As a group, require students to write steps of a computational problem using specific mathematics language. Do not worry about spelling, grammar or even complete sentences in the beginning. Assign journal entries describing an activity completed in class. Encourage students to write questions they cannot answer in their journals especially if they are shy. Also ask them to write what they particularly liked about an activity or what helped them most during the activity. Ask them for suggestions to make learning easier for them. Challenge students to write vocabulary definitions in their own words using prior experiences linking perhaps to their native experiences. There exist many games and activities on line and in periodicals. Utilize these resources to make learning vocabulary fun and less of a chore. Basic games that work well for learning and reviewing vocabulary are tic/tac/toe, bingo, concentration, jeopardy, and vocabulary ball. Jeopardy and vocabulary ball are most effective in my classroom. The Jeopardy board is homemade from foam board, colorful library card pockets and answers written on index cards. Students in groups vie for points. "Eggspert" is an electronic signaling device for teams to use to answer questions. I have many different "balls" that students love to use. They are homemade on large plastic balls purchased from a local store. Vocabulary ball has mathematic definitions written on it and the student must give the vocabulary word when it is their turn. Rules of play will be attached in an appendix for many different activities.

6. Integrate technology with lessons.

The school in which I teach has a centralized computer lab with twenty four computers that work most of the time. In addition, the school has a mobile wireless lab that holds twenty laptops. I prefer the wireless laptops because of the convenience of simply rolling the lab into the classroom. Only a few teachers utilize this marvelous piece of technology, so I can reserve most times I need it without any problems. As with any innovative equipment, the initial one or two times of use are difficult for both teachers and students. After the orientation period, however, technology becomes an optimal learning tool-easy and effective. (Buchanan, 1998)

7. Use humor and laughter with ease.

Teach the meanings of common math terms that have multiple definitions outside the context of mathematics. For example, ask students what they think of when you say the word "mean." You will receive many responses, most not mathematical in nature. Some responses will be quite humorous. Laugh with students and encourage laughter. It is good for your health!!! (Helpguide, 2006)

Which reminds me, I absolutely love laughter and good natured humor and incorporate it into my lessons each day! I must list the health benefits of laughter at this point and how it contributes to a successful atmosphere for learning. According to scientific research, hearty laughter provides us with a workout equivalent to several minutes on a rowing machine or stationary bicycle. (Helpguide, 2006) It massages and strengthens muscles in the abdomen, intestines, diaphragm and face. Try laughing for just one minute. If it is a truly hearty laugh, tears will be streaming from your eyes and you will be clutching your stomach and sides. Laughter has proven to lower stress, elevate moods, and rid a person of anger. It lowers blood pressure, protects the heart and improves our overall emotional health. Furthermore, a sense of humor is essential to our mental health because it increases our ability to connect with others by sharing pleasant feelings, allowing more conversation, making eye contact and increasing our level of energy. (Helpguide, 2006) Needless to say, it makes us feel good! During a normal school day, if laughter has not erupted naturally within the confines of a lesson or activity during class, I abruptly stop what I am doing, look around the room, and burst out laughing. Of course, laughing is contagious, so students start laughing and then we all ask each other, “What are we laughing about?” which sends us into another fit of laughter.

Oh, my apologies, back to mean . . . after humorous or scary definitions of the word, explain the mathematical definition. Model the steps of computing the mean of a set of data by using the high temperatures of the past week. I would be willing to bet a dozen chocolate covered donuts that students will now remember the word due to this one experience. This is a good time to introduce the word “average” as another word for “mean.”

8. Use different approaches for learning mathematics.

Utilize multiple instructional strategies to assist ELL in their approach to learning mathematics. Design lessons that utilize visual, auditory, tactile and kinesthetic senses. (Janzen) This type of learning can be incorporated into lessons using charts, graphs, manipulatives and real objects in conjunction with oral explanations and presentations using the overhead projector, smartboard and computer. Design hands on activities and vary groupings and partners. You may wish to assign roles to each member in small groups to ensure each member is a vital part of the group. Independent work, groups of two, small groups or whole class instruction should be utilized during appropriate parts of the lesson. Motivate students to learn by presenting them with real life experiences for problem solving situations which give meaning to them. Furthermore, make interdisciplinary connections. Application among different subject areas tends to develop critical thinking and reasoning skills and allows students to make thematic connections. Most importantly, during mathematics instruction, increase focus on reasoning skills with less emphasis on language skills.

9. Check for understanding.

Check for understanding often within a lesson. (Janzen) English language learners typically will not ask questions if they do not understand something. If you ask them, "Do you understand," they will nod in the affirmative whether they do or not. Therefore, the teacher has the responsibility for determining if students understand directions, a task and the processes of that task. You can usually tell by their eye movements and body gestures if they appear uncomfortable with the task. When giving instructions or steps to follow, use informal language, enunciate clearly, add gestures, point to objects, act out the task, draw pictures and progress in sequential steps. You should repeat the explanation to the entire class, simplifying the language, then asking a classmate to repeat the steps in their own words. If you realize the ELL still does not understand, you should go to them privately and explain or pair them with a student who does understand. Working with another student will ease the tensions and probably increase the level of understanding and learning. In addition, distribute instructions to each group. Study guides will also aid in understanding concepts. Listing steps on the chalkboard might also prove to be helpful. This will further convince students that you understand their plight and are willing and able to make things easier and more enjoyable for them. Who knows, the next time English language learners do not understand, a hand may be raised high in the air.

10. Use manipulatives.

Models and manipulatives are essential tools for ELLs in mathematics. (Janzen) I use items such as dried beans, buttons, macaroni noodles, beads, Hersheys chocolate bars, M & M's, graph paper, paper geometric models along with Harcourt and Houghton Mifflin ready made manipulatives. Of these, I regularly use fraction bars, fraction circles, counters, calculators, base ten blocks, protractors, metric/standard rulers, compasses, grams, kilograms, balance, scales, ounces, pounds, gallon, pint, quart, cup, liter and milliliter containers, etc. Students absolutely enjoy learning by using manipulatives and they remember what they have learned. Using fraction bars or circles helps them explain "why" and "how" you can add 3/12 and 7/12 and "why" 10/12 is equivalent to 5/6. Then later, "how" they can add 2/6 and ¾ and "why" 13/12 is considered an improper fraction equivalent to 1 1/12. Most students can learn how to add and subtract fractions using chalkboard, paper and pencil, but do they really understand "why" and "how" the process works? It is amazing to observe students, especially English language learners, discovering sums and differences of fractions using fraction bars with paper and pencil nowhere in sight! Once understanding has been achieved, it is simple and obvious to write and follow the steps of the procedure on paper. Using manipulatives makes it obvious "why" numerators are added or subtracted, but not denominators. Yes, it takes an extra amount of time, but understanding the concept and the ability to apply this concept in various subject areas makes the time well spent! I cannot emphasize the use of manipulatives enough. Imagine the student who may have only studied the metric system. How on Earth can length be taught and understood without use of both standard and metric rulers, containers, and measures of weight and mass? I equate this to learning the steps of riding a bicycle without a bicycle on which to practice.

11. Introduce relevant hands on activities.

In addition to manipulatives, students should be exposed often to a variety of quality hands on activities. My favorite activities come from the AIMS program which integrates math and science. I also use reliable, tried and true internet resources for activities. And have found quite a few to be excellent. Normally, I "tweak" activities to add my own creative flair or to more aptly suit the needs of my students. When in the creative mood, with time on my hands, I even design my own activities! Teachers should always work through an activity first before assigning it to students. This eliminates mistakes, wasted time and provides information with clues used to assist students. Remember also that the activities presented to students should involve application problems in context situations. Furthermore, activities should be relevant to students and stimulate higher level thinking skills.

12. Integrate different cultures into lessons.

Recognize and embrace the fact that English language learners are an important multicultural resource. (Janzen) Acknowledge, celebrate, study and explore differences and similarities as part of the regular curriculum. Accomplishing this will encourage discovery of unique experiences, prior learning and students' strengths. Discuss various approaches to mathematics in different cultures. Use a semantic web on the board to discover what ELL know about a topic. Then connect this prior knowledge to new learning. Integrate different cultures and authentic materials into lessons affirming that diverse experiences and culture are important and relevant. I use menus, brochures, trip packages, catalogs, phone books, newspapers, sale papers, maps, and internet resources to involve my students in activities where they plan vacations, an Italian dinner, a Mexican fiesta, etc.

13. Be considerate of English language learners.

Guide your dialogue with ELL by enunciating words clearly and somewhat slower in a normal, pleasant tone of voice. Pause between sentences giving students time to interpret and respond. Simplify your message, paraphrasing and emphasizing only key ideas using gestures and visual aids to clarify your message. If necessary, repeat your message, simplifying language even more and using shorter sentences. If pronouns are used, enunciate them clearly, however, it is better to use proper names wherever possible. Give ample wait time for students to process information and answer. Speak to ELL student privately and not in front of the entire class if conveying an important or private message. Above all, avoid using slang terms and idioms. (Janzen) Obviously, these would create additional confusion. Can you imagine looking outside to see it "raining cats and dogs"? In addition to modifying speech, it is equally important to be an active listener. This can be accomplished by giving full attention to the English language learner, making a genuine effort to fully comprehend. Give student extra time to speak as pauses may indicate they are searching for the right word to use. Avoid overcorrecting their speech as this may discourage further conversations and participation. Ask questions to show interest in what they are conveying to you.

14. Encourage peer interaction.

Another important instructional strategy is encouraging active learning and verbal interaction among students. (VDOE, 2004) This strategy overlaps in other strategies as well, but I feel it is important enough to restate. Design hands on activities which you have tried yourself and are relevant. Implement activities that encourage verbal interaction among ELL and their classmates. If strengths of students have been identified, assign roles within small group settings that match strengths. Introduce topics which stimulate discussions of real world mathematical experiences.

15. Teach organizational and study skills.

Finally, but perhaps most importantly, teach organizational skills specifically to English language learners. (VDOE, 2004) Open a mathematics textbook and show students how to read pages from top to bottom and left to right. Identify and explain key sections and other resources within the book. Point out examples and illustrations, graphs and tables. If available, give them a copy of the textbook in their native language, in addition to the English textbook. If permissible highlight important key words, phrases and directions in the English text. Demonstrate to students how to organize notebooks and binders. I require individual notebooks per subject. I label each notebook on the front cover with a black permanent marker. I emphasis that only math goes in the notebook labeled math. All notes, quizzes and homework are written in math notebook. Nothing is removed or torn out of the notebook so it is comprehensive. I further teach students to work one page after another, not skipping pages. I additionally require use of an assignment book which is printed specifically for our school. This book is used to record daily assignments and communicate daily between home and school, if necessary. Our school also promotes weekly communication using a yellow folder which is printed specifically for our school. Parents expect students to bring the yellow folder home every single Tuesday. In the folder, parents find weekly grading and behavior reports, test papers, quizzes, projects, and other assignments that have been graded. In addition, flyers and brochures concerning school and community events are placed in the folder. Students return folders every Wednesday. When folders are open, the left side has a pocket for papers to be signed and returned to school the following day. The right side pocket holds papers that may be kept at home. This folder makes it especially easy for parents of ELL students and they know to expect it each and every Tuesday.

Organizational skills also include coaching students on memorizing content, using mnemonic devices, study skills, note taking skills and test taking skills. Teaching students "how" to take notes or even copying notes is an excellent avenue for learning how to write. Assignments and tests should be modified for ELL. Tests should consist of multiple choice questions and matching involving eight or less vocabulary words. If fill in the blank or short answer is provided on the test, a word bank should also be supplied. Instruct students to always place their name on the test first. Encourage them to take a deep breath, relax and do their best. Instruct ELL to carefully read directions (hopefully simplified), and work out all mathematics problems. Look for answer choice. If their answer is not listed as a choice, instruct student to recheck their work. Always choose an answer, even if it is just a guess. Try to eliminate ridiculous answers. Instruct students to double check their work to be sure all questions have been answered before turning in the test.

ESL Specialist Collaboration

This thesis has been designed to assist elementary and perhaps middle school teachers in taking an active role in the education of mainstream students who are learning English as a second language. However, schools that have an ESL specialist on staff are fortunate to possess such a valuable resource. (Kottler, 2002) The ESL specialist can take care of special needs of an ELL while also providing a safe haven and a place for students to retreat. Regular classroom teachers should collaborate with ESL specialists to strengthen the connection between home, academics and the regular classroom setting. The specialist specifically serves as a language teacher, a resource person, and a family liaison contact. (Kottler, 2002) As a language teacher, the specialist introduces and teaches English as a second language to improve skills in listening, speaking, reading and writing in specific subject areas. The specialist can provide valuable resource to the regular teacher by suggesting appropriate adaptations to the classroom or curriculum and acting as an advocate for ELLs in areas of academics, cultural and behavioral situations. (Van de Walle, 2007) The specialist will also provide a welcoming environment for ELL and their families, along with interpreters who will encourage and translate communication among all present. Perhaps most importantly, the specialist will relate cultural and educational practices and expectations for parents, students and school staff. As the ESL specialist and regular classroom teacher begin to work as a team to plan and deliver instruction, comfort levels will improve, expertise and instructional materials will be shared, and both teachers will become learners themselves, each in different areas. Ultimately, the ELL will achieve success in such an effective environment for learning.

Assessment Modifications

According to the National Council for Teachers of Mathematics Assessment Standards, assessment is defined as "the process of gathering evidence about a student's knowledge of, ability to use and disposition toward mathematics and of making inferences from that evidence for a variety of purposes (NCTM, 1994, p.3) In addition, the equity standard calls for high expectations for all students, respecting the unique qualities, experiences and expertise of every student and recognizing individual needs. The purpose of assessment is to monitor student progress, make instructional decisions, evaluate achievement and evaluate program. Student assessment should reflect their knowledge of concepts, procedures, processes involving problem solving, reasoning, and communication, and lastly, disposition which ultimately displays confidence in their mathematical ability. (Van de Walle, 2007)

Too often, teachers assess student performance only by using tests and quizzes. In fact, assessment should occur every day in one form or another. Inevitably, assessment should be a part of daily instruction which should enhance learning and act as a tool for making instructional decisions. Keeping all this in mind, creating assessments for ELLs can be a challenging process especially in specific subject areas. Obviously, formal tests and quizzes alone cannot possibly accurately measure an ELLs proficiency in mathematics. But they are a tool used by state and national educational boards to measure student progress. Therefore, it is necessary to expose ELLs to this type of assessment. However, modifications can help ease the student into testing situations using the following modifications (Haynes):

- simplify language in test by using short sentences and easier vocabulary;
- provide word banks;
- read test orally to student;
- extend the amount of time to complete test;
- allow student to take test in the ESL classroom if one is available;
- reduce the number of questions and answer choices on the test; For example, instead of ten matching vocabulary words, list two sets of five words with two sets of five matching definitions;
- use multiple choice and matching options instead of short answer and essay questions;
- allow breaks. Remember these students are working twice as hard, translating first, then working problems. Their brains get tired;
- allow use of a bilingual dictionary;
- provide manipulatives;
- simplify directions possibly highlighting key words or phrases;
- use peer interpreters; and
- choose only a portion of the test for grading.

The last modification listed above was an option I used with my ELLs during the past year. I discovered through the testing process, that ELLs performed better on different parts of the test according to their level of English proficiency. So, I generated tests using multiple choice, matching, diagrams, fill in the blank and short answer. I graded only the section of the test the student did well on and removed the other sections of the test. This boosted their confidence and provided me with valuable assessment information to generate future tests. Generating sometimes as many as five different tests took additional planning, but it was worth my time and effort. When students received their "tweaked" version of the test, and saw their grade, they broke out into a happy face, thankful for being given a chance to succeed. They also seemed more motivated to work even harder.

Perhaps even more effective than modifying formal tests and quizzes for ELLs is using different forms of assessment. Actually this strategy is probably more effective because assessment becomes a daily part of the instructional process. Alternate forms of assessment are usually less dependent on language, more based on skill and relevant to real life situations. All forms of assessment should recognize student achievement and create goals for continued learning. Following is a list of alternate assessment strategies for ELLs (VDOE, 2004):

- create diagrams, models, graphs, dioramas
- write in math journal which can include drawings and/or reflections of an activity performed in class or a prompt such as…make a list of things you can do in less than one minute. Do not grade spelling, punctuation, grammar, etc.
- complete KWL charts: What I KNOW…What I WANT to learn…What I LEARNED.
- keep portfolios of students work inclusive of individual and group projects, tests, quizzes, diagrams, reflections, KWL charts, etc.
- work with partners on small group projects
- problem solve in cooperative learning groups

- complete observation checklist
- sorting activities, for example, sort numerical sentences by their sum or difference
- self-assessment using a KWL chart, math journal, or self grading
- create rubrics listing components to be measured
- differential scoring involves giving two grades, one on content and skills, the other on English language proficiency
- complete graphic organizers or venn diagrams
- use a problem solving rating scale

1	3	5
I do not understand this problem		I can explain this problem

1	3	5
I do not know where to start		I can solve the problem and explain my solution

- reflection feedback "How did you feel about this activity?" Students should draw a smiley face, frownie face, or neutral face to answer this question. Would you like to do this activity again? Students should answer yes or no and explain the reason for their answer. (VDOE, 2004)

To track an ELL student's progress most accurately involves the use of a variety of assessments, both formal and informal. While less formal assessments may provide more insight to student progress and effective instruction, it is important to note that these students must pass Virginia Standards of Learning and meet requirements of No Child Left Behind which involves formal standardized testing.

CHAPTER 4

ACTIVITIES

Structure of Lesson Plans

All activities have been specifically designed for fifth grade English language learners in the area of probability and statistics. Student objectives, Virginia Standards of Learning (VSOL) and Principles and Standards for the National Council for Teachers of Mathematics (NCTM) are listed for each activity. Targeted key words and materials needed for each activity are also provided. The instructional plan basically corresponds to the Madeleine Hunter Model which I have used with much success throughout many years of teaching. This plan includes anticipatory set, vocabulary emphasis, relevance, modeling, guided practice, independent practice, closure and assessment. At the culmination of each activity is a list of adaptations which were used specifically for English Language Learners within the instructional setting. An estimated amount of time for each activity was purposely omitted due to the fact that different students learn at different rates and in a multicultural setting, this amount of time may vary even more; however, most activities were designed to be completed in two or three class periods.

Take a Survey

Subjects: Mathematics/Statistics

Grade Level: 5 - Specifically adapted for English Language Learners (ELL)

Objectives: Students will

- choose a question to survey a selected group of people;

- collect data from their survey;
- represent data in a frequency table; and
- make conclusions based on data collected.

Correlating Virginia Standards of Learning:

5.18 The student will, given a problem situation, collect, organize, and display a set of numerical data in a variety of forms, using bar graphs, stem-and-leaf plots and line graphs, to draw conclusions and make predictions.

National Council for Teachers of Mathematics (NCTM): Principles and Standards

Data Analysis and Probability Standard

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

  In grades 3-5 all students should-

  - design investigations to address a question and consider how data-collection methods affect the nature of the data set;
  - collect data using observations, surveys, and experiments;
  - represent data using tables and graphs such as line plots, bar graphs and line graphs;
  - recognize the differences in representing categorical and numerical data.
- Develop and evaluate inferences and predictions that are based on data. In grades 3-5 all students should-

- propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.

Materials Needed:

- paper
- pencil
- math notebook
- math journal

Key words:

- survey
- data
- tally
- frequency table

Instructional Plan

Anticipatory Set:

- Ask students to get comfortable on floor around your chair.
- Read Guess Who My Favorite Person Is by Byrd Baylor.
- While reading the story, pause after several pages to give students time to view beautiful illustrations and make comments on their favorites. If ELL students are not making comments after awhile, ask them about a specific favorite of theirs only if they appear comfortable in the setting.

Vocabulary emphasis:

- Group students in pairs, especially mindful to group each ELL student with a good reader of the English language.
- Instruct each student in the pair to locate the key words above in the glossary of their mathematics textbook or in a dictionary.
- Each student should read the word and its definition to the other aloud giving the ELL practice in listening to and speaking English. Encourage the English speaking student to help the English Language Learner pronounce words, repeating them over and over as necessary.

Relevance:

- Ask students, “Why is it important for us to know favorite things of people?” Responses might be as simple as “to get to know a person better,” or may be more thought provoking as “to know what kind of foods to purchase” or “to know how many toys to manufacture.”
- Suppose you are the CEO of a video game series and want to know which game to produce the most of without making too many to sell? Conduct a survey to determine the favorite game? Or perhaps, look at sales charts to determine which has sold the best so far. Which information would be easiest to gather?

Modeling:

- Say to students, “I want to know everyone’s favorite meat to eat.” How could I determine this?” Illicit responses. Some students will suggest naming a meat and students raise their hands if it is their favorite meat to eat. Others might suggest writing their favorite meat on a small piece of paper.

- Ask students to name different meats aloud as you write a list of them on the board. Discuss which meats you might want to combine. For example, do students want to list hamburger and steak as two different meats or combine them as "beef"? What about seafood, white meats, pork or chicken, etc.? Students must decide if they want to list specific meats versus more general meats.
- Draw a tally chart on the board (I am fortunate to have a Smart Board which I use often in place of a traditional chalkboard) listing meat choices that students have agreed upon.
- Instruct students to vote only once for their favorite meat as it is named aloud.
- As students raise their hands indicating their favorite meat, count the number, and add tally marks to the chart beside each meat. Make sure you, as the teacher, vote also as you are part of the class.
- When voting is complete, count the tally marks. The total number should equal the total number of students and teacher in the classroom. If the numbers are not equal, ask students what might have happened. Someone might have voted twice or maybe

someone got so caught up in the activity, they forgot to vote or perhaps someone does not like meat at all which leads to another choice on the tally chart such as no favorite meat or vegetarian. Obviously, this can lead to much discussion on why people are vegetarians? Why do some people choose not to eat meat? Is this a healthy choice? Can certain foods be substituted for meat? All these questions can lead to wonderful extension activities especially when integrating mathematics, science and language arts.

- Tell students there is an even more efficient way to display this information using a table. Draw a frequency table on the board, listing meats and the frequency with which they were chosen. Tell students this is called a frequency table and have them repeat the words. Is there a better way to list meats and their frequency in order? Some students will immediately tell you to list the meats in order of their popularity from greatest to least or least to greatest. Make another frequency table beside the first one you drew on the board. Ask students if the information or data is still the same. They will quickly see that it is, but a frequency table more easily shows the most favorite meat versus the least favorite meat.
- What conclusions can you make about my survey of the class's favorite type of meat? Set a timer for two minutes to give pairs the opportunity to determine conclusions derived from the data.

- When time has expired, ask students to state their conclusions orally as you, the teacher, write them on the board. After each conclusion is written, ask members of the class to determine if it is an accurate conclusion in the form of "thumbs up," yes it is, or "thumbs down," no, it is not a conclusion.

Guided Practice:

- Tell students they now get to conduct their own survey. Ask them how they should begin? Students will work in pairs.
- Pairs discuss different questions they would like to ask when conducting their survey. Choose only one question. Every pair of students should have a different question.
- Decide on a sample group. Avoid wasted time by informing classroom teachers before hand that your students will be conducting a short, one question survey of students and/or teachers. Exclude any teachers who indicate they do not wish to participate. If a pair's question is grade or gender specific, assign them accordingly; otherwise, any grade level may be assigned.
- Ask students to make a prediction about their survey before actually conducting the survey. Write the prediction in math notebook.
- Instruct students to record data in their math notebook using a tally chart and frequency table. Students should also copy the question

they are using for the survey indicating the grade level that was surveyed and the classroom teacher's name.

- Ask students to carefully study the results of their survey. Ask them if their prediction was correct. If not, explain reasons why results were different from the hypothesis.

Independent Practice: (Display list on assignment board or present to ELL as a handout)

- Write three conclusions you can make from the results of your survey.
- Write definitions of each keyword in your math journal.
- In your math journal, describe the steps of conducting a survey.
- Write a short letter to the students in the classroom you surveyed. State the question you asked them, the results of the survey and your conclusions.

Closure:

- Ask students what they learned through this activity. Encourage use of keywords, specifically data, survey, tally marks, and frequency table.
- Ask students, "During which part of the activity today did you learn the most?"
- Ask four different students to place the four new keywords on the classroom's "word wall".

Assessment:

- Check the four independent practice exercises listed above.

- In math journal, instruct students to write "I know how to conduct a survey." Beside the statement, draw a smiley face, straight face, or a frowny face indicating how well you "think" you understand this activity.
- Complete the following rubric to record observations:

	Good	Fair	Poor
Student and a partner discussed a variety of questions before choosing only one to conduct a survey.	5	3	1
Student and a partner conducted a survey using the assigned group.	5	3	1
Student recorded results of the survey and recorded data in the form of a frequency table.	5	3	1
Student made good conclusions based on the results of the survey.	5	3	1
Student worked cooperatively with a partner to complete the survey activity.	5	3	1

Specific adaptations for English Language Learners (ELL):

- Think-Pair-Share
- Think-aloud Pair Problem Solving
- Thumbs up/Thumbs down
- Target vocabulary (four keywords)
- Visuals for Support

  - Word wall
  - Modeling tally marks on board
  - Modeling frequency table on board
- Checklist assessment
- Math journal assessment
- Observation assessment

Computer Graphing

Subjects: Mathematics/Statistics/Technology

Grade Level: 5 - Adapted specifically for English Language Learners (ELL)

Objectives: Students will

- create and print a bar graph on the computer using results of a survey conducted in a previous lesson;
- identify parts of a bar graph including the title, x-axis and y-axis;
- Choose an appropriate incremental numbering system to label the y-axis;
- label categories on the x-axis; and
- read a bar graph making conclusions.

Correlating Virginia Standards of Learning:

5.18 The student will, given a problem situation, collect, organize, and display a set of numerical data in a variety of forms, using bar graphs, stem-and-leaf plots and line graphs, to draw conclusions and make predictions.

National Council for Teachers of Mathematics (NCTM): Principles and Standards

Data Analysis and Probability Standard

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

  In grades 3-5 all students should-

  - represent data using tables and graphs such as line plots, bar graphs and line graphs; and
  - recognize the differences in representing categorical and numerical data.

- Develop and evaluate inferences and predictions that are based on data.

  In grades 3-5 all students should-

  - propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.

Materials Needed:

- results from survey conducted during previous lesson
- computer – one per student or one per student pair
- printer
- math journal

Key words:

- x-axis
- y-axis
- bar graph

Instructional Plan

Anticipatory Set:

- Ask for a volunteer to review the process of conducting a survey;
- Encourage each pair of students to share the survey question they used in the previous lesson, name the class that participated in the survey, and share an important conclusion revealed from the results of the survey.
- Ask students if they can suggest other ways to display data. A student will probably suggest graphing techniques.
- Inform students they will create their own graph in class using results from their survey using a computer and printer. You will witness much excitement from students at this point!

Vocabulary emphasis:

- Group students in pairs, especially mindful to group each ELL student with a good reader of the English language.
- Instruct each student in the pair to locate the key words above in the glossary of their mathematics textbook or in a dictionary.
- Each student should read the word and its definition to the other aloud giving the ELL practice in listening to and speaking English. Encourage the English speaking student to help the English Language Learner pronounce words, repeating them over and over as necessary.

Relevance:

- Ask students where they have seen examples of graphs. They will mention television, magazines, books, newspapers, etc.
- Ask students, "Why do you think graphs are used?" They may suggest that graphs are easier to read and find important information quickly; they are neat in appearance without a lot of words, and conclusions can be gathered easily.

Modeling:

- Select a model of a bar graph from the Smart Board or draw a model on the chalkboard or poster board. The model should include an x-axis, y-axis and bars. At this point, avoid using a title and other labeling.
- Ask students to identify the kind of graph pictured on the screen or board. What else do students notice about the graph? Students will notice the color and number of bars depicted on the graph.
- Say to students, "What information does this model of a bar graph give you?" They will look confused because nothing has been labeled on the graph.
- "What could be added to the graph to give us more information?" Suggestions will include a title, what the bars represent and numbers.
- Add a title to the graph.
- Label the x-axis "Colors" naming each bar a different color.

- Label the y-axis "Number of Votes, and list numbers at regular intervals beginning with zero.
- "Now, can you provide information about this graph? Lots of responses here.
- "Suppose I want to buy a present for each student in my class on their birthday."
- Use a Smart Board and computer to enter "Create a Graph" website. Model creating a graph using new data.
- Ask students, "Which month of the year will be most expensive in terms of buying birthday presents?"
- Choose a pair of students to make a frequency table listing all twelve months. Instruct students to raise their hand when their birthday month is named.
- Once frequency table is complete, use data to create a bar graph.
- Go to the following website http://nces.ed.gov/nceskids/graphing/ or Google search "Create A Graph". Once website is on screen, follow these steps:
    - Select "Start Making Graphs."
    - On the next screen, select "Bar graph."
    - Choose direction of graph. (vertical)
    - Choose shape. (rectangular)
    - For style of graph, choose a background color (no color), grid or bar color (any color), and appearance (2D). It is

important to show students how to experiment with various colors, shapes and dimensions.

    - There are tabs on the right hand side of the screen. Choose Data tab. Enter a title, label both x-axis and y-axis, and list the source used for the survey (ex. Mrs. Neal's homeroom).
    - Enter the number of bars that need to be created under items (twelve bars are needed for twelve months of the year.)
    - Choose one group, then type item labels by naming each month and listing the number (value) of students with birthdays during that month. Minimum value will be the lowest number in the data (zero) and maximum value will be the greatest number from the data (6).
    - Select Labels tab and choose "yes" for showing label. Experiment with different fonts and choose one you prefer.
    - Select Preview tab. If preview of bar graph appears as you like it, select print!

Guided Practice:

- Assign laptops to students or use the computer lab. Students will need data they recorded from previous lesson on surveys.
- Students may choose a partner or work alone to create their bar graph. Even though the teacher modeled the activity, it has many parts.

- English Language Learners (ELL) should be given a handout with all steps listed in order for creating a graph and perhaps even what to select and/or enter.
- As the teacher, you will be available to assist students and provide hints or suggestions while students are creating their graph.

Independent Practice: (Display a list of assignments on chalkboard and/or prepare a handout for English Language Learners.)

- Write a paragraph in your math journal indicating which method you prefer to show results of a survey and tell why you like this method.
- Explain that tomorrow, the class will conduct another short survey together in class and show the results of the survey on a bar graph created by hand. Do you think this will be more difficult or easier than creating a graph using a computer? List at least one reason why you believe this. Instruct ELLs to write the following sentence in their math journals, completing it by the following day:
- Tomorrow, I will create a graph by hand. I think it will be ______________ because__________________________________ ____.
- Complete worksheet: Going to New Heights: Immigration to the United States from *Statistics and Probability*, page 44.
- Extra Credit: Research to find the number of immigrants entering the United States during the last five years. Create a graph either

by hand or using a computer to show the results of your research. Write three conclusions you can make using the new information. Give students at least one week to complete this assignment.

Closure:

- Ask students what they learned today about making a bar graph using the computer. Students should specifically refer to title, labeling x-axis and y-axis.
- Ask three volunteers to place the three new vocabulary words on classroom "word wall."

Assessment:

- Check students' computer generated bar graph. Use the following rubrics type checklist:

Does the bar graph have a title?	Yes	No
Is the x-axis labeled correctly?	Yes	No
Is the y-axis labeled correctly?	Yes	No
Does numbering follow regular intervals?	Yes	No
Is the source of the survey named?	Yes	No
Is there evidence of creativity in choices?	Yes	No
Did the ELL choose to work with a partner?	Yes	No

- Read students' math journal entries to check for understanding.
- Check immigration worksheet from *Statistics and Probability*, page 44.

Specific lesson adaptations for English Language Learners (ELL):

- Think-aloud Pair Problem Solving
- Partnered with a good English speaking student.
- Hands on computer activity with individual assistance from teacher and choice of partner.
- Visuals
- Target three keywords
- Assignments listed on handout.
- Listing of steps and/or instructions for guided practice
- In math journal, begin with a sentence and blanks to complete.

Investigate and Construct Bar Graphs

Subjects: Mathematics/Statistics/Science

Grade Level: 5 - Adapted specifically for English Language Learners (ELL)

Objectives: Students will

- estimate, count and sort M & M® candies by color;
- arrange data using a frequency table;
- use data to construct a bar graph;
- analyze and interpret data from a bar graph; and
- weigh, record and compare weights.

Correlating Virginia Standards of Learning:

5.18 The student will, given a problem situation, collect, organize, and display a set of numerical data in a variety of forms, using bar graphs, stem-and-leaf plots and line graphs, to draw conclusions and make predictions.

National Council for Teachers of Mathematics (NCTM): Principles and Standards

Data Analysis and Probability Standard

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

  In grades 3-5 all students should-

  - design investigations to address a question and consider how data-collection methods affect the nature of the data set;
  - collect data using observations, surveys, and experiements;
  - represent data using tables and graphs such as line plots, bar graphs and line graphs; and
  - recognize the differences in representing categorical and numerical data.

- Select and use appropriate statistical methods to analyze data.

  In grades 3-5 all students should-

  - describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed.

- Develop and evaluate inferences and predictions that are based on data.

  In grades 3-5 all students should-

- propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.

Materials Needed:

- one large bag of M&M® candies
- small bags of M&M® candies (one per student)
- white drawing paper (one per student)
- centimeter graph paper (two sheets per student)
- crayons, markers or colored pencils
- rulers
- balance
- grams

Key words:

- estimate
- balance

Instructional Plan

Anticipatory Set:

Hold up a large bag of M&M® candies and ask students, "What can you tell me about M&M® candies?" Gather a variety of student responses which will include that they taste good, they come in different colors, they melt in your mouth, not in your hand, characters, commercials, etc. Ask students, "How could you use a Bag of M&Ms® to make a bar graph?" Obvious answers will include sorting them by color. “Today, you will construct a bar graph using data from your individual bag of M&Ms® and yes, you may eat them after you have recorded data in a table! Someone remind us what a bar graph must contain in order for information to be gained easily.”

Vocabulary emphasis:

- Group students in pairs, especially mindful to group each ELL student with a good reader of the English language.
- Instruct each student in the pair to locate the key words above in the glossary of their mathematics textbook or in a dictionary.
- Each student should read the word and its definition to the other aloud giving the ELL practice in listening to and speaking English. Encourage the English speaking student to help the English Language Learner correctly pronounce words, repeating them over and over as necessary.

Relevance:

This has been discussed at length during the previous lessons.

Modeling:

The teacher will-

- Hold up a large bag of M&M® candies and estimate the number of candies in the bag aloud to students;
- Ask students to write teacher’s estimate in their math journals and then decide if this is a reasonable estimate. Ask students to discuss

with their partner if the teacher's estimate seems too high or too low and indicate that in their journal giving reasons why.

- Read information listed on bag of candies, including ingredients and weight.
- Use a balance to measure the weight of the candies. Is the weight different from the number indicated on the bag? Why might this be?
- Take a sheet of white drawing paper, writing a title at the top, and drawing an x-axis and a y-axis.
- Pour candies onto white paper, sorting them by colors in a bar formation.
- Identify the colors along the x-axis and label x-axis as colors of M&Ms®.
- Ask a volunteer to use a calculator to calculate the total number of candies in the bag.
- Was the teacher's number close to the actual number of candies? Was students' estimate closer than the teacher's estimate?
- Record data on table.
- Use centimeter graph paper to reconstruct bar graph using crayons, colored pencils, or markers to identify the number of each color of candies.

- Ask students to discuss conclusions with a partner, choosing three groups to share their conclusions writing them on the board beside table and bar graph.

Guided Practice:

- Give each student a small bag of M&Ms®.
- Instruct them to follow the steps as they were modeled. Steps may be listed on board or presented as a handout, especially to ELLs.
- Students may work in pairs to assist each other and discuss results and conclusions, but each should complete activity using their own candies, making their own table and bar graph.
- Record the following information on the attached worksheet:
    - Estimate the number of candies in your bag. Discuss this with your partner.
    - Count the exact number of candies in your bag.
    - Calculate the difference in your estimated total and the actual total number of candies.
    - Read information found on bag including the weight.
    - Use a balance to find the actual weight.
    - Was there a difference in weight? Discuss with your partner why this may have happened.
    - Place title at top of white drawing paper and draw an x-axis and y-axis.
    - Line up candies according to color in a bar formation.

- Record this data in a table.
- Once data is recorded, you may eat the M&Ms®.
- Use centimeter graph paper to create and color a bar graph indicating the number of each color of M&M® in your bag.

Independent Practice:

- Instruct students to copy table of class results for the total of each color of M&Ms® in math notebook. This can easily be accomplished by requiring each student to list the number of each color from their bag on the board. Assign calculators to each student requiring each pair to add a different color. Then all students can calculate the total number of candies for the class.
- Use this data to create a bar graph showing the class total of M&Ms® per color.
- Compare your individual results with total class results. In your math journal, indicate if the results were similar. Also, write three conclusions you can make from the class totals. Name other foods you could use to conduct the same activity (fruit loops, trail mix, etc.).
- Project due in one week: Go to the following website: http://www.mms.com/us/about/history/story/
  Investigate the history of M&M® candies. Construct a time line, listing important dates and events of M&Ms®. Be creative with

your time line adding illustrations and fun facts! Share results and display time lines in hallway.

Closure:

- Ask students to choose a partner to discuss and compare creating a bar graph using the computer and constructing one by hand. One person from each group share similarities and differences of the two methods. Explain which method you prefer to use and why.
- Ask two volunteers to place the two new vocabulary words on classroom "word wall."

Assessment:

- Check students' hand constructed bar graph. Use the following checklist:

Does the bar graph have a title?	Yes	No
Is the x-axis labeled correctly?	Yes	No
Is the y-axis labeled correctly?	Yes	No
Does numbering follow in regular intervals?	Yes	No
Is the source of the survey named?	Yes	No
Is there evidence of creativity?	Yes	No
Did the ELL choose to work with a partner?	Yes	No

- Read students' math journal entries to check for understanding.
- Check worksheet corresponding to M&M® activity.

- In math journal, students should use a self-assessment strategy to indicate their ability to construct a bar graph and make conclusions using a smiley, neutral or frownie face.

Specific lesson adaptations for English Language Learners (ELL):

- Think-aloud Pair Problem Solving
- Option to partner with another student
- Visuals
- Target two keywords
- Assignments listed on handout.
- Listing of steps and/or instructions for guided practice
- Assessment checklist
- Manipulatives (candies, calculator, ruler, cm graph paper)
- Think-Pair-Share
- Numbered Heads Together.

Construct a Circle Graph

Subjects: Mathematics/Statistics/Science

Grade Level: 5 - Adapted specifically for English Language Learners (ELL)

Objectives: Students will

- choose a question to survey a selected group of people;
- collect and organize data from the survey;
- represent data using a circle graph; and

- make conclusions based on data collected.

Correlating Virginia Standards of Learning:

5.18 The student will, given a problem situation, collect, organize, and display a set of numerical data in a variety of forms, using bar graphs, stem-and-leaf plots and line graphs, to draw conclusions and make predictions.

National Council for Teachers of Mathematics (NCTM): Principles and Standards

Data Analysis and Probability Standard

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

  In grades 3-5 all students should-

  - design investigations to address a question and consider how data-collection methods affect the nature of the data set;
  - collect data using observations, surveys, and experiments;
  - represent data using tables and graphs such as line plots, bar graphs and line graphs; and
  - recognize the differences in representing categorical and numerical data.

- Select and use appropriate statistical methods to analyze data.

  In grades 3-5 all students should-

  - describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed.

- Develop and evaluate inferences and predictions that are based on data.

In grades 3-5 all students should-

- o propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.

Materials Needed:

- paper
- pencil
- pre-made circle graph
- crayons
- chalk
- kite string or yarn

Key words:

- circle graph
- survey
- percentages

Instructional Plan

Anticipatory Set:

- Ask students to quietly move their desks against walls and sit in a circle in the middle of the floor.
- When students are seated in a circle, ask them to think about what they ate for breakfast this morning.
- Ask “Why did you eat this for breakfast?” Listen to comments that will probably include “it is easy and fast,” “I can eat them on the

bus," "I ate breakfast at school," "We were out of milk," "My Mom doesn't do breakfast," "We slept late," "My Grandma lives with us and she believes we should have biscuits and gravy every morning…," etc.

- Make a list of the various breakfast items students ate on the board. Assign a color to represent each item: pop tarts-red; biscuits and gravy-tan; eggs-yellow; waffles/pancakes-brown; cereal-white, etc.

Vocabulary emphasis:

- Ask one student to locate circle graph in the glossary and read it aloud to the class.
- Ask students to review what a bar graph is.
- Explain that a circle graph is another type of graph that can be used to display information about different categories just like a bar graph.
- A circle graph is shaped like a circle instead of a rectangle.

Relevance: Often, information gathered from a survey will be presented in various forms including bar graphs, circle graphs, stem and leaf, line graphs, etc. It is important to have the skills necessary to read information from a graph and draw conclusions from it.

Modeling:

- While students are seated in a circle formation, ask one student to stand in the center of the circle holding a long string attached to a piece of chalk.

- While student is holding the looped end of string in the center of the circle, a second student will stretch out the string with chalk end and proceed to "draw" a circle on the carpet.
- Instruct each student to choose one piece of construction paper corresponding to what they ate for breakfast that morning.
- Ask students holding the same color of construction paper to stand together on the chalk drawn circle. Students should be spread out evenly on the circle with approximately the same amount of space between them.
- Hand a string measured to be length of the radius of the circle to each student in the circle who begins a new color indicating a different breakfast food.
- You, the teacher, then take the opposite ends of all strings and stand at the center of the circle.
- You have just made a human circle graph revealing what students ate for breakfast.
- What conclusions can you make from the circle graph? Encourage responses such as more than half of us ate _________ or less than half of us ate ______ or only a few of us ate a hot breakfast, etc.
- Ask student which colors take up the most room in the circle. Which colors take up the least amount of room in the circle. Why do you think this is so? Refer back to the reasons they mentioned

earlier in the lesson about why they ate what they did for breakfast this morning.

- Now, let us change our question for the circle graph. This time, choose a color of paper that indicates what your favorite breakfast food is. In other words, if you had a live-in chef at your house who fixed breakfast for you every morning, what would you order?
- Ask students to form a new circle with those of the same color standing together, again equally spaced apart.
- Again, hand strings the length of the circle radius to students who start a new color indicating a different food.
- You, the teacher, hold the opposite ends of each string at the center of the circle.
- Now ask if the data has changed. Which colors take up the most room in the circle? Which colors take up the least amount of room in the circle?
- What conclusions can students make using the new data?

Guided Practice:

- Tell students they now have the opportunity to make their own circle graph using data from a day in their life.
- On the board, write the following data indicating how you, the teacher spend most Sundays:

  10 hours – sleeping (nighttime and afternoon nap);

  1 hour – personal (shower, make-up, etc.)

2 hours – cooking and eating

2 hours – worshiping in church

5 hours – hiking/bike riding

1 hour – reading

2 hours – watching television

1 hour – chores (dishes, laundry, etc.)

- Ask students what they notice about the total amount of time…they should notice it adds up to twenty four hours.
- Instruct students to write in their math journals indicating how they spend a day in their life. They may choose any one day they prefer. Remind them to include visiting grandparents, shopping, sports activities, homework, movies, video games, etc.
- Once they have listed their activities of a single day, give them a circle graph divided equally into twenty four parts.
- Instruct them to use the circle graph to show data of a day in their life.
- Remember to add a title and use different colors to represent each part of your day.

Independent Practice:

- Tell students you went to see the movie, *Cars*, at the Cinemall in Abingdon. After the movie, tell them you stood outside the theatre and asked one hundred different people to tell you their favorite type of potatoes.

- Write the results of your survey on the board so students can copy it into their math notebook: mashed – 30 people; baked – 50 people; fried – 15 people; and chips – 5 people.
- Give students a circle graph equally divided into one hundred parts. Instruct students to use the "potato data" to construct a circle graph.
- Upon completion of circle graph, students should write three conclusions they can make from the circle graph. Students may use the following prompts to report results:
  - Most of the people surveyed …
  - About half the people surveyed …
  - Almost no one …
  - The number of people who like _____ potatoes is equal to the combined number of people who like _____, _____, and _____ potatoes.

Closure:

- Ask students to review what they learned while making a circle graph.
- During which part of the lesson did you learn the most?
- Ask a volunteer to place the new word, circle graph on the classroom's word wall."

Assessment:

- Check the independent practice exercises using a rubric.

- Read math journal entries and evaluate student understanding of a circle graph.
- Use the following rubric to assess class participation:
- Give a paper/pencil worksheet assessment at the end of this lesson plan.

Specific lesson adaptations for English Language Learners (ELL):

- Think-aloud Pair Problem Solving
- Visuals for support: word wall, human circle graph, and pre-made, equally divided circle graphs
- Cued prompt response beginnings for journal entries
- Target one keyword
- Authentic information used for graphing
- Specifically designed rubrics
- Activities presented on handout sheets listing steps for guided and independent practice
- Manipulatives: pre-made equally divided circles, string, people
- Numbered Heads Together.

Stem and Leaf Displays

Subjects: Mathematics/Statistics

Grade Level: 5 - Specifically adapted for English Language Learners (ELL)

Objectives: Students will

- collect authentic data through active participation
- create a stem and leaf plot using authentic data
- make conclusions based on results of activity
- conduct an experiment to collect relevant data
- create a stem and leaf plot using relevant data
- use wireless laptops to create and print a stem and leaf plot

Correlating Virginia Standards of Learning:

5.18 The student will, given a problem situation, collect, organize, and display a set of numerical data in a variety of forms, using bar graphs, stem-and-leaf plots and line graphs, to draw conclusions and make predictions.

National Council for Teachers of Mathematics (NCTM): Principles and Standards

Data Analysis and Probability Standard

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

  In grades 3-5 all students should-

  - design investigations to address a question and consider how data-collection methods affect the nature of the data set;
  - collect data using observations, surveys, and experiments;
  - represent data using tables and graphs such as line plots, bar graphs and line graphs;
  - recognize the differences in representing categorical and numerical data.

- Develop and evaluate inferences and predictions that are based on data. In grades 3-5 all students should-
    - propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.

Materials Needed:

- sticky notepads-two different colors to represent ones place (leaves) and tens place (stems)
- T-chart with stem and leaf appropriately labeled
- stop watch
- pennies-one per student
- eyedroppers-one per student
- small cup of water-one per student
- index card labeled "estimate" and "actual"
- highlighters (enough for students to share)
- poster board cut into fourths with one-fourth for each student

Key word:

- stem and leaf plot

Instructional Plan

Anticipatory Set:

- Read <u>The Math Curse</u> by Jon Scieszka.
- Ask students to share ways math has popped into their lives just this morning. They will probably mention things like bus

numbers, lunch money, etc. Encourage them to search their minds a little deeper for responses such as the number of miles to school, the number of lucky charms they ate for breakfast, the time they woke up, etc.

- Explain that today they will conduct an experiment and participate in an activity in which math is used yet a different way. Today's lesson involves placing numbers in a different kind of graph called a stem and leaf plot.

Vocabulary emphasis:

- Ask a good reader of the English language to locate stem and leaf plot in the glossary of their math book and read it aloud to the class.
- Ask for volunteers to review what they already know about surveys, bar graphs and circle graphs.
- Explain that bar and circle graphs are typically used to compare data in categories while a stem and leaf plot is used to organize numerical data in order from least to greatest.
- A stem and leaf plot is another way that data may be organized and displayed allowing every number to be listed in a nice visual display of data.

Relevance:

- Stem and leaf plots offer yet another way to organize data quickly. Businesses are dependent on statistics for growth. Newspapers, magazines, reports and reviews use various graphing techniques as an easy and effective way to present and analyze data.

Modeling:

- Place students in groups of two and give each student two different colored sheets of sticky notes, one yellow the other green.
- Explain they each will be timed for one minute to determine the number of sit-ups they can do in one minute. Each person in the pair will hold their partner's feet and count the number of sit-ups they do in one minute.
- Instruct students to record their number of sit-ups using a dark colored crayon, writing the digit in the ones place on the green sticky note and the digit in the tens place on the yellow sticky note. Write numbers as large as the note so it can be easily read when displayed on the board.
- Time one student from each pair performing sit-ups for one minute while their partner is holding their feet and counting the number of sit-ups.
- Instruct students to switch places so that the second student may also be timed while doing sit-ups.
- Record the number of sit-ups you did on the sticky notes being careful to place the ones digit on the green sticky note and the tens digit on the yellow one. For example, if you performed 52 sit-ups

in one minute, place the 2 digit on the green sticky note and the 5 digit on the yellow sticky note.

- Draw a "T-chart" on the board labeling the left side "stem" and the right side "leaf". Tell students the leaf stands for the value of the digit located in the ones place while the stem stands for the value of the digit located in the tens place. Hence the data is represented in two parts.
- Relate this mathematical information to a real live tree. Draw a tree with limbs showing one limb or stem of a tree can hold many leaves.
- Ask students in each pair to place their numbers on the T chart, overlapping stems, but not leaves. The teacher should stand at the board to assist students saying the number of sit-ups out loud as she places the stem and then the leaf on the T-chart.
- Once all numbers have been placed on the T-chart, ask students to look for ways to make the chart even easier to read the results. The numbers for the ones place (leaves) will probably be out of order as well might the stems. Students will probably suggest placing the stems in order from least to greatest and the leaves in order from least to greatest.
- Ask students to form conclusions related to the numbers on the stem and leaf plot. They will probably suggest that the least number of sit-ups performed in one minute was ___, while the

greatest number of sit-ups was ____. Someone else may offer that no one did less than ___ sit-ups or more than ___ sit-ups. Encourage students to look for the number of sit-ups most students performed.

Guided Practice:

- Inform students they are going to do an experiment and use the classroom results to construct a stem and leaf plot.
- Coach students through the following steps:
  - ➢ Move your desk so that it is not touching another desk.
  - ➢ Gather and place the following materials on your desk-one index card, two different colored sticky notes, one paper towel, a penny, an eye dropper and a cup of water. (These materials should be located conveniently in one area of the classroom providing easy access for students. Ask students 4 or 5 at a time to gather the needed materials on a tray.)
  - ➢ Examine the eyedropper and penny and think about the size of one drop of water. Estimate how many drops of water you think will fit on the head of the penny and write your estimate on the side of the index card labeled "estimated drops of water".
  - ➢ Place penny head side up on paper towel with cup of water placed beside the paper towel to eliminate unnecessary movement of the penny.

- Fill eyedropper with water from the cup.
- Carefully and slowly add drops of water to the head of the penny, counting each drop as it falls onto the penny. Continue the process until the water overflows onto the paper towel.
- Record the actual number of drops of water that fit on the head of the penny on the side of the index card labeled "actual number of drops".
- Compare your estimate with the actual number of drops of water that fit on the head of the penny.
- Record the actual number of drops on two sticky notes, green indicating units or leaves and yellow indicating tens or stems.
- Place sticky notes on class stem and leaf plot located on the chalkboard.

- Once class stem and leaf plot is complete, ask students if the stems and leaves appear to be in the correct order. Ask students to make any changes necessary so that stems and leaves are in order from least to greatest.
- Ask students to carefully examine the stem and leaf plot and answer the following questions aloud during class discussion.
    - What was the least number of drops of water that fit on the head of a penny? What was the greatest number of drops of water?

- Was there the same number of drops reported by more than one student? If so, name that number.
- Are the pennies exactly the same size? Are the eyedroppers exactly the same size and shape?
- Why do you think the number of drops of water varied from person to person? Illicit responses from students that include different sized eyedroppers, the angle water was dropped onto the penny, size of drops, patience, steady hands, the distance eyedropper was held from penny, distractions, etc.
- Ask students if they could produce an experiment similar to this one that might create a different set of results. Encourage student responses which might include variables such as different coins, different sized eyedroppers, different liquids (coke, oil, milk, etc).This would be a wonderful extra credit assignment!

Independent Practice:

- Give each student a wireless laptop computer.
- Type weather.com into the URL address box.
- Choose one of the following locations: Denver, CO, Madison, WS, Portland, ME, San Francisco, CA, Seattle, WA or Washington, DC.
- Type the name of your chosen location into the “Local Weather” box and click on “go”.

- When your location comes up on the computer screen, click on its name.
- Click on "month" located at the top of the screen.
- Choose the previous month so all days of the month will appear.
- Print the location's previous monthly temperatures.
- Collect printed copy.
- Use a highlighter to indicate each days' high temperature.
- Use poster board to make a stem and leaf plot of your location's high temperature for the month of ___. Make a title for the plot such as "High Temperatures in Denver during September".

Closure:

- Ask volunteers to review what they have learned about a stem and leaf plot.
- Encourage specific vocabulary such as stem and leaf, t-chart, stems, leaves, order and least to greatest.
- Ask students how this type of graph differs from bar and circle graphs. Make sure they understand that bar and circle graphs compare data while stem and leaf plots arrange data in numerical order.

Assessment:

- Ask each student to share their individually created stem and leaf plot with the class. They should tell which city they chose, why this city was chosen, the least highest temperature, the greatest highest temperature, and the temperature that was recorded the greatest number of times along with any other interesting information.

- Instruct students to write about making a stem and leaf plot in their math journals. List any problems you had making it. Write three conclusions you can make from your stem and leaf plot.
- Study the following stem and leaf plot and answer the following questions.

Math Test Grades

Stem	Leaves
6	4
7	1 3 8 9
8	1 1 3 3 3 5 5 6 8
9	3 5 7 7 9
10	0

How many grades are recorded in the stem and leaf plot?

What is the lowest grade?

What is the highest grade?

Did one grade appear more times than the others? If so, list this number.

How many students scored 97?

How many students scored 88?

How many students scored 96?

What conclusions can you make about the math test grades from this class? (Hopefully, they will notice that most grades were above 80 which is good and only one person failed the test.)

- Specifically designed rubric for penny experiment.
- Specifically designed rubric for independent activity.

Specific adaptations for English Language Learners (ELL):

- Authentic, relevant results and numbers for making stem and leaf plots
- Hands on experimentation
- Fun activities which allow interaction and informal conversation among students
- Target one key vocabulary word
- Technology support for relevance
- Visuals for support including word wall, modeling stem and leaf plot on board and computer printouts
- Cued prompts for journal entries
- Materials provided and centrally located for experiment, guided and independent practice
- Specifically designed rubrics
- Manipulatives
- Cooperative pairings
- Informal assessments – math journal and observation
- Prepared handout listing steps for independent practice

- Specifically designed lesson plans
- Non-threatening environment

Stem and Leaf Technology

Subjects: Mathematics/Statistics

Grade Level: 5 - Specifically adapted for English Language Learners (ELL)

Objectives: Students will

- collect authentic data through active participation
- measure their height to the nearest centimeter
- use wireless laptops and networked printer to create stem and leaf plot of class results

Correlating Virginia Standards of Learning:

5.18 The student will, given a problem situation, collect, organize, and display a set of numerical data in a variety of forms, using bar graphs, stem-and-leaf plots and line graphs, to draw conclusions and make predictions.

National Council for Teachers of Mathematics (NCTM): Principles and Standards

Data Analysis and Probability Standard

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

  In grades 3-5 all students should-

    - design investigations to address a question and consider how data-collection methods affect the nature of the data set;
    - collect data using observations, surveys, and experiments;
    - represent data using tables and graphs such as line plots, bar graphs and line graphs;
    - recognize the differences in representing categorical and numerical data.
- Develop and evaluate inferences and predictions that are based on data.

  In grades 3-5 all students should-
    - propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.

Materials Needed:

- meter sticks
- wooden or sturdy standard ruler-units not important
- wireless laptops
- networked printer
- Smart Board

Key word:

- stem and leaf plot

Instructional Plan

Anticipatory Set:

- "Who knows how tall they are to the nearest centimeter? One centimeter is about the width across your pinky fingernail. Estimate how many centimeters tall you think you are and record this number in your math journal. You will use this record to compare your estimate with your actual height."
- "What can we do to find our actual height to the nearest centimeter?" Listen and accept all suggestions finally leading students to the idea of taping a meter stick to the wall.
- "Will one meter stick be tall enough?"
- Ask student volunteers to tape two meter sticks to the wall, one on top of the other for a total height of 200 centimeters.

Vocabulary emphasis:

New vocabulary will not be emphasized in this lesson; however, mean, mode, median and range will be introduced as new vocabulary as a lead in to tomorrow's lesson specifically targeting these words.

Modeling:

- After deciding to tape meter sticks to the wall, ask a student to volunteer to do this. Discuss placing 0 centimeters at the floor of the wall, taping the meter stick at the bottom and top.
- Of course, we will need two meter sticks since none of us is shorter than 100 centimeters. Ask students how many centimeters are in two meters. "Is anyone taller than two meters?"

- Ask a second student to tape the second meter stick immediately above the first, beginning with 0 centimeters, taping at 0 and at the top.
- Instruct students to remove their shoes (you should do this also) and demonstrate how to stand straight in front of the meter sticks.
- Ask a student to place a standard ruler flat on top of your head. Step out from under the ruler while student continues to hold ruler on the exact point of your height.
- Read your height to the nearest centimeter aloud and record it on the chalkboard.
- Continue this process until all students have recorded their height on the chalkboard.
- Once all heights are recorded on the board, ask students to sit on floor in front of Smart Board.
- Go to Shodor.org choose student enrichment, search by subject matter mathematics. Choose mathematics, then math connections and finally resources. Scroll down page until you find stem and leaf and click on this link. Explain to students they will be entering all heights into the data box during guided practice
- But, for now, "I will enter yesterday's math quiz grades into the data box: 92, 88, 72, 96, 100, 85, 92, 88, 92, 100, 96, 92, 84, 80, 92, 68, 92, 88, 76, 100".
- Once all grades have been entered choose update and "presto" the stem and leaf plot is complete. Students will probably make comments about

how much quicker the computer can place these numbers in order than they can by hand.

- Students may also notice calculations of mean, mode and median. If you click on “answers,” the computer will give the values of these.
- Ask students if they can determine what any of these words represent. They might notice that mode equals 92 and that is the grade that was listed the greatest number of times. Mean and median will not be as obvious. Explain to students they will learn more about these vocabulary words during tomorrow’s mathematics lesson.

Guided Practice

- Give students a handout of the steps they should follow to make their own stem and leaf plot of students’ heights.
- Distribute wireless laptops and ask students to begin.
- Make yourself available to assist students if they become confused or cannot follow the steps on the handout. Students sitting close to each other are also encouraged to assist each other.
- Students’ heights should remain in a list on the board for students to enter as data for a stem and leaf plot. Tell students to enter each person’s height in the data box as they observed me doing with quiz grades earlier during the modeling process. They should type the number, followed by a comma, then the next number, followed by a comma, etc. with no spaces.
- Each student should print a copy of their stem and leaf plot.

Independent Practice:

- Instruct students to use the printed version of their stem and leaf plot to answer the following questions:

  1. What was the shortest or least height recorded in the classroom? _____

  2. What was the tallest or greatest height in the classroom?_____

  3. Was one height recorded more than any other? If so, what was that height? _______________

  Complete the following sentences:

  4. Most of the students in my class are between _____ centimeters and _____ centimeters tall.

  5. No one in my class is shorter than _____ centimeters.

  6. No one in my class is taller than _____ centimeters.

  7. My height to the nearest centimeter measures _____. My height is actually (greater or less) than what I estimated my height to be.

  8. If all students could balance by standing on each others' heads, one on top of the other, like a ladder reaching into the clouds, together, we would be __________ centimeters tall. (Students may use a calculator.)

  9. If our total measured height was changed from centimeters to meters, our class height would be about _______ meters.

  10. In your opinion, do you think it is better to create a stem and leaf plot by hand or using a computer? Explain the reason for your

answer.

____

____

____

Closure:

- Ask students to give advantages of making a stem and leaf plot using a computer.
- Ask students if there are advantages of making a stem and leaf plot by hand.
- Ask students if there are disadvantages of making a stem and leaf plot using a computer.
- Ask students if there are disadvantages of making a stem and leaf plot by hand.

You might be surprised by their advantages and disadvantages of each method of making a stem and leaf plot. Students who are nervous using computers create a high level of stress for themselves. They are often fearful of entering an enormous amount of information only to choose the wrong command, loosing all information. Hence, they must re-enter all their data. Some students have limited keyboarding skills which makes entering data a nightmare. On the other hand, doing anything by hand generally takes longer and neatness is often a factor.

Assessment:

- In your math journal, describe what a stem and leaf plot is. Also make a list of the graphs you have learned to construct so far during mathematics or science class.
- Beside your list of graphs, draw a smiley, frownie or neutral face representing how well you can make each of these graphs.
- Check the ten questions from independent practice for understanding.
- Collect printed copies of computer generated stem and leaf plots.
- Specifically designed rubrics for technology activity.

Specific adaptations for English Language Learners (ELL):

- Authentic, relevant results and numbers for making stem and leaf plots
- Hands on experimentation
- Specifically designed rubrics
- Manipulatives
- Cooperative pairings
- Informal assessment – math journal and observation
- Handout listing steps for independent practice
- Specifically designed lesson plans
- Non-threatening environment
- Visuals on chalkboard
- Modeling on Smart Board

Walk the Line

Subjects: Mathematics/Statistics

Grade Level: 5 - Specifically adapted for English Language Learners (ELL)

Objectives: Students will

- physically participate in an interactive demonstration of making a line graph
- identify increases and decreases in results revealed in a line graph.
- compare and contrast line graphs with bar graphs, circle graphs and stem and leaf plots.
- use wireless laptops and networked printer to create a line graph

Correlating Virginia Standards of Learning:

5.18 The student will, given a problem situation, collect, organize, and display a set of numerical data in a variety of forms, using bar graphs, stem-and-leaf plots and line graphs, to draw conclusions and make predictions.

National Council for Teachers of Mathematics (NCTM): Principles and Standards

Data Analysis and Probability Standard

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

  In grades 3-5 all students should-

  - design investigations to address a question and consider how data-collection methods affect the nature of the data set;

    - collect data using observations, surveys, and experiments;
    - represent data using tables and graphs such as line plots, bar graphs and line graphs;
    - recognize the differences in representing categorical and numerical data.
- Develop and evaluate inferences and predictions that are based on data. In grades 3-5 all students should-
    - propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.

Materials needed:

- shower curtain-one with horizontal and vertical lines forming a grid works best
- ruler
- dry erase marker
- wireless laptop computers-one per student
- networked printer
- centimeter graph paper-one or two sheets per student
- colored pencils
- self adhesive dots
- highlighter

Key word:

- line graph

Instructional Plan

Anticipatory Set:

- Hold up a thermometer (the larger the better). Ask students what it is and for what purpose it is used. Encourage all comments which may include weather, body temperature, water temperature for bathing, safe temperatures for cooked meat, room temperature, etc.
- Students may also mention Celsius and Fahrenheit scales on the thermometer. Explain that just as a ruler has two scales, so does a thermometer. Celsius uses metric units while Fahrenheit is the customary or standard unit of measure.
- "Today, you are going to research a city's low temperatures for the past month and make a line graph showing low temperatures for each day of the month. This type of graph is another way to present data in addition to the graphs you have learned about before today."
- Review bar graphs, circle graphs, and stem and leaf plots. Explain that bar graphs and circle graphs compare different categories while a stem and leaf plot shows numerical data. A line graph also shows numerical data, but the data is collected over a period of time. Time periods may be expressed in hours, days, weeks, months, or even years.

Vocabulary emphasis:

- Group students in pairs making sure to group each English Language Learner with a good reader and speaker of the English language.
- Write the different types of graphs on the board in the following order: bar graph, circle graph, stem and leaf plot, and line graph.
- Instruct students to locate each type of graph in the glossary of their mathematics book and read each definition aloud to each other.
- After reading aloud all definitions, instruct each student to write the definition of a line graph in their math journal.

Relevance:

Ask students why weather is so important to us. They will no doubt give reasons such as the type of clothes to wear, type of shoes to wear, when to plan a vacation, when to do yard work, and participate in extra-curricular activities, etc. Explain to students that information revealed in a line graph can also show patterns in the weather in a particular place during a specific period of time.

Modeling:

- Ask a couple of students to help you tape a grid type shower curtain to the floor. If you cannot find one at a reasonable price, purchase an inexpensive clear or white liner and draw permanent vertical and horizontal lines forming a grid.
- Give each student a table indicating the number of students who were absent during the past two weeks from the entire school population. Tell students they will help you place this information on the shower curtain in the form of a line graph.

- Ask students to think of a good title for the graph using the data they have. Listen to all suggestions and choose one to write at the top of the shower curtain. Use a dry erase marker so the shower curtain can be used over and again.
- Next, explain that similar to a bar graph, the x axis and y axis must be labeled. Label the x axis as days. Ask students how many days should be listed on the x axis. Ask them why there are not fourteen days.
- Label each vertical line as a different day such as Sept. 12, Sept. 13, or 9/12, 9/13, etc. Tell students to notice that the line itself is labeled not the space between the lines.
- Ask students what they think the y axis should be labeled. After consensus, write number of absences as the label for the y axis.
- Instruct students to carefully study the number of absences during the past two weeks. Ask what is the greatest number of absences? The scale for the y axis must begin at 0 for the minimum value and the maximum value should be a little above the greatest number displayed within the data. So if the greatest number of absences is 30, then the scale should extend to 32 or a number at the appropriate interval.
- Ask students to count the number of horizontal lines and decide on an appropriate interval. When a student suggests the best interval by 2s, 3s, 4s, or 5s, proceed to label each line horizontally.
- Give ten different students a self-adhesive dot. Explain they will place their dot at the appropriate place on the grid while the rest help. For

example, student number one must place a point on the grid showing 20 absences on September 12th.

- Instruct student to walk first to the day, then up the horizontal line until they reach the number on the graph indicating the number of absences on that day. They should place their self-adhesive dot on the exact point of location. If the number does not fall precisely on a line, decide on an estimated location for the point which is dependent on the interval.
- Continue this process until all absences for the ten days have been located and a point has been placed on the grid for each day and the number of absences for that particular day.
- Ask for nine more students to volunteer to connect the points.
- After the first two points have been placed on the grid, instruct a different student to use a ruler and dry erase marker to draw a line connecting these two points.
- Continue this process until a line connects each point to the next point.
- Begin asking questions mid way through the interactive demonstration such as, "What do you notice about the number of absences from Monday to Tuesday?" "Were there more or less absences on Tuesday?" "In what direction does the line go from Monday to Tuesday?" Explain that as the line goes up, the number of absences increase and as the line goes down, the number of absences decrease. "What happens if the line stays straight?" Ask a student to walk the line encouraging others to indicate if

the number of absences are increasing, decreasing or remaining the same from day to day.

- Discuss reasons why there might be an increase or decrease in absences from day to day.
- When line graph is complete, ask students to stand back and observe their masterpiece.
- Ask the following questions:

  On which day(s) was the greatest number of students absent?

  On which day(s) was the least number of students absent?

  On which day(s) was the same amount of students absent?

  Did the number of absences increase or decrease from day 6 to day 7?

  Day 9 to day 10?

  Between which two days did the number of absences increase the most?

  Ask a student to walk this portion of the line.

  Between which two days did the number of absences decrease the most?

  Ask a student to walk this portion of the line.
- Take the line graph from the floor and hang it on the wall for students to view and use as a guide to complete their own line graph.

Guided Practice

- Give each student a wireless laptop.
- Instruct students to type weather.com into the URL address box.
- In the choose location box, type Boston MA. Pull down a wall map and ask a student to locate this place on the map. Discuss where it is in

relation to our town of Abingdon, VA. Ask if anyone has visited Boston or has relatives who live there. Can anyone predict if the temperatures in Boston for the month of September will be about the same or much different from our temperatures in Abingdon.

- Once the city's local weather has loaded, instruct students to choose "month". Choose the previous month so all days will have accurate temperatures and not just predictions.
- When the monthly forecast is present on the screen, ask students what they observe. The should indicate high and low temperatures, dates, scale in degrees Fahrenheit, amount of precipitation, indoor cooling and heating, etc.
- Instruct students to print a copy of this data, then shut down their laptop.
- Highlight the low temperatures for each day of the month. This is the data students will present on their line graph.
- Provide students with a list of steps to assist them with construction of the line graph for the "Daily Low Temperatures in Boston during September".
- Give students a handout listing the following steps of making their line graph:
    - Turn graph paper so that the x-axis has the longest side in order to accommodate thirty or thirty-one days.
    - Write a title at the top of the graph.
    - Label the x-axis.
    - Label the y-axis.

- Look at the greatest low temperature for Boston during the month. Be sure to extend the graph a few degrees above this temperature.
- Choose an appropriate interval. Begin at zero and number each line using the interval you have chosen.
- Use a colored pencil to place points on the grid indicating the low temperature for each day. Use the colored pencil to connect each point to the next consecutively. One or two colors may be used, but discourage multiple colors as graph will look too busy and may be difficult to read.
- Turn in the line graph when it is complete.

Independent Practice:

- Hand back line graphs to students noting any corrections that need to be made.
- Give each student a worksheet with questions to answer using their line graph as a resource. (Have a few good copies of correctly constructed line graphs available for students to use if their individual graph has multiple mistakes or is difficult to read.)
- Explain how to make a line graph by listing the steps in your math journal. Complete this sentence in your math journal: The hardest part of making a line graph is ______________________________ and the easiest part is ____________________________________.
- In your math journal, list two differences and two similarities between a bar graph and a line graph.

- In your math journal, list two differences between a circle graph and a line graph.
- In your math journal, list two differences between a stem and leaf plot and a line graph.
- Complete this sentence in your math journal: I like to make _______________ (choose a form of graph) because________________.
- Using the line graph of low temperatures in Boston during September, add a second line indicating the high temperatures in Boston during the same month. Use a different color to locate points of high temperatures. Use your printed copy of data to get the high temperatures and follow the same steps you used to construct the first line graph.

Closure:

- Ask a student to volunteer to review the steps of constructing a line graph.
- "In what circumstances would making a line graph be more effective than another type of graph?" (Changes over a period of time)
- Ask a volunteer to place line graph on the classroom "word wall".

Assessment:

- Check each student's individually hand constructed line graph using a specifically designed rubric:
- Read all journal entries to check for understanding of constructing a line graph.
- Check worksheet with questions on line graphing activity.

- In their math journal, instruct students to use a smiley, frownie or neutral face to indicate their ability to construct a line graph and make conclusions about the data.

Specific adaptations for English Language Learners (ELL):

- Highly visual and interactive modeling activity
- Technology visuals
- Target only one keyword
- Step by step instructions-oral and written
- Self-assessment
- Manipulatives
- Specifically designed lesson plans
- Non-threatening environment

Summarizing Data

Subjects: Mathematics/Statistics

Grade Level: 5 - Specifically adapted for English Language Learners (ELL)

Objectives: Students will

- calculate the mean or average of a set of data.
- identify the median of a set of data.
- identify the mode of a set of data.
- calculate the range of a set of data.

Correlating Virginia Standards of Learning:

5.19 The student will find the mean, median, mode, and range of a set of data.

National Council for Teachers of Mathematics (NCTM): Principles and Standards

Data Analysis and Probability Standard

- Select and use appropriate statistical methods to analyze data.

  In grades 3-5 all students should-

  - Describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed;
  - Use measures of center, focusing on the median, and understand what each does and does not indicate about the data set; and
  - Compare different representations of the same data and evaluate how well each representation shows important aspects of the data.

Materials needed:

- Smart Board
- construction paper
- scissors
- ruler
- poster board
- pre-made labels indicating mean, median, mode and range
- scales
- calculators-one per student

Key words:

- mean (average
- mode
- median
- range

Instructional Plan

Anticipatory Set:

- Load brainpop.com on Smart Board. Choose math and click on mean, mode, median and range.
- Play video for an entertaining introduction for the meanings of these terms of central tendency.

Vocabulary emphasis:

- Assign English Language Learners to a partner who has good reading and speaking skills of the English language.
- Locate the following vocabulary words in the glossary of mathematics textbook: mean, mode, median, range.
- Read the definition for each word aloud to each other.
- Copy the definition of each word in math journal.
- Note the following vocabulary tips: mode = number listed the most times. Notice that **mode** and **most** have four letters each and they both begin with the letters "mo"; median = the number in the middle after numbers have been arranged in order. Notice that **median** and **middle** have six

letters each. Also discuss the median of an interstate being in the middle of two opposite traffic patterns.

Relevance:

- Explain to students that statistics are used every day in our lives and affect the decisions we make even when we are not aware of it. For example, some children buy a certain type of shoe regardless of price because every other child has it. Perhaps children become involved in a certain sport because all their friends joined. Perhaps you are a baseball player not because your friends are but because you are a good pitcher and rarely strike out when at bat so you are a valuable member of the team.
- Believe it or not, statistics play a huge role in your decisions. We interpret statistics to figure out what the numbers are telling us which therefore lead us to certain choices and decisions.
- When you are looking for the most popular shoe, you would essentially be searching for the mode or the one shoe that stores sell the most. This statistic would probably indicate the most popular shoe.
- If you are a punter on the football team, your coach is probably more interested in the average or mean of your punts.
- In school, when your grades are averaged to reflect a six weeks grade on the report card, average is important if the honor roll is your goal. But the median or middle grade of the class may be as important to you. For example, if there are nineteen students in your class and the median grade is 85 and your grade is a 96, that means you are in the top half of the class.

Whereas, if your grade is an 80, you are in the bottom half of the class. Hence if your grade is exactly 85, you are smack dab, squeezed in the middle of grades of all students with exactly half scoring above you and exactly half scoring below you.

- Mean, mode, and median are calculated differently. Which one you choose to use depends on different situations.

Modeling:

- Ask seven students to volunteer to step on scales to measure their weight. (Be sensitive to those who may be overweight or underweight.)
- As each student steps on the scales to be weighed, read their weight aloud to the class.
- Record each students' weight on construction paper.
- Give each student their weight on construction paper and ask them to hold it in front of their chest.
- Ask students what would be the best order for these seven students to present themselves. They will probably suggest least to greatest.
- "Now that our weights are in order from least to greatest, we can easily find the median, mode and range of these seven weights."
- Write mean, median, mode and range across the top of the chalk board.
- "Look in your math journal and read the definition for mode. Do you see the same weight listed more than once?" If not, this set of weights does not have a mode since each weight is listed only once. If one weight is

listed more than once, write that weight under the word mode on the chalkboard.

- "Now read your definition for median. Is there a number exactly in the middle of the list?" Have three students on each side of the median sit down while the median continues to stand. Notice there are three weights less than the median and three weights greater than the median.
- "Read your definition for mean. Another word for mean is average. Clear your calculator. Add each number in the list of weights to find the sum total. Then divide the total by seven because that is the number of students who recorded their weights. The quotient when the sum is divided by seven is the mean or average. In other words, if we could add a little weight to the students who weigh less than the average and take away a little weight from the students who weigh more than the average, then all students would weight exactly the same."
- "Practice by finding the mean of this set of weights: The five members of my family weigh 203 lbs., 132 lbs., 190 lbs., 145 lbs., and 190 lbs. To find the mean or average of the weights in my family, first add all five numbers (wait while students do this step) and then divide the sum by five because there are five weights listed. The quotient is the mean or average weight. The mean of these weights is 172 lbs. My mother and I weigh less than the average weight while my Father and two brothers weigh more than the average of our weights. In other words, if my mother and I

put on a few pounds (we really do not want to do this) and my father and two brothers lost a few pounds, we would all weigh 172 lbs."

- Instruct students to calculate the range of my family's weights by subtracting the least amount from the greatest amount for a range of 71 lbs. This means that there is 71 lbs. difference in the greatest weight and the least weight.
- Label five sheets of construction paper with my family's weights. Ask five volunteers to hold these weights in front of their chest. If students are not in order, ask them to get in order from least to greatest. Identify the mode and the median asking students to review what each of these words means first, then naming the weight that matches each word.

Guided Practice

- Give each student a strip of construction paper that measures 2 inches by 18 inches.
- Instruct students to measure the length of their foot using the strip of construction paper and a ruler following these steps:
    - ➢ Take your right shoe off. Place your right foot on the strip of construction paper. Be sure your heel is at the end of the strip. Use a pencil to mark where your big toe ends. Cut of any excess paper.
    - ➢ Use a ruler to measure the length of the strip of paper to the nearest inch. This is the length of your foot to the nearest inch. Write the

number of inches of your foot on the strip of construction paper using a dark colored crayon.

- Ask students to place their construction paper strips indicating the length of their feet end to end in order from least to greatest on the floor.
- Encourage students to make observations at this point. You might hear comments such as "The length of our feet barely fit along the length of our classroom…My foot is the smallest one…My foot is the longest one…I wonder how many of our feet it would take to go around the gym, etc."
- Write mean, mode, median and range across the top of the chalk board. Ask students to write these words in their math notebook, each one on a different line.
- "Again, read definition of median and look at labeled strips of construction paper on the floor. Write the number you believe to be the median."
- Follow the same procedure for finding mode and range.
- "Use your calculator to find the mean or average of the length of our feet. Carefully read the definition, then compute the mean and write this value in your notebook." There will probably be 18 – 22 numbers to add. You, as the teacher, may wish to write the numbers on the board to speed up the calculation process.
- Once all students have determined the mean, mode, median and range of the lengths of their right feet, ask for volunteers to write the answers on the board under each word.

- "Do these numbers make sense? Are they reasonable?"
- Involve students in discussion and answering questions:

  Look at the mode. How many students have feet the same length?

  Look at the mean of the set of numbers. How many feet sizes are shorter than the mean? How many are longer than the mean? Look at the median of the set of numbers. It is smack dab, squeezed in the middle of all the numbers. Look at the range of numbers from the shortest to the longest. Why do you think there is such a difference in the size of our feet?

Independent Practice:

- Create a worksheet such as the one here which gives authentic, relevant information and ask students to calculate the mean, mode, median, and range.
  - Tess and Tyler have a printed copy of their grades in math for the past two weeks. They were surprised to find they have the same mean or average because their grades were not exactly the same. Use the grades listed below to calculate the mean (average), median, mode and range for both students. Place answers in the table provided.

    Tess: 94, 100, 80, 92, 100, 70, 74, 80, 85, 85

    Tyler: 98, 100, 80, 81, 87, 68, 80, 78, 96, 92

    List each set of numbers in order from least to greatest:

    Tess:

    Tyler:

	TESS	TYLER
MEAN (average)		
MODE		
MEDIAN		
RANGE		

- Mrs. Neal did sit ups for exactly one minute five days in a row. The first day she did 42 sit ups in one minute. The second day, she only did 38 sit ups in one minute. The third day, she was back up to 42 sit ups. On the fourth and fifth days, she did 54 sit ups. Calculate the mean, mode, median and range.

Closure:

- Ask four different students to give definitions for mean, mode, median and range in their own words.
- Ask five more students to use this list of numbers written on the board to calculate mean, mode, median and range: 26, 12, 10, 22, 10
- First student should place numbers in order from least to greatest followed by the remainder of students who should identify and write the numbers for mean, mode, median and range.
- Ask for different volunteers to add the key words to the classroom word wall.

Assessment:

- Check worksheet from independent practice.

- Use a specifically designed rubric to evaluate guided practice.
- Read journal entries to check for understanding.

Specific adaptations for English Language Learners (ELL):

- Highly visual, hands-on activities
- Target key words
- ELL paired with good English speaking student
- Variety of manipulatives
- Authentic and relevant activities
- Handout with steps defined
- Think-Pair-Share
- Non-threatening environment
- Fun atmosphere

Chances Are Good!

Subjects: Mathematics/Statistics

Grade Level: 5 - Specifically adapted for English Language Learners (ELL)

Objectives: Students will

- determine probability of given situations.
- conduct experiments to determine probability.
- express probability in the form of a fraction.
- engage in an activity which will provide strategies for predicting probability.

Correlating Virginia Standards of Learning:

5.19 The student will

a. solve problems involving the probability of a single event by using tree diagrams or by constructing a sample space representing all possible results.

b. predict the probability of outcomes of simple experiments, representing it with fractions or decimals from 0 to 1, and test prediction; and

c. create a problem statement involving probability and based on information from a given problem situation.

National Council for Teachers of Mathematics (NCTM): Principles and Standards

Data Analysis and Probability Standard

- Develop and evaluate inferences and predictions that are based on data
- Understand and apply basic concepts of probability
    - Describe events as likely or unlikely and discuss the degree of likelihood using such words as certain, equally likely, and impossible;
    - Predict the probability of outcomes of simple experiments and test the predictions;
    - Understand that the measure of the likelihood of an event can be represented by a number from 0 to 1.

Materials needed:

- Small paper bag

- 1 red marble
- 2 blue marbles
- 3 yellow marbles
- 6 green marbles
- pre-made spinners
- number cubes each numbers from 1 to 6 (two cubes per pair of students)
- coins (one for each student)
- dry erase board and marker (one per student)

Key word:

- probability

Instructional Plan

Anticipatory Set:

- Announce “We will get out of school today due to a large amount of snow.” (It is September.) Students will laugh and say “no, way” or “I wish”, etc. Ask students if this is an impossible situation. They will respond that it is impossible because it never snows in Southwest Virginia during the month of September.
- “How could we restate this announcement so that it would be possible to leave school early today?” Students might suggest scenarios such as “We will get out of school early due to flooding”; “We will get out of school early today because of a fire or a bomb threat”; etc. Both are possible, but not certain. Use

rectangular shaped labels to write the following words or phrases and place them on the board using magnets: Definitely, Likely, Unlikely, and Impossible.

- Give each student a dry erase board, marker, and eraser (Kleenex makes a good eraser).
- Tell students you are going to make different statements and they should write one of the words or phrases listed on the board to indicate the chances of each situation actually occurring. Use authentic and relevant situations:
  - Ann (choose a student in the class) will one day be a doctor.
  - Aaron will one day be a model.
  - Mrs. Neal will one day be President of the United States.

    Encourage all comments, but remind students to use their boards to respond, holding it up for you to check their responses. Ask students why they chose the response they did. Continue…
  - Watauga Elementary School will one day house prisoners.
  - Abingdon, Virginia will be listed among the country's most historic cities.
  - Dr. Abel, our principal, will visit our classroom today.
  - You will eat lunch today.
- Show students a paper lunch bag. Open it and show them it is empty. Place five yellow marbles inside the bag. Ask questions

such as "What is the probability or likelihood I will pick a yellow marble from this bag?" Students will answer "definitely" because it is the only color of marble in the bag. How do they know this? They watched me place only yellow marbles in the bag. "What is the probability or likelihood I will pick a red marble from this bag?" Students will answer impossible because only yellow marbles were placed in the bag.

- Remove all marbles from the bag. Show students that the bag is once again empty. Place one red, two blue, three yellow and six green marbles in the bag.
- Ask volunteers to give a situation that would definitely occur. Students will suggest picking a red, blue, yellow or green marble from the bag or picking two marbles of any color from the bag.
- Ask students to present a situation that would be likely to occur, but not definite. Students will probably suggest picking a green marble from the bag since there are more green marbles in the bag, but other colors also.
- Ask students to give a situation that would not be likely, but is not impossible. Again they will probably suggest picking a red marble since there is only one red marble in the bag with the majority of the marbles being other colors.
- Finally, ask student to present a situation that is impossible. Lots of possibilities and some will be funny!

Vocabulary emphasis:

- Instruct students to locate probability in the glossary of their mathematics textbook. Ask students to read the definition aloud to themselves.
- Students should then write the definition of probability in their math journal.

Relevance:

- "How do you choose what clothes and shoes to wear to school?" Students will suggest that it depends on the weather, whether they have gym class, whatever is clean, what Mother has laid out for them, etc.
- "Probability in terms of weather helps you determine what to wear. For instance, if you are certain it is going to rain, you will probably wear a raincoat and carry an umbrella. If you are certain the temperature will be 90 degrees, you will not wear a winter coat, a hat and gloves."
- "Probability also allows you to take certain risks while avoiding others. For instance, if you are taking gym class and you wear cowboy boots instead of tennis shoes, you are taking a risk of getting hurt or hurting someone else. If you drive a car through town you are risking your life and the life of others because you probably do not have experience driving and certainly do not have a license at the ripe old age of ten. If you go surfing, you are taking a risk of getting bitten by a shark, but the probability of that actually occurring is so small, you decide to take the risk because surfing is so much fun. If you like to skate board, wearing

pads and a helmet will decrease the probability of getting serious injuries." And the list goes on.

Modeling:

- Show students four different spinners each divided into different parts with each part labeled a color. Hang large spinners on the chalkboard for easy viewing. Then ask the following question: "What is the probability the arrow will stop on the color green on each spinner?" Students may still give answers of definitely, likely, not likely and impossible.
- Explain to students they can also use a fraction to describe the probability of an event occurring. For example: "Looking at the first spinner which is divided into four equal parts with each part colored yellow, red, green and blue, one part is green and there are a total of four parts. So the probability of the spinner stopping on the color green is ¼. This means if you were to spin the spinner four different times, it would likely stop on green at least one of those times."
- "Looking at the second spinner, notice the spinner is divided into eight equal parts, with two parts colored yellow, two parts colored red and four parts colored blue. So the probability of the spinner stopping on green is 0/4 because green is not a color choice on this particular spinner."
- "Notice the third spinner is divided into six equal parts with one part red, two parts blue and three parts green. The probability of the spinner stopping on green is 3/6 or ½ which means if you spin the spinner six times, probably three of those would land on green."

- "Finally, the last spinner is divided into eight equal parts with one part yellow, one part red, one part blue, one part green and four parts pink. The probability of the spinner stopping on green is 1/8.
- Gather students in a semi-circle and ask a volunteer to choose a spinner from the board and sit in the floor with the spinner facing the other students. Tell the student she is going to spin the spinner a total of twenty five times. Ask a different student to record the number of times the spinner stops on each color on the chalkboard. Before beginning the activity, ask students to predict the color they think the spinner will land on most and least. Ask them why they made this prediction.
- Keep all students involved by asking them to keep up with the total number of spins and let the spinner know when they have completed the total number of spins. When activity is complete, ask students to make conclusions about the data. Ask students, "Which color did you predict would yield the highest number of spins and the lowest number of spins? Was your prediction correct?" You will find some students will choose a color regardless of probability because it is their favorite color or a lucky color!

Guided Practice

- Pair students into groups being sure to pair English Language Learners with a student who has good command of the English language.
- Give each pair of students two number cubes numbered one to six and a data sheet to record results of their probability activity.

- Ask a student to read the title of the data sheet aloud which is “Sum of two Cubes.”
- Ask students how they think two number cubes can be used to experiment with probability. They will name several different ways, ultimately leading to the idea of adding the numbers on each cube to determine the probability of a particular sum.
- Tell students they are going to conduct an experiment involving probability. Give students a data sheet and a handout with steps of the experiment which lists the following instructions:
    - ➢ Before beginning the experiment, place a smiley face beside the sum you predict will be rolled the greatest number of times. Place a frownie face beside the sum you predict will be rolled the least number of times.
    - ➢ Roll both number cubes.
    - ➢ Add the two numbers to get the sum.
    - ➢ Place a tally mark beside that number on the data sheet.
    - ➢ Roll the cubes a total of 50 times.
    - ➢ Record the sum each time.
    - ➢ Keep up with the number of rolls by counting tally marks.
    - ➢ One person in the pair should roll the number cubes the first twenty five times with the second person recording tally marks. Switch jobs for the second twenty five rolls.

- Before beginning the experiment, ask students to examine their data sheet and notice the possible outcomes of the experiment. The least number listed is 2 and the highest number listed is 12. "Why is the number 1 not listed?" Even though ones are on both number cubes, two is the least sum that can be rolled. "Why is the number 12 the largest number listed on the data sheet?" Because the highest sum can be rolled with two 6's which have a sum of 12. No higher sum is possible.
- Instruct students to examine the data sheet carefully and think about the experiment they are getting ready to conduct. "Place a smiley face beside the sum you think will be rolled more than any of the others. "Place a frownie face next to the sum you think will be rolled the least number of times." Hopefully, students will begin thinking about the different combinations sums can be rolled, but let this occur naturally, and discuss it after the experiment.
- Send students to the floor to begin their experiment. Walk around to different groups to assist if necessary. Encourage discussion among partners. Suggest that one person roll the cubes 25 times while their partner records tally marks, then switch jobs so that both partners are involved in each portion of the experiment.
- When students complete the activity, as them to answer the questions at the bottom of the data sheet. "Which sum was rolled the most and the least? Was your prediction correct?"

- Instruct students to return to their desks when they have completed the experiment.
- Discuss results of the experiment with the entire class. "What did you notice about the number of times each sum was rolled?" They will suggest that certain sums have a greater probability of being rolled because the sum can be obtained in more than one way. There is only one combination of numbers resulting in a sum of 2, 3, 11, and 12. There are two combination of numbers resulting in a sum of 4, 5, 9, and 10, while there are three combination of numbers resulting in a sum of 6, 7, and 8. "In your experiment what fraction of the sums was 2? 3? 4? And so on."
- "If I asked you to graph the results of this experiment, which type of graph would be the best to show results?" Since bar graphs and circle graphs compare categories, one of these would be best. Line graphs show change over a period of time which is not a variable in this experiment.

Independent Practice:

- Give each student an activity sheet listing steps of a new probability experiment, "Heads or Tails." Conduct the experiment at home. (Sheet attached)
- In your math journal, write three conclusions you can make about the spinner activity we conducted together in class.
- Also in your math journal, write three conclusions you can make about the "Roll a Sum" experiment you conducted with your partner.

- Construct a circle graph or a bar graph showing the results of "Roll a Sum".

Closure:

- Ask for a student to volunteer to give their own definition of probability. Ask others to add to this definition if necessary.
- "How can probability be determined?" Students should suggest through observations, experimentation, research and data collection.
- "Think about a good activity that could involve probability and write about it in your math journal."
- "Tomorrow, I will teach you a fun game that uses probability." This is the game of SKUNK.

Assessment:

- Create a specifically designed rubric to assess student performance and cooperation during "Rolling a Sum" experiment.
- Read math journal entries to check for understanding.
- Check data sheets for "Roll a Sum" and "Heads and Tails."

Specific adaptations for English Language Learners (ELL):

- Hands on experimentation
- Whole class discussions
- Paired with a good English speaking partner
- Authentic and relevant results
- Target one word vocabulary
- Handouts listing steps of each activity

- Visuals
- Opportunity to learn and share with partner without intimidation
- Pre-made circle graph
- Enjoyable, active learning
- Non-threatening environment

SUMMARY

Teaching probability and statistics to English Language Learners has become a course of passion for me. In fact, the love that I have acquired through teaching these students has renewed my initial passion for education. Throughout the entire process of developing and presenting this thesis has involved a tremendous amount of research and reading. Much information is available for teachers who have English language learners mainstreamed in the regular classroom; however, it is not to be located in one or two books. It took many months just to research the many avenues of information available in books, journals, and internet sites, all of which were credible with their own advantages and disadvantages. Therein lies the problem of educating English language learners in the mainstreamed classroom. Even the most outstanding teachers do not have the time to spend researching this overwhelming amount of information. Therefore, they do the best they can with what they already know in addition to perhaps reading a book on the subject or attending a workshop, neither sufficient. Every teacher has their own way of teaching with strengths and weaknesses, so they must research enough proven educational material to find the strategies that work best for all students in the regular classroom.

Before they even attempt this feat, they must know the students who are in their classroom and identify their needs. Everyone associated with education knows this base of knowledge is different every year with each new class of students. Only when the diversity of the classroom has been unveiled can a teacher begin to effectively plan for student success in all areas. This may in fact only occur during the week before the school year begins. As you can imagine, this may be extremely overwhelming for even the most effective and organized teacher. Hence, I embarked on a long journey of preparing a specific set of lessons on probability and

statistics particularly designed for the English language learner in the mainstreamed regular fifth grade classroom.

Valuable proven research begins the thesis with knowledge teachers must have in order to effectively teach in a multicultural setting. I have intentionally included in this paper minority reports, culture based disparities, cultural norms, challenges created by diversity and advantages of a diverse classroom. In my opinion, these are prerequisites to teaching a diverse group of students and they are well defined in the early chapters of this thesis.

Clearly as important, I have included the different stages of English language learners in conjunction with learning strategies, instructional practices, and assessment modification. The classroom environment is also an important aspect of a multicultural classroom ensuring student comfort and success. And if your school is fortunate to have an ESL specialist on staff, you have someone with whom you can collaborate and determine the best strategies for students with a diverse backgrounds. Lastly, but important also, is learning to become an effective teacher so that all students regardless of background can learn in a safe environment and succeed both academically and socially.

It is important to note that I have implemented every strategy in this paper with much success during the past two years. My lesson plans for probability and statistics have been tweaked each time I have used them in the classroom. But overall, they are really good effective lessons and my former students have enjoyed them. In addition to probability and statistics, it also became easier to incorporate some of the same techniques into other mathematics lesson.

I chose to concentrate on probability and statistics because I believe it to be relevant and useful in the life of students. It also contains unique vocabulary and it was important to include that aspect into the lessons as English language learners must deal with the language barrier.

Furthermore, this topic allows students to interact with each other, depend on each other and assist each other. It fosters communication among students and helps English language learners learn to speak English and understand the language. All students are involved and challenged within each specific activity.

President George W. Bush has insisted no child be left behind. As a result, students must pass standardized tests to graduate from high school. Therefore, at the elementary level, a solid foundation is important for future academic success. We, as teachers, must strive for excellence in our teaching practices, in addition to helping all students regardless of their diversity recognize their true academic potential in a positive, non-threatening environment.

REFERENCES

Adeeb, Patty,and Janet Bosnick. *Hands-on Mathematics + Multicultural Education = Student Success*. Research Room EdChange Multicultural Pavilion. Retrieved July 6, 2005 from http://www.edchange.org/multicultural/papers/math.html

Associated Press. *One out of Every Seven People in America is Hispanic*. Roanoke Times. June 9, 2005.

Bishop, Alan J. *Educating the Mathematical Enculturators*. ICMI Regional Conference, Shanghai, China, July, 1994.

Blackwood, Ann. *The Mailbox Math Series: Probability, Statistics, and Graphing*. Greensboro: The Education Center, Inc., 1999.

Buchanan, Keith, and Mary Helman. *Reforming Mathematics Instruction for ESL Literacy Students*. Eric Digest. Retrieved July 8, 2005 from http://www.ericdigests.org/1998-2/reforming.htm

Cary, Stephen. *Working with Second Language Learners: Answers to Teachers' Top Ten Questions*. Portsmouth: Heinemann, 2000.

Clark, Julia V. *Minorities in Science and Math*. May, 1999. Retrieved July 6, 2005 from http://library.educationworld.net/a9/a9-122.html

Clutter. Ann W., and Ruben D. Nieto. *Understanding the Hispanic Culture*. Ohio State University Fact Sheet. Retrieved July 10, 2005 from http://ohioline.osu.edu/hyg-fact/5000/5237.html

Echevarria, Jana, and Anne Graves. *Sheltered Content Instruction: Teaching English-Language Learners with Diverse Abilities*. 2nd ed. White Plains: Pearson Education, Inc., 2003.

Gorski, Paul C. *Key Characteristics of a Multicultural Curriculum*. EdChange. Retrieved July 6, 2005 from http://www.edchange.org/multicultural/curriculum/characteristics.html

Haynes, Judie. *Challenges for ELLs in Content Area Learning*. Retrieved July 10, 2005 from http://www.everythingesl.net/inservices/challenges ells content area 1 65322,php

Helpguide. *Humor and Laughter: Health Benefits and Online Sources*. 2006. Retrieved February 20, 2006 from http://www.helpguide.org/life/humor laughter health.htm

Janzen, Heidi. *Helping English Language Learners in the Math Classroom*. New York: Glencoe/McGraw Hill, 2000-2005.

Johnson, Catherine W. Statistics, Graphing and Probability. Greensboro: Carson-Dellosa Publishing Company, Inc., 1994.

Kelly, Charles, Lawrence Kelly, Mark Offner and Bruce Vorland. Effective Ways to Use Authentic Materials with ESL/EFL Students. The Internet TESL Journal. Vol. VIII, No. 11, November 2002. Retrieved July 21, 2005 from http://iteslj.org/

Kottler, Ellen, and Jeffrey A. Kottler. *Children With Limited English: Teaching Strategies for the Regular Classroom*. 2nd ed. Thousand Oaks: Corwin Press, Inc., 2002

Lee, Lesley. *The Ell Advantage: Bilingual Students and Mathematics*. Pacific Eisenhower Mathematics and Science Regional Consortium. Retrieved July 21, 2005 from http://www.prel.org/products/paced/oct04/ms ELLadvant.htm

National Council for Teachers of Mathematics. *Principles and Standards for School Mathematics*. The National Council of Teachers of Mathematics, Inc., 2000.

Noel, Jana. *Notable Selections in Multicultural Education*. Guilford: Dushkin/McGraw-Hill, 2000.

Padron, Yolanda N. and Hersholt C. Waxman. *Teaching and Learning Risks Associated with Limited Cognitive mastery in Science and Mathematics for Limited English Proficient Students*. Third National Research Symposium on Limited English Proficient Student Issues. Retrieved July 6, 2005 from http://www.ncela.gwu.edu/pubs/symposia/third/padron.htm

Perkins, I and Flores, A. (2002). Mathematical notations and procedures of recent immigrant students. *Mathematic Teaching in the Middle School*, 7, 346-351.

Presidential Advisory Commission. *From Risk to Opportunity: Fulfilling the Educational needs of Hispanic Americans in the 21st Century*. March 31, 2003. Retrieved July 6, 2005 from http://www.yesican.gov/paceea/final.html

Shireman, Myrl. *Statistics and Probability*. Mark Twain Media, Inc., 1995.

Thompson, Dr. Gail L. *The Real Deal on Bilingual Education: Former Language-Minority Students Discuss Effective and Ineffective Instructional Practices*. Horizons. Winter 2000: 128-138.

United States Department of Education. *No Child Left Behind*. Retrieved July 8, 2005 from http://www.ed.gov/nclb/landing.jhtml#

Van de Walle, John A. *Elementary and Middle School Mathematics: Teaching Developmentally*. 6th ed. White Plains: Pearson Education, Inc., 2007.

Virginia Department of Education. *Instructional Services: Standards of Learning Resources*. Retrieved July 8, 2005 from http://www.pen.k12.va.us/VDOE/Instruction/sol.html

Virginia Department of Education. April, 2004. *Mathematics: Strategies for Teaching Limited English Proficient (LEP) Students*. Retrieved July 6, 2005 from http://www.pen.k12.va.us/

VITA

MARY JO JOHNSON NEAL

Personal data:	Date of Birth: February 24, 1959
	Place of Birth: Richmond, Virginia
	Marital Status: Married
Education:	Public Schools, Abingdon, Virginia
	B.A. Elementary Education, Virginia Tech, Blacksburg, Virginia 1981
	Continuing Mathematics Education, Emory and Henry College, Emory, Virginia 1982
	Gifted Education, University of Virginia, Cohort, Abingdon Extension Office, Abingdon, Virginia 1984
	Dwight D. Eisenhower Professional Development Program, Emory and Henry College, Emory, Virginia 1993
	M.S. Mathematics Education, East Tennessee State University, Johnson City, Tennessee 2007
Professional Experience:	Mathematics-Science Teacher, Damascus Elementary School, Damascus, Virginia, 1981-1991
	Mathematics-Science Teacher, Greendale Elementary School, Abingdon, Virginia, 1991-2003

Mathematics-Science Teacher, Watauga Elementary School, Abingdon, Virginia, 2003-Present

Honors and Awards: Who's Who Among America's Teachers

Leadership Program for Mentoring Teachers, Emory and Henry College

Teacher Advisory Committee for William King Regional Arts Center

Virginia Commission for the Arts Grant: Appalachian Culture and Living History Accounts

Mentor Teacher, Emory and Henry College, Emory, Virginia