Promising Strategies for Young English Language Learners Acquisition of Math Content Knowledge

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This research for implementing promising strategies for English Language Learners was motivated by my aspiration to become a bilingual teacher. Therefore, I worked to gain a more profound knowledge about the specific needs of this population of learners. I wanted to first discover what general information I could gather about ELLs in order to become more of an expert on the subject myself. Another aspect of my research consists of qualitative analysis of my work with the ELL students. I participated in a program called the Number Sense Project (NSP) at Augustana College. The number sense project (NSP) is one element of a partnership between Augustana College and Longfellow elementary, a Title 1 school in Rock Island, IL. The NSP promotes young children’s understanding of number. This “number sense” study allowed teacher candidates to teach small group lessons (1-2 students) in a kindergarten classroom at Longfellow. As one of the teacher candidates participating in the NSP, my specific focus in this classroom was on Spanish speaking English Language Learners (ELLs) and these are the students I refer to in this study. During my small group lessons with the kindergarteners, my purpose was to discern which teaching strategies improved ELL acquisition of math content with a concentration on the use of the students’ native language during the lessons. A variety of research exists that mentions strategies classroom teachers can use to improve ELLs math performance. My findings support some of these strategies while others are not corroborated by my evidence.

In order to further clarify my position, it is necessary to define what it means to be an ELL student. According to the Illinois State Board of Education (2004), English Language Learners are “linguistically and culturally diverse students who have been identified through reliable and valid assessment as having levels of English language proficiency that [prevent] them from accessing, processing, and acquiring unmodified grade level content in English and, thereby, qualifying for support services” (Gottlieb et al, p. 29). The Illinois State Board of education also mentions that there are five different levels of English Language Proficiency since each ELL has a unique situation and varies in their level of English acquisition. The goal is to have these students reach the highest level and “bridge” from learning English into meeting “state academic content standards” (Gottlieb et al, 2004, p. 4).
Research on academic achievement demonstrates that ELLs have a tendency to perform poorly in school as compared to their native English-speaking peers. In 2000-2001, 10% of ELLs were held back and statistics show their dropout rate is four times that of native English-speaking classmates (McKeon, 2005). Until students are assessed as being proficient in English, they are considered to be ELLs and are still highly at risk. Another regrettable reality is stated in DeVillar’s investigations, which have revealed that there is a strong correlation between ELL status and poverty status (as cited in Ganesh & Middleton, 2006). This reality enhances the alarm that educators experience about the achievement of these students.

This apprehension is warranted as ELLs become a larger part of the United States population. In 2006, the National Clearinghouse for English Language Acquisition (NCELA) found that the number of Limited English Proficient Students (LEPs) has grown 57% since 1996. That statistic was recorded four years ago, and given that the number of ELLs is constantly growing signifies that the percentage probably increased since then. To relate the large number of ELLs to their poverty status, Goldenberg (2008), states that “ELLs are at risk for poor school outcomes not only because of language, but also because of socioeconomic factors” (p. 10).

ELLs’ math achievement is significantly lower than that of their peers. This is not usually accepted by the general population, since many assume that ELLs should only be struggling in reading and other literacy related subjects. It has also been found that the United States pays more attention to literacy than it does to the development of math abilities (Cross et al, 2009). In the case of ELLs, many assume that math is the same in all cultures and therefore should be able to cross cultural and language barriers. However, this assumption is incorrect. Math includes a significant amount of difficult vocabulary. This vocabulary is especially difficult for ELLs because the words used in a math context have different meanings than when they are used in everyday conversation. For example, words such as table, column, row, sum, etc. are sometimes used in everyday speech, but have completely different meanings or are spelled differently when used in a math context. In fact, some of these words are homonyms that provide an additional challenge for ELLs (Williams & Livers, 2009). Vocabulary is not the only literacy-related portion of math that ELLs struggle with. Math contains academic language rather than conversational
language. As emphasized by Cady et al (2010) “students may be conversant but still find academic language or mathematical terms a challenge” (p. 477). In order to express themselves mathematically ELLs must have a firm understanding of the mathematics discourse along with the ability to speak academic English (Roberts, 2009).

Due to their status as ELLs, story problems and other problem solving exercises are difficult for ELLs to understand because of their limited English proficiency. Jordan et al (2009) assert that low-income children showed weaknesses on math assignments with large verbal components, such as story problems. Since a large portion of low-income children are ELLs this could be a possible cause for the results of this research. Ganesh and Middleton (2006) corroborate this assertion by suggesting that the words, phrases, and symbolic representations used in math that many adults “take for granted” are not common knowledge for ELL students (p. 135). These researches argue that because of previously mentioned information and other factors, numerous math learning opportunities are unreachable for ELLs because they do not comprehend or speak English.

Copious amounts of research have demonstrated that math can be defined as a “language” of its own. According to Dale & Cuevas (1987) research needs to take seriously the metaphor of math as a language (as cited in Secada, 1991). As time progresses, the literature has shown to be doing exactly that. In the journal of Democracy & Education, Roberts (2009) defines the “language” of math by declaring that “learning what it means to ‘talk’ math is about learning the language of mathematics as a discipline, which is not just word-based, but also representational” (p. 32). This “language” of math is continually coupled with a sufficient amount of academic English and includes academic vocabulary, symbols, and other abstract concepts. The problem with academic English and ELLs’ learning process is shown by the study of Ganesh and Middleton (2006) where they discovered that teachers seemed oblivious to how much English was included in their math teaching. Educators in this study did not realize how much of their speech was not understood by their ELL students. Students cannot be expected to learn these abstract concepts if they are not able to understand the meaning behind them.
It is no surprise that a burning question in the modern day classroom is how to support the learning of this low-achieving group. Not only do these students have numerous obstacles to overcome, they represent a large portion of the United States population. The role of the teacher is to make sure that every student’s needs are met. However, statistics show that as a group, ELL students are performing far below the average academic level. Although the purpose of the “number sense” study focuses on kindergarten ELLs, Jordan and colleagues (2009) stress that problems in learning math are cumulative and only become progressively worse throughout struggling students’ academic careers. The issues these students have in early elementary education follow them for the rest of their academic career. Research has established that the mathematics achievement gap only grows wider as students’ progress into higher levels of their education (Jordan et al, 2009). The Colorado Department of Education (2009) found that the graduation rate for Limited English Proficient students was 53.3% while the state total of all students was 74.6%. Roberts (2009) proposes that mathematics achievement is an effect of the high dropout rates for ELLs. The clearly identified problem is that ELLs are dropping out of school and performing poorly in mathematics for the many reasons mentioned previously. The research suggests that the low achievement of ELLs is due to students not being able to learn the “language” of math and academic English simultaneously. These students have to work twice as hard to perform at the same level as the average native English speaker and this may be an explanation for their low math performance.

The literature recommends various solutions to this problem. Since vocabulary is such a significant component of the “language” of mathematics, the strategies for assisting ELLs with English vocabulary acquisition are abundant. Williams and Livers (2009) focus on using a meaningful context to help students learn math. Teachers need to make math culturally relevant to their students. This is important because then students can relate their previous knowledge to the topic. Since they already have prior information about the subject, they will find it more interesting and become more engaged in the math lesson. Another strategy these researches mention is that the teacher can change the context if it is not relevant to the lives of their ELL students. They can also “lighten the linguistic load” by using more basic vocabulary rather than trying to utilize specific terms about a certain concept (p. 241). For example, ELLs...
do not need to use words such as till or acre in a math problem about farms. The word land and farm would probably suffice. In addition, these researchers speak about mentioning new vocabulary before and after the lesson. Throughout the literature there are discrepancies on which method, introducing vocabulary before or after, serves ELL students better in their process of English vocabulary acquisition.

Cady and other scholars (2010) have additional information about strategies that will support ELLs in learning English math vocabulary. They assert that translating words into the students’ native language will help them learn the vocabulary. Other recommendations are speaking slower, repeating words, simplifying sentence structure, and avoiding idioms. However, these recommendations are not always practical in a classroom atmosphere with many students vying for the teacher’s attention. A goal of the “number sense” study is to unearth strategies that are effective and practical for the general or bilingual classroom teacher. Using visual cues is a good technique which will demonstrate the meaning of vocabulary that may be unfamiliar to the ELLs. This helps to make the English words less abstract by tying them to concrete objects and the students’ lives. The students will have a visual connection which will serve them better than an auditory meaning given in a language they do not yet comprehend (Cady et al, 2010). Roberts (2009) expresses the idea of teaching vocabulary after the student has been able to comprehend what the concept means. Then the student should be able to know what the new “label” for the concept signifies. Roberts (2009) also talks about using the students’ first language and allowing students to express their math ideas in that language. She even asserts that allowing students to use their native language will allow them to process higher cognitive skills more easily. She mentions the importance of students’ culture as a context and recognizing students’ diverse cultural experiences as well.

A more recent idea in the world of teaching mathematics is including as much “math talk” as possible in every situation. Math talk can be defined as mathematically relevant words or phrases. Klibanoff et al (2006) found a significant relationship between the amount of “math talk” the teacher used in the classroom and the increase of students’ mathematical knowledge. The more “math talk” the teacher used in her classroom, the more the knowledge of conventional mathematical concepts grew. For ELLs the
amount of math talk would be extremely important because it would help them develop math vocabulary. Infusing math into conversations with the students, such as including basic prepositions and other spatial concepts, will be extremely beneficial to this group of students (Klibanoff et al, 2006).

Jensen (2007) was the head of a study where the purpose was to discover the use of the students’ native language and math achievement. In this case, he primarily focused on Latino kindergarteners. He discovered that kindergarten teachers who used Spanish during classroom instruction scored slightly higher in math. Even though their scores were only slightly higher, this data is significant because this math score was recorded in the first semester of kindergarten. This study demonstrated that native-language use affected students in the beginning of the learning process. However, this information begs the question of what can occur if the infusion of native-language in classroom instruction is continued throughout elementary school. These findings imply that native-language use will become more significant in students’ math achievement and test scores over time. Consequently, using ELLs’ native language in the classroom will be an important accommodation. Research reported by August and Shanahan (2006) has shown that oral and literacy skills that are developed in the students’ native language can then be utilized to facilitate acquisition of oral skills and literacy in the English language. The issue with this strategy is that it is not applicable to all teachers of ELLs because not all teachers speak the native language of the ELL students in their class. However, the study suggests that educators who include ELLs’ native language in their classroom are better able to meet the needs of their ELL students (Jensen, 2007).

A reoccurring strategy in the literature is using technology with ELL students to improve their comprehension of math concepts. Kim and Chang (2010) found computers used specifically for math in the math classroom were related to a reduction in the gap of math achievement between native English speakers and ELL students. Computers will help alleviate the issues ELL students have, such as helping with vocabulary, comprehension, and help provide flexibility on how students are able to pace themselves (Kim & Chang, 2010). The researchers recommend that educators carefully use this as a strategy for their students to help them succeed. Their research also found accommodations that can be made to computers
so that ELL students can use them for various educational tasks which will help them achieve higher in
math. Some examples are text-to-speech, bilingual features, using pictures, and/or movies. This study
demonstrates that technology can be a powerful tool if accommodations are made and students are guided
by an adult or teacher while using the computer. If these accommodations are not made and students are
expected to use the technology themselves, then the opposite effect occurs (Kim & Chang, 2010). The
study conducted by Ganesh and Middleton (2006) explains that ELLs are not able to access the software
learning opportunities due to their lack of fluency in English because they cannot follow the directions the
computer gives or read what the computer is telling them. It did not help that the teacher did not guide the
ELL students while they were using the computer. Another important strategy is using concrete objects or
“manipulatives” to help ELLs learn math concepts. These are considered technology in the research of
Ganesh and Middleton (2006). ELLs will benefit from these concrete objects because they assist in being
able to visualize math ideas and can be used as a way to decrease the abstractness of math in general.

Lindhom-Leary & Borsato (2006) agree with this statement by suggesting that technology and materials
are the vehicles that can be used to promote the educational success of ELLs.

Teachers need to modify the way that they test ELLs as well. Mathematical proficiency cannot be
determined if the students are not able to read or understand the question being asked of them. A strategy
for this issue is shortening the test item. Research asserted that the length of a test item has show negative
effects for ELLs (Martiniello, 2009). A way for teachers to help eliminate potential bias is to shorten
these test items and to include schematic representations for students to follow. Research found that they
help offset the linguistic complexity of the test item (Martiniello, 2009).

The literature presents a variety of methods that will support the learning of English language
learners. In addition to these strategies, there lies the question of which academic program will best
support the high number of language learners in the public schooling system today. There are many
choices from English Immersion to Bilingual Education. As discussed in the study conducted by Ganesh
and Middleton (2006), the goal of English immersion is to have the students speak, read, write, and think
in English. Bilingual education follows the opposite mantra. Bilingual education can be described as an
educational program that uses the student’s first language as a tool for classroom instruction while the student embarks on the journey of learning their second language of English (Sosa, 1993). The next step for future research is to discuss which type of program is feasible or even a good choice for English Language Learners. However, the most important goal is to find which strategies work in the classroom for all teachers from Bilingual educators to the mainstream English classroom. It is undeniable that ELLs are not receiving the help they so clearly need. Finding strategies that work with actual ELL students has an important implication for current educational policy. There is not a sufficient amount of research published on the teaching and learning of math with younger students who are concurrently learning English (Cross et al, 2009). Solving the dilemma of the underachievement of English Language Learners will continue as researchers unearth new and corroborate evidence of old strategies that positively affect the math achievement of ELLs.

**Program Description**

The Kindergarten Number Sense Project (NSP) served as a vehicle for unearthing and corroborating evidence of effective strategies that benefit math acquisition of elementary ELL students. NSP is the official name of the project that is in conjunction with Longfellow, a Title 1 elementary school in Rock Island, IL. This program developed from a partnership between Augustana College and Longfellow, which is located only a few blocks from the college campus. The elementary school has a diverse population and serves mainly low income students. According to the 2009 Illinois School Report Card¹, this elementary school has a Latino population of 38% which allows for a large amount of Spanish-speaking ELLs. Math work in the kindergarten classroom began in late August of 2009. Teacher candidates enrolled in Augustana’s Elementary Math Methods course were assigned a partner and a group of 3 kindergarten students. The goal was to help these students learn and improve their number sense competence. Due to a grant received by one of the professors at Augustana College, 6 of the teacher candidates

candidates were able to continue working with the kindergarteners for the rest of the school year. Each of the teacher candidates planned and implemented lessons with small groups or individual students 3 days a week. I was one of those teacher candidates and I used the time I spent with the kindergarteners during the 2009-2010 school year to gather data regarding the math achievement of young ELL students.

Data Collection and Analysis

From March to May of 2010 I videotaped the lessons I taught with ELL kindergarten students. I was in the classroom for 4 hours each week and I videotaped for about 2 hours of that time, since I did not have every lesson with ELLs. By the end of the school year I had about 20 hours of video data. I later viewed each video at least twice, searching for evidence of teaching techniques which seemed to promote the children’s understanding. As I watched, I coded segments of the video data by categorizing it into various strategies that were used continuously throughout my lessons and seemed to have a positive impact on the learning curve of my students. After coding the data, I discovered which strategies I used that assisted ELLs in their acquisition of math content. Other sources of data that informed my investigation of effective teaching strategies included careful analysis and coding of videotaped lessons, my ELL students’ math achievement records, planned curriculum assessments, and an interview-based assessment of children’s basic counting abilities (Richardson, 2002). In many cases these students were being taped as these assessments were being administered to them. They were taped to provide me with a visual of the students completing the assessments, as well as a physical copy of their work. Additional video footage of an NSP team member and another research assistant interacting with these ELL students was available to me. This allowed for comparison data of when the students were in an environment where the teacher did not necessarily use the strategies that will be discussed in this report.

Longfellow Elementary School’s kindergarten mathematics curriculum utilized Math Trailblazers, ©2008 Kendall/Hunt Publishing, Dubuque, IA.
The Participants’ Level of English Proficiency

Even though the definition of English Language Learners seems very broad and general, the Illinois English Language Proficiency Standards have five different levels they outline as the “progression of language development” (Gottlieb et al., 2004, p. 4). The ELL students I taught during the NSP were all at varying levels of language development. The five levels are: entering, beginning, developing, expanding, and bridging. A description of these levels can be found in Figure 1. After moving through the level of “bridging”, the goal for ELL students is that they will now be able to achieve the Illinois academic content standards (Gottlieb et al., 2004). I will mainly be focusing on 4 students during my research. Each of these girls is at a different level of language development. I have identified them at a certain level based on the Illinois state standards for English language proficiency. I looked mainly at the standards of English language proficiency for social and instructional purposes and for mathematics. After analyzing the video data and the Illinois standards, I identified which level I believed my students should be placed. Ava and Beth were identified as moving from beginning to developing, Betty as developing, and Rachel as expanding as summarized in Figure 1. These different levels affect how native language instruction helps these students with math content. They are important to remember when deciphering which strategies work best in the classroom.

Promising Teaching Strategies for ELLs

The strategy I found most beneficial was infusing instruction with the students’ native language, which in this case was Spanish. This method works well when used in conjunction with offering ELL students vocabulary support. When watching the video data taped by Dr. Egan, an NSP team member, in the beginning of the school year, it became obvious that the ELL students needed vocabulary support. In the video Dr. Egan was administering a Kathy Richardson assessment to an ELL student. The assessment was conducted completely in English. A description of the video is provided below.
5- Bridging
• the technical language of the content areas;
• a variety of sentence lengths of varying linguistic complexity in extended oral or written discourse, including stories, essays, or reports; oral or written language approaching comparability to that of English proficient peers when presented with grade level material
• specific and some technical language of the content areas;
• a variety of sentence lengths of varying linguistic complexity in oral discourse or multiple, related paragraphs;

4- Expanding (Rachel)
☐ oral or written language with minimal phonological, syntactic, or semantic errors that do not impede the overall meaning of the communication when presented with oral or written connected discourse with occasional visual and graphic support

3- Developing (Ava, Betty, and Beth)
• general and some specific language of the content areas;
• expanded sentences in oral interaction or written paragraphs;
☐ oral or written language with phonological, syntactic, or semantic errors that may impede the communication but retain much of its meaning when presented with oral or written, narrative or expository descriptions with occasional visual and graphic support
• general language related to the content areas;

2- Beginning (Ava and Beth)
• phrases or short sentences;
☐ oral or written language with phonological, syntactic, or semantic errors that often impede the meaning of the communication when presented with one to multiple-step commands, directions, questions, or a series of statements with visual and graphic support
• pictorial or graphic representation of the language of the content areas;

1- Entering
• pictorial or graphic representation of the language of the content areas;
• words, phrases, or chunks of language when presented with one-step commands, directions, WH-questions, or statements with visual and graphic support

Taken from the Illinois State Board of Education: Illinois English Language Proficiency Standards for English Language Learners (K-12). Copyright ©2004 State of Wisconsin. All rights reserved.

Figure 1: Illinois Levels of Language Proficiency for ELLs
Dr. Egan asks an ELL student named Ava\(^3\) to make a “guess” of how many red circles are on the table. She shrugs her shoulders and so he asks her to count the manipulatives on the table and try to find out how many there are. Ava counts incorrectly so he gives her a smaller pile of red circles to count. Dr. Egan again asks Ava to make a guess of how many red circles she thinks are on the table. He asks her if she can do that. She nods her head and instead of making a guess she begins counting immediately even after Dr. Egan asks her how many she thinks are there.

Situations very similar to this one occurred with two other ELL students in the same kindergarten classroom. The students reacted either with ignoring the word guess and beginning to count out loud or shrugging their shoulders and then counting. My analysis of this video was that Ava and the other ELL students had no idea what the word “guess” meant. That was a difficult English word for them to grasp so they were not able to follow the directions given by Dr. Egan. This is one reason vocabulary support is imperative. The word “guess” was not meaningful to Ava and there was not Spanish scaffolding to help her understand. Ava has a lower level of English language proficiency and given her status as a “beginning to developing” ELL student, this signifies that she needed Spanish support, which she did not receive during the assessment. Due to these circumstances, neither Dr. Egan nor I have any idea whether Ava was actually capable of making a “guess” about how many circles were on the table. As the literature suggests, Ava did not have a meaningful context to place the word “guess” so she had no way to decipher what it meant. This vignette suggests that an important vocabulary support is using native language in order to provide a meaningful context for the student. When I conducted the Richardson assessment again in the spring with the ELL students I framed the word differently. I administered the assessment to check the students’ progress and found that they could indeed make a guess, although they were not always extremely accurate. In order to frame the vocabulary, I spoke in Spanish and I never used the word “guess” or “conjectura.” Instead, I asked the students how many circles they thought were in the pile

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\(^3\)Ava is a pseudonym, as are all other names used for children in this report.
without counting. I emphasized the words “without counting” so they knew that they were supposed to think instead of knowing for certain the exact number of circles.

By doing this, I was creating meaning for these students rather than just believing that they did not have the mathematical skills necessary to make a guess. This scaffolding can be done in either Spanish or English. My research has shown that ELLs learn English vocabulary pretty quickly and even begin substituting English words for Spanish ones. For example, one of my students told me that she wanted a yellow one of those rubber bands or as a direct quote “Yo quiero un yellow de estos”. However, she said everything in Spanish except for the word “yellow.” If teachers taught both Spanish and English vocabulary in the classroom, then students would have twice the amount of vocabulary in two languages. Why the student knew the word “yellow” was because her kindergarten teacher had created meaning for that word. Therefore, when working with ELL students, teachers should try to find every avenue possible to make meaning for vocabulary in English and Spanish.

The literature refers to connecting math to the students’ lives and personal experiences. Math is an extremely abstract discipline and that is why without the vocabulary support strategy mentioned previously it is extremely difficult to learn math. The students are not only dealing with the abstractness, but also with a language barrier. Therefore, I have found that making meaning for ELL students must come from two sources: scaffolding in their native language and making math problems culturally relevant. We used the computer in order to help the kindergarten students learn number sense during the NSP. One of the computer games used word problems to help students deal with solving math problems in this manner. The word problems were all in English. I helped the girls read the problem, but it was obvious they did not understand any of what I had read to them. A description of the video is provided below.

The problem read “Ryan had 1 marble. His sister gave him 8 more marbles. How many marbles did Ryan have then?” I asked the girls to show me with the objects on the computer screen how many marbles Ryan had. It was obvious by the amount of time they sat staring at the computer screen that
they had no idea what was going on. They did not even put the correct number of objects on the screen. Instead, they only put 8 marbles and did not understand that the problem had two addends. After this problem we did another one. The next problem was “Consuela had 4 pictures. Her sister gave her five more pictures. How many pictures does Consuela have now?” I asked one of the girls to show me the first part of the math problem with the objects on the computer. I read the first half of the problem to her in English. I then read it again to her in Spanish. After I read her the problem in Spanish and explained it to her, Betty said the correct answer of nueve. I congratulated her since 9 is correct. After I spoke the problem in Spanish there was very little wait time and not nearly as much confusion for the students.

This vignette shows that the girls did not only have a language issues, but cultural ones as well. Especially with the first problem, a marble may not be a term that these students are familiar with or understand. In order to make this problem relevant to these students’ lives I would use another object, such as a food item that they usually eat or jewelry, which these girls are always wearing. The marbles did not connect to their lives. On the other hand, the second math problem was much more relevant to these students. In their kindergarten classroom, they are always getting their picture taken and using their portraits for projects. Therefore, “pictures” is a much easier word to understand. The cultural relevancy of this word problem and the Spanish scaffolding made the problem overall much easier to solve. The first problem did not have enough meaning and was too abstract for the ELL students to understand. A promising method for fixing this issue is making sure that the word problems do not contain a term or concept that is not inherent in the students’ culture or is not something that has been introduced in the classroom. Teachers can change the context of math problems while keeping the numbers and operations the same. It would not matter if Ryan had 1 tomato or 1 marble. This is a strategy that will make all the difference for bilingual and mainstream educators. Teachers do not necessarily need native language instruction to help the ELLs understand word problems. Also, they could use dictionaries to translate difficult or imperative words into the students’ native language.
Relating math activities to students’ personal lives is another facet of cultural relevance. During one of my videotaped math lessons, I was doing an activity on ways to make the number 10. The activity taken from *Math Trailblazers* (2008) included a story about a snake taking bears out of a jar in order to eat them. While I was explaining the premise of the activity, one of the girls named Betty began asking me questions in Spanish about snakes. She then went into a long story about how she found a snake in the garden located in her backyard. I sat there listening to everything she said and allowing her to express herself in her native language. I then used that story to relate to our math lesson. I told Betty (in Spanish) that the snake had 8 bears in the jar (and I put them in the jar) but he wanted to have 10 in the jar. I asked her to tell me how many more bears the snake needed in order to have 10 in the jar. She then told me that the snake needed 2 more. She knew the answer without hesitation.

The personal experience involving a snake provided Betty with a meaningful context that made the math lesson less abstract, which is an asset to all students. Instead of having to think about 8+2 is 10, she was able to think in terms of the snake getting his lunch. Again, the Spanish scaffolding, cultural relevance, and connection to personal experiences assisted the ELL students in having success with math content. Scaffolding in Spanish is not the only reason to infuse instruction with the students’ native language. Another essential aspect is allowing the students to express themselves in their native language. They should be given the opportunity to discuss math concepts in Spanish. This is a potential reason why Betty was able to understand addition so quickly. She felt free to share her personal stories in her own language in a low-anxiety atmosphere. A pattern has appeared as I analyze my video data. I have found that students seem more comfortable (judging by body language), talkative, and eager to share when the lesson is conducted in their first language. I discovered this by comparing my video data to the data of a research colleague who conducted her lessons in English with the same ELL students. I saw visible differences in their personalities, behavior, and general understanding of the lesson material.

My research colleague, Laura, taped a lesson with Betty and Beth. Her lesson was about how to combine numbers in different ways in order to have a sum of 10. This is the same objective as the “snake” lesson I mentioned earlier. I can see by the girls’ body language that they do not feel as comfortable.
Betty seems much shyer and not as eager to express herself. She also does not share any stories with my research colleague about her personal experiences, which was commonplace in our lessons together. I believe that the nervousness the two girls felt had nothing to do with Laura’s personality, but rather the language in which she was instructing them. Another possibility is that Betty does not yet have enough confidence in her English abilities to share personal stories with Laura. The fluidity of the first language gives her the confidence she needs to break through her timid demeanor. Without this support, she is no longer able to share in the same capacity with the teacher. Furthermore, both girls need longer wait time to come up with an answer and sometimes never reach the correct answer. These glaring differences can serve as an argument for the already mentioned strategies. If these strategies are not used, then my findings have suggested that these students do not perform at as high a level as when the methods are executed. There are times when teaching ELLs, that confusion occurs because of a language barrier. A description of a situation such as this is described below.

*Laura wants Betty to make 10 by creating the combination of 2 and 8. She has her make a column of 2 and one of 8 and asks her if the sum is 10. The problem occurs when Betty makes the column of 2 and Laura says “And we have 2 in one and how many in the other?” Betty is confused and responds by holding up the column of 2 saying “2 and 1 and…” She begins to count the other column. She is so confused because she does not understand why one column has 2 and the number 1. She answers that she has 9 because she cannot understand where that other number 1 is coming from. She changes her answer to 12 which of course is not the correct answer either.*

This vignette was interesting to view because these were concepts I knew that Betty and Beth understood. They seemed to be having issues with everyday counting, which is not usually the case. Once I took a closer look at the data I realized that they were confused by the simple omission of a noun. What Laura meant was that Betty had two blocks in one column and she wanted her to find how many she had in the other column. However, Laura omitted the word column, as is common in the English language.
Due to her limited English skills, Betty could not comprehend what Laura was saying when she excluded the noun. She thought that Laura meant she had 2 blocks in the number 1, which did not make any sense to her. That is why she struggled for about 2 minutes in trying to count how many were in the other column of 8. When working with ELLs even omitting a simple part of speech can cause concern. The largest problem is a teacher who does not understand that the behavior of ELLs signifies that they are fighting a language barrier rather than a lack of math content knowledge. This is an issue because it appears that these ELL students are not even able to count correctly, let alone complete basic addition. A teacher who does not implement strategies geared toward helping ELLs achieve in math, would believe that these students are at a much lower level than is actually the case. The language barrier can appear to be a deficit in content knowledge, when really it is just an inability to speak the English language. The vast differences between the implementation of these promising methods and the absence of them in teaching, demonstrate that they can change the achievement of ELLs in the acquisition of math content. Scaffolding in Spanish, relating to personal experiences, and allowing students to express themselves in Spanish illustrated a significant difference when these variables were removed.

Another strategy for teaching ELLs recommended by the literature is the concept of “math talk”. As mentioned earlier “math talk” can be defined as mathematically relevant words or phrases in speech and written communication. “Math talk” includes commonly used math phrases such as take away, corner, sides, row, column, etc. When examining my video data, I found numerous references to math talk. There was math talk occurring in Spanish and English. Also, there were instances where the language was the not the issue, it was that more math talk was necessary for the child to understand. Studies have demonstrated that math talk facilitates greater math comprehension, especially in young children. Klibanoff et al (2006) found a positive correlation between the amount of math talk the teacher used in the classroom and the students’ math achievement. What the literature does not mention is the significance “math talk” has for ELL students. They need the additional support of this strategy, even more than native English speakers.
Incorporating “math talk” into all math activities is extremely important. This is how students learn the meaning for certain vocabulary, because they are learning by action rather than simply listening while the teacher explains the word. I discovered numerous examples of “math talk” in my video data. A good example of geometry “math talk” is using geo-boards to have students make shapes. However, this activity would not be as meaningful without “math talk.” I made sure the students knew that a triangle was defined in that manner because it had three sides and three corners. I used the Spanish vocabulary to describe the shape saying “lados” and “rincones.” I made sure to point to the sides of the triangles that were created on the geo-board. Then I asked the students to show me what the sides were so I knew that they understood the concept. While using the geo-boards and creating all those shapes I tried the saturate the lesson with key math vocabulary. Words like big, small, sideways, long, sides, corners, points, tall, etc. are words that kindergarteners need to learn in a context where they can see how these words are used to describe objects. “Math talk” can be integrated by asking students to express themselves and explain math content using specific math vocabulary. When students are able to do this in their native language, they can go more in depth into their content knowledge, especially if the teacher has used Spanish “math talk” with these students beforehand. A description of students using “math talk” to explain their content knowledge is depicted below.

In this lesson I am working with Betty and Beth again. I am doing a formative assessment with the girls to see if they recognize which number combinations have a sum of 10. I am asking them orally and they respond with a yes or a no. I first ask the girls if 9 and 1 make 10 and they nod their heads in agreement. So far they have been answering my questions correctly, so I decide to give them a more difficult question. I ask the girls if 2 and 2 equal 10. They both shake their heads and say no. I ask them both how they know this does not equal 10, “¿Cómo saben esto?” I am holding a column of 10 blocks in my hand. Betty takes two of them and says in Spanish “If you take away one (tower of 2 blocks) and then you take away 2 more (from the tower of 10) it’s not 10, it is going to be 4.” Another key element in this video is that Beth was also eager to share her response as to why 2 and 2 do not
make 10. This supports the theory of native language creating a low-anxiety environment where students want to share their thinking process. During the same lesson, I ask the two girls if 10 and 0 make 10. Beth repeats the word zero in an inquisitive manner. So I ask the girls if they understand what “zero” means. Betty responds by saying “0, 1, 2, 3...” Then she states in Spanish, “First is the zero and later 1.” Then I ask the girls what the sum of 10 and 0 would be and Betty responds with 10 and this reveals that she comprehends the concept of the number zero.

To a teacher without an understanding of “math talk” this may not seem like an important moment for Betty and Beth. On the contrary, it demonstrates their comprehension of math, ability to use math talk, and ability to express themselves coherently. Betty knows mathematically related terms such as “take away” which is a precursor phrase to understanding subtraction. She also shows that she can add numbers onto others without recounting. She knows 2, and 2 more is 4, rather than having to re-count all of the objects to find her answer. Zero is a notion that is very difficult for young students to understand. They believe that 1 is always the first number that begins the counting sequence. They wonder where this strange number zero falls in their knowledge of ordinal numbers. Betty made it apparent that she knows zero comes before the number 1 in the counting sequence. She knows what zero signifies as well because she was able to answer correctly when I asked her if 0 and 10 were still 10. “Math talk” is essential in both languages. During another instance, I tell Rachel and Ava to make me groups of shapes, but in this case I use the word “formas” which is the Spanish word for shapes. Rachel has no idea what I am saying when I use the word “formas,” but begins making her groups when I say the word “shapes” in English. This shows that she has been exposed to “math talk,” but it has not been in her native language. The major concern is that students do receive this type of scaffolding, whether it is in their first or second language.

The promising strategy outlined in my video data is using as much “math talk” as possible in all math activities. My data suggests that numerous deficits in math understanding are not only due to language barriers, but a lack of exposure to “math talk” entirely. My findings depict various examples where the
During the lesson I want Ava and Rachel to categorize shapes. I hold up two blue circles that are obviously different sizes and ask Ava what the similarities are between the two circles. Ava responds in Spanish by saying “Small and large.” I correct her by saying that I want the similarities and she gave me the differences. It is obvious that she does not understand because she takes the two circles into her hands and keeps discussing their differences. She states that she actually said the reverse of what she meant, which is that she pointed at the larger circle and called it small and called the small one large. I tell her that, while what she is saying is true, the similarities are that the circles are the same shape and color. She nods in agreement.

Looking back on the lesson I can see what went wrong. It was not that she did not recognize that both shapes were circles and blue, but rather she did not know what the word “similarities or similitudes” meant in Spanish or English. This word had never been introduced to her in a “math talk” situation. She has not been exposed to this mathematically relevant word and herein lays the problem with her lack of comprehension. If I had explained what similarities meant and given her an example during this lesson, then I could have dissolved her confusion. That would have been an opportunity to use “math talk” effectively. If I had taken that opportunity, then Ava would have better understood the directions and the math activity in general.

Another video tape shows the students’ confusion with the math word “total” which is the same word in English and Spanish, only it is pronounced differently. I asked the girls to give me three different towers that all together had a total of 10. Instead I received 3 towers of 10 each. The issue here was that Betty did not comprehend what the word “total” meant. I did try to explain this word to her by showing her what 3 towers that had a “total” of 10 would look like. Even more “math talk” explanation would
have really cemented the concept for her. This is a strategy that will be beneficial to all students, but it will especially propel the ELL students to a higher level of math understanding.

There is one more example of where “math talk” would have eradicated confusion in a lesson with Beth. I was trying to help her understand the differences between a rectangle and a square. I wanted her to see that the sides on a square are the same size, but on a rectangle they are not. I asked her in Spanish if all the sides on the rectangle had the same size or “tamaño.” She counted the number of sides and said yes. It was evident that she thought size meant the number of sides. I asked her in English and she still did not comprehend what I was asking. To correct her mistake I had her put the shapes on top of one another in order to see if they matched up. They did not and she seemed to understand the size of them after she saw how they did not fit together. The sides were different between the two shapes. When students answer a question incorrectly teachers can learn to ask themselves, do they not understand the entire concept or is there not enough thoroughly explained “math talk” in the lesson that is causing them to become confused? Once teachers take advantage of the strategy of infusing as much “math talk” as possible in their lessons, they may find less confusion in all students, but they will especially see improvement in their ELL students.

An earlier concept in education was that teachers should instruct the students every step of the way, rather than allowing the students to discover for themselves. Currently, instructional practice is morphing into something entirely different. This change is something I refer to as “free exploration.” This is when the teacher gives the students the materials, general rules, and the objective of the lesson. The teacher turns the learning over to the students and allows them to figure out for themselves how to accomplish the goal of the lesson. The teacher offers guidance when students are stuck, but otherwise it is the students who discover for themselves what the teacher wants them to learn. A fantastic benefit of this strategy is that students not only accomplish the goal of the lesson, they discover other important concepts along the way. Also, the end result is much more meaningful to them because they were the ones who found the answer using their own creativity, rather than the teacher giving them directions every step of the way. It is truly a student-centered rather than a teacher-centered approach. Where this “free exploration” strategy
appears most often in my data is when we were working with geo-boards during the geometry unit. I told the students which shape I wanted to see and it was up to them to create it for me. I did not show them an example of the shape on the geo-board or how to make it beforehand. They were forced to use their problem-solving strategies to achieve the goal of the lesson. Descriptions of two different free exploration sessions are described below.

I give the two girls geo-boards and rubber bands. I tell them I want them to make me a hexagon on the geo-board. Rachel shouts out “But I don’t know how to make a hexagon!” I show her a block shaped like a hexagon and tell her I want that on her geo-board. I reassure that she indeed can do it and if it is too hard then I will help her. However, right now it is up to them to make the hexagon on the geo-board. Ava goes straight to trying to make one on her geo-board and after I reassure Rachel she begins manipulating the rubber band to create one as well. Ava creates what she thinks is a hexagon and shows me her board. In actuality it is not a hexagon, but it is close. What she made was a very large trapezoid. Since a trapezoid is half of a hexagon, it is obvious that she has almost reached the correct answer. I tell her that she was incorrect, but that she is on the right track and should try again. Ava shows another shape that is still not the correct answer. I can see that the girls are becoming frustrated so we make a hexagon together.

However, they experienced how to manipulate the rubber band on the geo-board and became more spatially aware. Even though they did not come to the correct answer and needed my assistance does not mean the free exploration was not a valuable learning experience. Their knowledge showed near the end when I gave them a formative assessment on the shapes and their names in order to review. The girls were much quicker than they were at the beginning of the lesson and were even able to identify the tricky trapezoid, even if they did not say the name correctly. Their exploration meant more to them than me showing them how to make a hexagon on the geo-board.
During this lesson I work with different students and number sense rather than geometry. I give Betty and Beth square manipulatives to work with. Their goal is to make me combinations of 10. At first I ask them to show me 2 groups that made 10. That is their goal and they can make me any groups they want. I let them explore with the squares and figure out which numbers work together. Betty begins using more than 2 groups to make 10. She ends up having 5 groups with 2 in each of her groups. I ask her to explain what she did to me and she goes through each of the groups and says in Spanish that “Here are 2, and here are 2, etc...” To make sure she understands I ask her how many are there in total. She says 10 and I know she understands exactly what she did.

If I did not allow her to explore, or had reprimanded her for not making 2 groups like I had asked then she never would have discovered that 5 groups of 2 make 10. That is a higher level of thinking and a precursor to multiplication.

When giving students the opportunity to explore, teachers should not correct their mistakes, but guide the students into seeing the mistake for themselves and why it had occurred. The teacher needs to learn how to give up some of her control and allow students to unearth their own learning path in order to obtain the final result. If I had corrected Betty’s use of 5 groups rather than 2 then she never would have made her discovery. Free exploration is so imperative because it permits the students to find their own path, with guidance, to the lesson objective. They are being active rather than reactive. If students attach personal meaning to something it is similar to relating concepts to personal experiences that was mentioned earlier. They are having a personal experience in the classroom that they will commit to memory. “Math talk” and math vocabulary are more significant when they are discovered through the free exploration of the child. They have a whole process and event to associate with the vocabulary word. When first employing “free exploration” the teacher may feel as though they are giving the students too much freedom. What I have discovered in my videos is that if I felt like I was giving too much freedom, I was actually not giving enough. There were times where I gave the student the correct answer too quickly rather than giving them the opportunity to find the correct response for themselves. As a teacher, I believe
it is a reflex to step in to give further instruction to a struggling student at the first sign of trouble. However, when the teacher’s desire is for students to discover the meaning for themselves, they must create personal significance rather than being given it by the teacher. Exploration gives students motivation to learn the material and they are more engaged in the subject. This is important for all students, but is especially pertinent to ELL students. They need to attach as much personal meaning as possible to vocabulary or “math talk” since it is not usually given in their native language. The more significance they give to the terms, the better they will remember and understand the language. This is a central strategy that all teachers could use in their classrooms, particularly in subjects such as math and science.

All the previously mentioned strategies are important for ELL students, but something that brings all of these methods together is the use of technology. With guidance from the teacher and ELL supports, literature has shown that technology can be another way to raise the math achievement of ELL students. Simply having ELL students use technology will not improve their math performance (Kim & Chang, 2010). The literature states that computers should be in the classroom instead of a lab, ELL students need teacher guidance while on the computer, and computer games should be modified to help ELL students follow directions on the machine (Ganesh & Middleton, 2006). However, if technology is implemented in this manner then Kim and Chang (2010) have found that the use of computers is correlated with a reduction in the gap of math achievement between native English speakers and ELL students. One of the team members of NSP possessed the knowledge and skills to create his own computer games. He was able to format them to meet the specific needs of the kindergarteners involved in the NSP. I have video data where I am using these games with my ELL students. The computers are inside the classroom and I am guiding the students throughout the process of using the games, which was suggested in the research study of Ganesh and Middleton (2006). These students were not isolated in a computer lab while struggling to understand the technology without assistance. Also, we usually used the computer with two students so they could work with one another.
My findings reveal benefits that come from using computers with all students. Students are more engaged in the subject matter when they are doing their math lessons on a computer. It creates an atmosphere of excitement for them. Since these are children living in a highly technological society, computers are a mode of communication to which they are frequently exposed. Incorporating them in the classroom helps hold their attention for longer periods of time since they are more accustomed to receiving information at high speed from a machine. Another benefit is the computer games gave them a visual representation of the math operations they were striving to understand and perform. Students will have an enhanced comprehension of math when the teacher can make it more concrete, rather than leaving it in its abstract form. The visual the computer provides give students a visual aid with which students can connect math concepts. When they think about addition they will think about a number line or brightly colored squares rather than trying to picture the numbers in their head. Numbers themselves are abstract and sometimes pose problems for young children to understand. A significant benefit of computers is that computer games are able to teach young students problem solving skills. Problem solving is a vital portion of math that many educators occasionally overlook. This is extremely unfortunate because these skills will help students in every other facet of life in addition to math.

Through these computes games, Spanish scaffolding, and social interaction one of my ELL students was able to learn how to count by 2’s through frequently playing these games. A description of this event is given below.

_I am working with Ava and Rachel on the computer. We are playing a game called “Ten Frame Fill.” A ten frame appears on the screen. A ten frame is simply a rectangle that is divided into ten separate squares or boxes. On the computer screen, a certain number of circles appear in the boxes and then the rest are left blank. Above the box it says “How many more to make 10?” The goal of the game is for the students to figure out how many more blue circles they need in order to make 10. This will help them with their automaticity of their “10 facts” which is a precursor to their mastery of basic_
addition. The girls I am working with understand the game so I am pushing them to tell me how many more circles are needed without counting. It is while I ask them to give me the answer when I determine that Ava has learned how to count by 2’s. The problem on the screen is that four of the boxes are filled with blue circles. She has to discover that 6 remain empty, which is the correct answer to the problem. When I tell her that she has to find the answer without counting, I see her holding up her thumb and pointer finger and it appears as though she is “squeezing” the boxes together. After she does that she finds the correct answer. Later on during our lesson, another question comes up with only two boxes filled with blue circles. Again, Ava “squeezes” the squares with her fingers and quickly finds the correct answer. This time I ask her to explain to me how she found the answer. She tells me that she was counting by 2’s. Now I understand that her hand motion was how she was counting two boxes at the same time.

Ava was able to use the visual representations provided by the computer to help her learn how to count by 2’s. The ten frame made the numbers much less abstract and therefore, she was able to learn a new counting strategy. After we played this game we went on to another that used a virtual number line to help students practice their addition facts. The girls did not answer any of these questions incorrectly. The “Ten Frame Fill” game helped them to understand basic addition to the number of 10 and was the connection they needed to help them learn how to perform addition. The advantages of computer games are that each game can build on one another and propel the student to a more advanced level of math. The games allow students to see the “bigger picture” of math. The important notion to remember about the method of using technology is that it must be employed in a certain way. The teacher cannot send an ELL student to use the computer alone and expect them to be able to accomplish the lesson objective. ELL students need direct guidance and to work with their peers on the computer. They will need additional supports such as translations and possibly text to speech. They could also use visual aids that will help them follow the directions on the screen. Without these additional supports, technology has not been
found to help close the math achievement gap between ELL students and native English speakers (Kim & Chang, 2010).

All of these promising strategies can work in conjunction with one another to improve the math achievement of young ELL students. Students will profit from the infusion of their native language in vocabulary support, math talk, and the use of technology. Furthermore, ELL students benefit from teachers who make lessons and vocabulary culturally relevant and allow these students to participate in “free exploration.” As will be discussed in the next section, there is evidence suggesting that Ava, Betty, Beth, and Rachel made strong achievement gains during their kindergarten year. As the teaching strategies described in this report were a large portion of the children’s learning experience, it is likely that these techniques contributed to the ELL students’ achievement. I have argued that these promising strategies assisted in enhancing the amount of growth that occurred in each of these individual ELL students. In conclusion, I will take a closer look at the progress of these students.

**Progress During the Year**

At the beginning of the NSP, Dr. Egan videotaped himself assessing the kindergarten students with the Kathy Richardson assessment (Richardson, 2002). At the end of the school year, I videotaped myself giving the exact same assessment with my 4 kindergarten ELL students. All of the ELL students demonstrated mathematical growth during the school year. Ava and Betty demonstrated the most pronounced achievement gains. Ava began her “number sense” journey by not understanding how to make a “guess” and could only count to 12. She was one of the students who had the lowest level of English proficiency and was at the “beginning to developing” stage of language development. The first time Dr. Egan saw her count the red circles on the table she skipped from 15 to 20 and from 29 to 50. It is obvious she did not have a good concept of the number sequence. However, when Dr. Egan asks her how many she counted she replies by saying 12, which signifies that she does have cardinality (which signifies that she recognizes the last number used when counting the objects represents the amount of objects present). She was able to make a pile of 9 red circles. She could not perform the one more/one less
operations correctly. These operations can be described as simply completing the addition operation of adding one to the already given number or completing the subtraction operation of taking away one. For example, 9 and one more is 10 or 9 and one less is 8. She either did not answer the questions or she said the incorrect answer. The Richardson assessment asks the student to count piles of unorganized objects and the teacher giving the assessment decides what number of objects is most appropriate for the level of the student. The assessment also has a portion where these counters or objects are removed from the workspace and the student has to answer the one more/one less question without the assistance of manipulatives. Ava really struggled in this section and only answered one of the questions correctly. It seems as though she was simply counting backwards for the “one more” section instead of actually understanding the math operations because these questions were not in sequence. From the first video I would not have believed that Ava would become one of the higher math students in the kindergarten class. My end of the year assessment with her was completely different.

In my May assessment with Ava she was able to count to 32 perfectly. However, there is an important difference in my assessment with Ava that did not occur in the one with Dr. Egan. I gave Ava the opportunity to count in English or Spanish, and she chose Spanish. The use of her native language and the opportunity for her to use it during the assessment supports the infusion of native language strategy mentioned. The next step of the Richardson assessment is to ask the student to “count out a particular quantity.” In August she could only count out 9 marbles. This time she counted out 18 accurately. Her growth in math was confirmed when she counted to 18 by 2’s. She took the pile of marbles and arranged them two at a time and counted them in that manner. Counting by 2’s at the end of kindergarten in a low-income school shows that the student has made mathematical progress. She knew how to do one more/one less with very few mistakes. She could do one more and one less to 100. For example, she knew that 59 and 1 were 60 and that 100-1 was 99. It took her a little while for her to give me the correct answer for 100-1, but she did eventually tell me the correct response. She knew all of those without manipulatives. Dr. Egan gave the kindergarten students the Richardson assessment called “counting objects” at the beginning of the year. There is another Richardson assessment that is more difficult called
“Changing Numbers.” At the end of the year we gave the students who excelled on the first Richardson assessment this one as well. Ava excelled on the first Richardson so I gave her this one as well. This one deals with basic addition and subtraction since the students have to change piles of numbers. “Changing piles of numbers” is a skill that deals with counting and learning basic addition and subtraction facts. The student is first given one number they must create with manipulatives. Then the student is asked to make that pile have a different number of objects rather than creating a new pile. For example, the student is asked to count out 8 marbles and then is asked to turn those 8 marbles into 10 marbles without making a new pile of 10. The goal of this activity is that the student will eventually be able to add 2 more marbles without having to think about it or count. Ava changes piles by counting by 2’s and is able to tell which number is more and which one is less. She can do very basic subtraction and addition. With some guidance she was able to tell me that she needed to take away 3 marbles in order to change 10 to 7. When I asked her to change 7 to 9 she added to marbles without hesitating and re-counting. She knew that 7 + 2 was 9. Again, this is a skill practiced and perfected in first grade rather than kindergarten. She also showed that she knew 2+3 was 5.

For a student who could only count to 12 in the beginning of the school year, this is noteworthy progress. She is now able to count by 2’s, complete basic addition in her head, knows how to subtract from 100, and understands the concept of one more/one less. Also, she knows how to guess instead of simply counting the objects and not comprehending what the word means. On the “Counting Objects” Richardson assessment her estimate was 30 which is a very good one since 32 was the actual number of marbles on the table. The assessments I gave to Ava were given in Spanish and she had the choice to answer in Spanish. She did most of her counting and said her numbers in Spanish, however sometimes I prompted her in English. Ava also demonstrated that she can answer correctly in English as well as her native language. There seems to be evidence that the promising teaching strategies I used contributed to Ava’s progress in number sense and geometry. Her progress can be connected to native language infusion, vocabulary support, cultural relevance, math talk, “free exploration”, and the guided use of technology.
She is not the only student who excelled because of the use of these strategies. Betty’s progress can also be tied to the implementation of the promising strategies that improve the acquisition of math content knowledge in young ELL students. Betty was not taped by Dr. Egan, but Richardson assessment data was recorded for her in the beginning of the year by a teacher candidate from Augustana College. I have access to that data and I looked at her results. Her Richardson assessment from August illustrates that Betty could only count to 7 although she was able to make an estimate. She tried to make a pile to 9, but she did not count accurately and with ease. However, it does say that she has cardinality. The data states that she had some issues with counting past 5. Even counting to 7 was slightly difficult and it is apparent that she needed more practice counting. When doing one more/one less she never knew the answer without counting. She was not able to think about the answer and reason it out in her mind. She had to count the new piles that were made in order to give the teacher the correct response. Since she was not able to understand the concept of one more/one less with the manipulatives, completing the operations without the manipulatives resulted in almost no correct answers. In fact, some of them were extremely far off the mark. Betty said that 3 and 1 were 16. Not only could Betty not count at the target level but she could not do one more/one less or count/think about a quantity without the presence of concrete objects. Betty was always counting or guessing rather than innately knowing that one more than 9 is 10. She did not understand the sequence or the pattern of the numbers.

In May, Betty was given the same Richardson assessment just like Ava was. She was able to make an accurate estimate on this one just like she did in August. She counted accurately to 31. She had some trouble making a pile of 18, but with some guidance she was able to create the pile correctly. This problem showed me that I had not worked with her enough on making piles of numbers. Instead we mainly focused on counting objects that were already placed into piles for her. This skill is different and she needs more practice in order to be ready to apply that math skill. The one more/one less section of the assessment indicated the most about Betty’s growth because this was the section that she really struggled with in August. She was able to tell me one more up to 13 without counting. She did not even hesitate; she knew the answer right away. She was able to perform one less from 13 as well. The gains she has
made in the concept of one more/one less are significant because in August she was always counting and not able to retrieve the answer mentally. We then moved to the section of the Richardson assessment where Betty no longer had the support of the manipulatives and the problems were not in sequence. She answered the majority of the questions correctly. This showed that she was able to perform basic addition facts. In the beginning of the year she could not add one more to a quantity and yet, during the year she knew that 2 and 2 made 4. We moved on to the Richardson assessment of “Changing numbers” because she did well on the “Counting objects” assessment. The first number I asked her to count out was 6. She did better on making a pile of 6 then she did of 18. I think the practice of previously making a pile of 18 helped her with this task. Betty quickly realized that 10 was more than 6 so she needed to add more to the pile in order to change it into the number 10. She added 4 quickly, although she did not add them all at the same time. Then I asked her how many she added to change 6 into 10. She took away 6 and knew that she was left with 4. She then told me that she needed to add 4 to 6 in order to make 10. She is not quite at the level of mastering basic addition facts, but is close. She came from only being able to count to 7, to knowing that 6 and 4 make 10 with the guidance of the teacher. She did well on the “Changing Numbers” assessment, but it showed that she was not quite ready to perform basic addition without guidance or manipulatives. The assessments reveal that she has a firm grasp of more, less, and how to add numbers to preexisting amounts. However, she cannot yet add the numbers in her head to the extent that a first grader could. Through the year, she progressed from not being able to count to having the ability to comprehend how to recognize her addition facts to 10. I am confident that the teaching strategies I utilized that were targeted to assist young ELL students with number sense and geometry concepts contributed to Betty’s growth.

There was no video data collected that compared the year long journey of kindergarten ELL’s working in a mainstream English classroom without the support of these promising methods. However, the data that was collected where the ELL students participated in math lessons taught only in English suggests that the findings of this data would support my argument. These strategies are beneficial and they do support the acquisition of math content knowledge of young English Language Learners. Of
course, they are not the only reason for the unforeseen growth these ELL kindergarteners have made throughout the school year. These students had a very dedicated regular classroom teacher whose efforts facilitated their progress as well as a devoted ESL teacher who used her time to improve their English proficiency skills in all subjects. Nevertheless, there is evidence that my strategies positively affected the results of the students Richardson assessments. How were they able to perform so well and overcome the numerous struggles they had in their content knowledge in August? These strategies are part of the answer to that conundrum, along with the commitment of their classroom teacher, ESL teacher, and family support.

Conclusion

ELLs are thoroughly struggling in U.S. public schools today and many do not graduate from high school. While these methods can help to slowly transform that bleak future, there is no guarantee that these techniques will work for every ELL in all classrooms in the U.S. Also, it is not certain that the progress that was made by these ELL students was due to these techniques. However, there is strong evidence that these students would not have developed their math skills as fully if it had not been for these strategies. The students have demonstrated that they not only understand how to perform mathematical operations, they know the meaning behind them as well. Instruction in the students’ native language and creating cultural relevancy allows the students to use their first language and make meaning out of abstract concepts. “Math talk” in Spanish and English helps students place the vocabulary in context and helps them to comprehend how to develop fluency in the language of math. “Free exploration” gives ELL students a chance to create meaning for themselves in their own language and connect it to their distinctive personal experiences. Finally, carefully created technology opens a door for ELLs of which they had previously not possessed the key. They can use technology to develop English skills, Spanish skills, and comprehend math in a unique environment tailored to their individual needs. The computer gives students accommodations that the regular classroom atmosphere cannot provide for
every lesson. As demonstrated throughout the report, there is verification that these strategies have a positive impact on English Language Learners acquisition of math content.

The number of English Language Learners is continually rising in the United States. Of this group, around 79% reported that Spanish is their native language (McKeon, 2005). Therefore, these strategies were tested with identified ELL students who speak Spanish as their native language. There are various practical implications for all teachers in the United States public school system. Whether a Bilingual or a mainstream English teacher it is a fact that ELLs will be in the classroom. These strategies will provide teachers with practical ways to tailor their math instruction to meet the needs of the ELLs in their classroom. When teachers implement research-based methods that assist ELLs it is possible to change the currently disheartening academic future of this group of students.
References


Illinois English Language Proficiency Standards for English Language Learners (K-12), Illinois State Board of EducationU.S.C. (February 2004).


