Mathematics for English Language Learners

Conference 2009

"Marriage of Writing and Mathematics"

Photo courtesy of Small Paws Rescue, Inc.

Presented by
Deborah Svedman,
M.Ed., NBCT
University of Texas at El Paso
June 29, 2009

About Deborah Svedman:

- 28 years teaching experience in El Paso, but it all started at a migrant school in Colorado
- Master's in Bilingual Education
- National Board Certified Teacher in mathematics
- Certified in Texas for secondary math, general elementary, and bilingual/ESL
- Taught all levels: 1st grade – graduate school, even P.E.
- Named Exemplary Teacher by U. S. Dept. of Education
- National Presidential Awardee for Excellence in Science and Mathematics Teaching
- dsvedman@utep.edu*

The Research Supports Writing

"In the majority of cases, both the language and the content taught in school are new to ELLs. Therefore, when language instruction is ***linked closely to real-life experiences, including the content or themes being taught in other classes,*** students have more success integrating the two." (Garcia & Godina, 2004; Short, 1999) (*my emphasis*)*

More Research…

"With teacher facilitation, students can access their content knowledge to bolster their academic language development and similarly use their language skills to gain more content knowledge.

Adolescents thrive in situations in which they recognize the relevance of what they are learning. By helping them understand how the acquisition of language and academic literacy skills will allow them to achieve at higher levels in other classes, they may become more motivated.

In a learning environment that incorporates language development with content or themes, students can see for themselves the importance of literacy skills in understanding the way material is presented and how texts are organized." (Moje et al., 2004) (*my emphasis*)*

Still more research…

"Thus, providing content- or theme-based instruction gives ELLs an important framework for assimilating new information and applying language skills learned across the curriculum." (Echevarria, Short, & Powers, 2006; Garcia & Godina, 2004; Schleppegrell, Achugar, & Orteíza, 2004; Short, 1999)*

TEKS and ELPS

- **Math TEKS: (7.2)** (C) use models, such as concrete objects, pictorial models, and number lines, to add, subtract, multiply, and divide **integers** and connect the actions to algorithms **(8.4)** The student is expected to generate a different representation of data given another representation of data (such as a table, graph, equation, or verbal description). **(8.14)(A)** identify and **apply mathematics to everyday experiences**, to activities in and outside of school, with other disciplines, and with other mathematical topics; **(8.15) (A)** **communicate mathematical ideas using language**; **(A.4) (A)** find specific function values, **simplify polynomial expressions,** transform and solve equations, and **factor** as necessary in problem situations; **(A.4)(B)** use the commutative, associative, and **distributive properties** to simplify algebraic expressions; **(G.1) (A)** **develop an awareness of the structure of a mathematical system**, connecting definitions, postulates, logical reasoning, and theorems; **(G.3) (A)** determine the validity of a **conditional statement, its converse, inverse, and contrapositive.**
- **ELPS (English Language Proficiency Standards**): (edited) **(c)(2)(C)** learn new language structures, expressions, and basic and academic vocabulary; **(c)(3)(F)** ask and give information; **(c)(5)(B)** write using newly acquired basic vocabulary; **(c)(5)(D)** edit writing for standard grammar and usage.*

My in-the-trenches research indicates that:

- ELL students have difficulty with ordinary English as well as the academic terms.
- Most TAKS problems involve reading in English, some of which is important and some not.
- It is not possible to teach students every word they need to know for the TAKS, so be sure to teach them the math concepts well and the academic terms that go with them.
- Observe the vocabulary on the next slide:*

Necessary TAKS vocabulary:

Shown below	Above	Widest
Narrowest	**Twice**	**Product**
Shift up/down	Shaded	Entire
Following	*How long	At **Least**
Reach	Choose	Trend
Replacement	**Solution** set	A few
Most of the _____	Some of the ___	No more than

*Distance *and* time **(terms found in math dictionary)**

(Selected by first-year ELL high school 9th and 10th graders from released TAKS tests 2004-2006.)*

How do I use writing in math?

- Writing can help reinforce understanding
- Writing helps internalize content material
- Writing can be used to explain some mathematical concepts – and this is what I will show you today.
- I'm asking you to be the ELL students and write examples so YOU will internalize and remember what to do in your classes.*

Get ready – pencil and paper, please!

- Common problems with denominators and/or monomial terms are:
- Students add denominators $\frac{1}{2}+\frac{1}{3}=\frac{2}{5}$
- Students add unlike terms $2x + 3y = 5xy$
- Students aren't taught in a way they understand or remember that to add (or subtract), things ***must*** be the same.
- We're going to physically demonstrate first, then write non-math examples to get the idea.*

Uncommon/Unlike Denominators

 +  =  ???

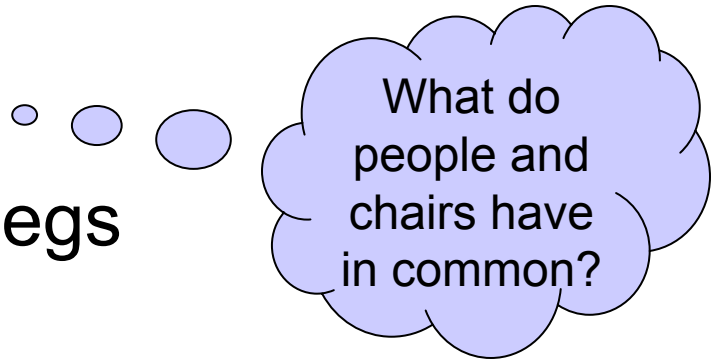
- The need for common denominators is obvious when students say, “3 dogs and 4 cats are 7 animals” or “5 girls and 2 boys equals 7 persons.”
- When students are told they already make common denominators naturally and automatically, they have more confidence to create them mathematically.*

Uncommon/Unlike Denominators

Expand to things that don't have an obvious connection:

3 people + 2 chairs = ??

3 people + 2 chairs = 14 legs



Build the vocabulary necessary and show the equivalencies:

3 people = 6 legs; 2 chairs = 8 legs

Now add: 6 legs + 8 legs = 14 legs

Students must realize that the numerators are not always "just added"*

Uncommon/Unlike Denominators Recap

- Students can write sentences demonstrating like and unlike denominators
- Give them several examples, then ask them to create their own
- They cannot use your examples and simply change the numbers.
- Encourage/require a variety of categories – cars, fruits, colors, school materials, furniture, animals, etc.
- Share with the class, give attention or bonus credit to most diverse, most creative connections.*

Inequalities

- Make a poster showing the signs. Use simple numbers:

Inequality signs	
$3 < 8$	3 "is less than" 8
$9 > 5$	9 "is greater than" 5
$6 = 6$	6 "is equal to" 6
$4 \leq 11$	4 "is less than or equal to" 11
$7 \geq 2$	7 "is greater than or equal to 2*

Inequalities

- Ask about activity requirements: voting, amusement park ride, movie ratings, or the catch-all, money.
- Determine what ages, amounts, or sizes are sufficient, which are insufficient, and write the concept using inequality signs and numbers.
- Write the concept in English using terms for inequalities such as “at least” or “up to.”
- Provide students with a basic list of terms to use.*

Inequalities vocabulary

Now let's write some examples:

You must be at least 16 years old to get a driver's license. Math sentence:

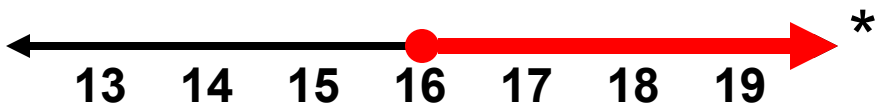
(word) **Age ≥ 16** (or variable) **A ≥ 16**

English sentences:

You must be *a minimum of* 16 years old to…..

You must be *no less than* 16 years old to….

Now a graph:



Integer Concepts

- Use object like rulers to demonstrate not having enough to take, thus “owing”
- Students understand concept of owing
- Emphasize negatives MUST have sign, like BC dates. No sign on a negative number is NOT correct.
- Now, make a t-table for a list…..*

Integer Concepts

- List of simple opposite words generated by students: up/down, right/left, in/out, etc.
- Also use winning, losing of games
- Directions: North/South, East/West
- Math: positive/negative (NOT fraction/decimal or whole/fraction, but fraction/reciprocal)
- Make a new list of opposites for money: spend/save; win/lose, earn/pay, give/receive *

Integer Addition Concept

- Demonstrate concept with items, then words, then numbers. “If you win 3 games and lose 5 games, are you more of a winner or more of a loser?” By how many games?
- If you win 3 games **and** lose 5 games**…then?**
- +3 **+** -5 **= -2**
- **Give how many examples??**
- **Vary the numbers, but keep them small**
- **Have students develop scenarios from numbers and write the sentences.***

Algebra Connections via Grammar

The Distributive Property and factoring are two related and often troubling concepts.

Simple sentence structures can be used to show how these concepts work.

Make sure you do several examples first with words, then transfer over to numbers.

KISS: postpone using negatives, fractions, or other distractions until they get the idea.*

Algebra Connections via Grammar

- “Jose, what two things do you like to eat?”
- “I like to eat pizza and hamburgers.”
- Write: Jose eats pizza and hamburgers.
- Ask class to create two sentences out of the one you wrote. They come up with “Jose eats pizza.” and “Jose eats hamburgers.”
- Ask what the difference is between the first sentence and the second two sentences.
- You have the same meaning, but different structures.*

Algebra Connections via Grammar

- Repeat procedure at least 3 more times, selecting different students and different things for them to list: colors, cars, school subjects, sports, etc. Emphasize that the meaning is the same; the sentence structure is different.
- Juana likes cumbias and hip-hop.
- Juana likes cumbias. Juana likes hip-hop.*

Algebra Connections via Grammar

Show the connections using a curved line:

Juana listens to cumbias and hip-hop.

Juana listens to cumbias.

Juana listens to hip-hop.*

Algebra Connections via Grammar

- Write a simple expression with numbers:

3(2 + 4) Ask students what the operations are. They ***must*** know that 3 is multiplied.

Using the same format as the sentences, ask students to "translate"

3 (2 + 4)

3·2 + 3·4

6 + 12

18

Verify with order of operations:

3 (2 + 4)

3(6)

18 ☺

Algebra Connections via Grammar

- You can introduce a negative by asking a student to list something he likes and something he doesn't like. The sentence process is still the same.
- Juan wears blue but doesn't wear pink.
- Juan wears blue. Juan doesn't wear pink.*

Distributive Property and Factoring Recap

- Relate to simple sentence structures
- Use student information to write sentences
- Rewrite to change the format, but not the meaning
- After several examples, switch to numbers
- After several examples with adding numbers, switch to subtracting numbers or negatives
- After several examples, include variables
- Progress to using x^2 if appropriate*

Math Poetry

TRIANGLE

Three sides form a triangle

Right has a right angle

Isosceles 2 egual sides

Ateepee is shaped like a triangle

No egual sides is scalene

Glue 2 triangles together to make a square

Like this: 

Equilateral 3 egual sides

Pedro Fragoso

RATIO

Ratio compare two numbers.
Also the propotion compare
Two numbers
If a ratio compares a number to
One hundred its a percent.

By
Jose Pablo Villarreal

English Speaking: Texas in July is hot outside.

- statement: If it's Texas in July, then it's hot outside.

  if p **then q**

- converse: If it's hot outside, then it's Texas in July.

  if q **then p**

- inverse: If it's not Texas in July, then it's not hot outside.

  if not p **then not q**

- contrapositive:

  If it's not hot outside, **then it's not Texas in July.**

  if not q **then not p**

Let's try some more!

- The cafeteria serves enchiladas only on Friday.
- If the cafeteria serves enchiladas, then it's Friday. (true)
- If it's Friday, then the cafeteria serves enchiladas. (true)
- If the cafeteria doesn't serve enchiladas, then it's not Friday. (true)
- If it's not Friday, then the cafeteria doesn't serve enchiladas. (true)*

Can you see the possibilities?

- Students are writing with a purpose.
- Students are learning the concept in words first, which can be applied to symbols and transferred smoothly later.
- Students can practice grammar glitches that negative statements in English cause.
- Students can use reasoning on simple everyday statements before moving to mathematical concepts and decisions.*

Mathematically Speaking

- We start with a statement of fact, like, “A triangle is a polygon.”
- **If-then statement:** If an object is a triangle, then it is a polygon (true).
- **Converse:** If an object is a polygon, then it is a triangle (false). This is false because not all polygons are triangles. A square is a polygon but not a triangle.
- **Inverse:** If an object is not a triangle, then it is not a polygon (false). A square is not a triangle, but it is a polygon.
- **Contrapositive:** If an object is not a polygon, then it is not a triangle (true).*

Round Robin Writing (never reading)

- Groups of 4-5 students, each with paper to write on.
- Students write conditional statement from statement of fact on their own paper, then pass the papers to persons on left.
- New person writes next type of statement on paper, then passes to the left.
- Keep rotating papers, but go back and compare notes after each group of conditional statements is finished. Check for reasonableness, correct usage of English, and true/false justifications.*

To recap:

- You can teach many ideas in math through parallel concepts in language. Look for them and you'll find them.
- You need to be supportive and give students reasons for writing in math class.
- You need to teach concepts, not just procedures, to your students.*