Welcome to:

Vocabulary COUNTS in Mathematics!

May 30, 2014 MMATYC 2014

Dr. Amber Rust, Anne Arundel Community College
with cooperation from Regina Souhrada, AACC

Assumption

When a student is not successful in mathematics, teachers usually assume the difficulty is with the student's mathematical ability or possibly the student's dislike of mathematics, but the truth may more likely lie with the student's poor ability to read the mathematics textbook.

(Draper, Smith, Hall, & Siebert, 2005; Kane, Byrne, & Hater, 1974; O'Mara, 1982)

Students' Common Experiences In Mathematics Classrooms

- Students find mathematics textbooks to be intimidating and confusing, therefore just skip past the explanations. (Draper, 1997)
- Students expect the teacher to be the expert, do all the talking, and be the center of the classroom.
- Students say the best means of learning mathematics are (Stodolsky, Salk, & Glaessner, 1991)

1. "hearing an explanation"
2. "asking someone"
3. "being told what to do"

5 Reasons why mathematics textbooks are difficult to read.

(Barton & Heidema, 2002)

1. Writing style in mathematics textbooks is compact and succinct with little redundancy.
2. Overlap between mathematics and everyday English vocabulary can cause confusion.
3. Have more concepts per word, per sentence, and per paragraph than any other kind of text.

5 Reasons why mathematics textbooks are difficult to read.

(Barton & Heidema, 2002)

4. Readers need to be proficient at decoding not only words but also numeric and nonnumeric symbols.
5. Layout of the text can inhibit comprehension. Students often skip over the worded parts looking for examples, graphics, or exercises.

Content Area Reading Strategies

- Reading strategies are not intended for students to *learn-to-read* but rather to *read-to-learn* from text.
- Reading Strategies are truly Learning Strategies
  - Students can use strategies to help organize and comprehend what is read.
  - Faculty can use strategies to check on student comprehension of what is read.

In Mathematics Vocabulary
(Rubenstein, 2007)

- Some words are…
  - found only in mathematics *(e.g., denominator, hypotenuse, polynomial, histogram)*
  - shared with science or other disciplines *(e.g., divide, radical, power, experiment)*
  - shared with everyday English, sometimes with different meanings, sometimes with comparable meanings in mathematics *(radical, fraction, similar, variable, median)*

7

and

Some words…

- have multiple meanings in mathematics (*e.g., point, cube, range*)
- Sound like other words (*e.g., sum & some, plane & plain, intercept & intersect, complement & compliment, hundreds & hundredths, pie & pi)*
- are learned in pairs that often confuse students (*e.g., complement & supplement, combination & permutation, solve & simplify, at most & at least*)

8

Vocabulary: Symbols

A symbol can also have…

- multiple meanings within mathematics.
- meanings in everyday English.
- meanings in other content areas.
- a need for several words to describe.
- placement that matters.
- the need to read in ways other than left to right.

9

Symbol(s)	Meanings/Placement
×	of, by, multiplication, a letter, a variable, an axis
:	ratio, scale, colon, URLs
3	x^3, 3^2, x_3, $\sqrt[3]{x}$
–	x^{-2}, -2, hyphen; can imply negation, subtraction, range
×, ( ), *, ·, *ab*	multiplication

Context Matters!

The procedure is actually quite simple. First you arrange the pieces into different groups. Of course, one pile may be sufficient, depending on how much there is to do, and how different the pieces are. If you have to go somewhere else due to lack of facilities, that is the next step. Otherwise, you are set. Do *not*, however, overload the unit.

11

The Criteria for Choosing Various Content Area Reading Strategies

- Easily incorporated
- Little if any learning curve for faculty member
- Research-based benefit for students

12

Frayer Model

Definition	Facts/Characteristics
WORD or SYMBOL	
Examples	Non-Examples

13

Frayer Model

Definition	Facts/Characteristics
An expression in this form is called a radical, ***b*** is called the radicand and the ***n*** is called the index of the radical. $\sqrt[n]{b}$	$\sqrt{a}$ is the positive square root of ***a*** $-\sqrt{a}$ is the negative square root of ***a***
RADICAL	
Examples $\sqrt[4]{81}=3$ ***because*** $3^4=81$ $\sqrt{1}=\sqrt[3]{1}=\sqrt[4]{1}=\sqrt[5]{1}=1$ $\sqrt[n]{0}=0 \quad \sqrt{9}=3 \quad -\sqrt{9}=-3$	**Non-Examples** $\sqrt{-9}=$ ***can't do*** Not a radical – this is a division sign $3\overline{)2205}$

14

Frayer Model

Definition	Facts/Characteristics
These are radical signs . When no superscript number is in front (called the index) it means it is square root. With a "3" index it becomes a cube root and so on.	*there is never an index=1 *odd roots are always the same sign as the number under the radical. $\sqrt[n]{1}=1 \quad \sqrt[n]{0}=0$
$\sqrt{}$ or $\sqrt[n]{}$	
Examples $\sqrt{9}=\pm 3 \quad \sqrt[3]{8}=\sqrt[3]{2\times 2\times 2}=2$ $\sqrt{\lvert 9\rvert}=3 \quad \sqrt[3]{-8}=\sqrt[3]{-2\times -2\times -2}=-2$ $\sqrt{\lvert -9\rvert}=3 \quad \sqrt[n]{x^n}=x$	**Non-Examples** $3\overline{)2205}$ Not a radical – this is a division sign

15

Your Turn!

Essential Characteristics
- contains water
- has a shore
- is surrounded by land except at areas where it meets another body of water
- larger than a pond

Nonessential Characteristics
- may contain water plants and fish
- likely contains fresh water
- may provide an area for recreational activity
- may provide a habitat for wildlife
- may be formed by glaciers
- may be an expanded part of a river
- may be formed by a dam

?

Examples
_____Ontario
_____Simcoe
_____Temagami
Ramsey _____
_____Victoria

(replace the blank with the unknown word)

Non-examples
- pond
- puddle
- swimming pools
- Elliot Lake (town)
- Georgian Bay
- Pacific Ocean
- St. Lawrence River

16

What is it?

Essential Characteristics
- is a number
- has no fractional or decimal part
- can be modeled with two color tiles

Nonessential Characteristics
- may be positive
- may be negative
- may be zero

?

Examples
-2
0
325

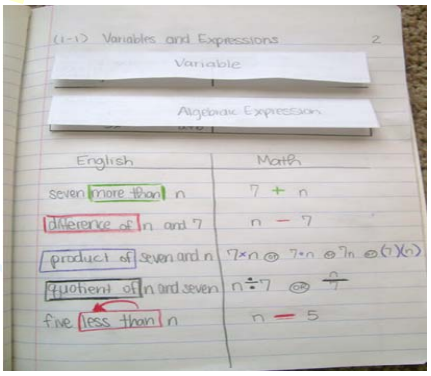
Non-Examples
0.5
-1.2
2/3

17

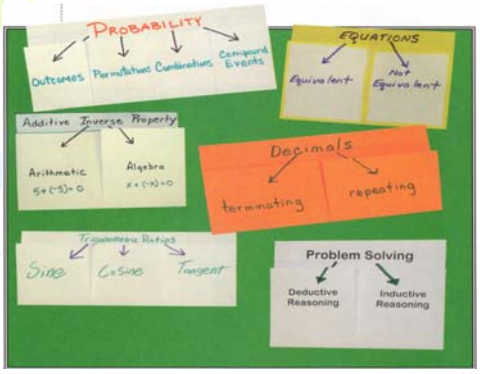
Foldables (Dinah Zike)

- Visually represents relationships in the textbook
- Make 2-dimensional information 3-dimensional
- Relate to and organize vocabulary differently from the textbook
- Can reach all learners including ELL students
- Can create study guides, illustrations, or examples
- *Fun!*

18

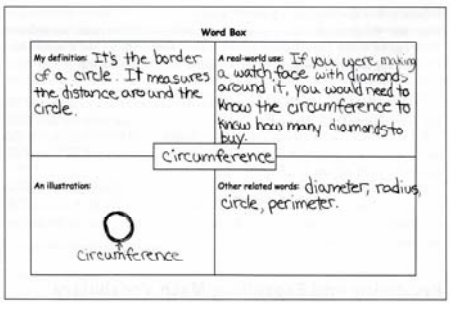


19



20

Word Box



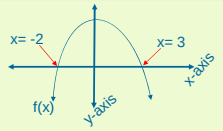
21

Verbal and Visual Word Association

Vocabulary Term(s)	Visual Representation
Definition(s)	Personal Association or a characteristic

22

Verbal and Visual Word Association

Root, Zero, Factor, Solution, x-intercept	
Each word can represent the answer to the function *y=f(x)* where *f(a)=0 and a is a root, zero, factor, solution, and x-intercept* -Point (a,0) is the x-intercept of the graph of y=f(x) -number *a* is a zero of the function *f* -number *a* is a solution of f(x)=0 -(x-a) is a factor of polynomial f(x) -Root is the function on the TI for this	Just find the answer to the function and that will be the zero. If I graph it, the zeros are where the function crosses the x-axis. Special Note: this is just for real solutions.

23

Concept Maps

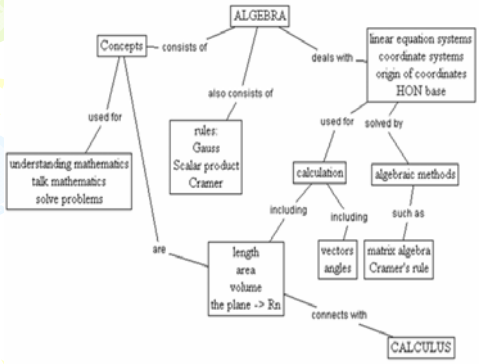
- Improve memory and comprehension of a topic. (National Reading Panel)
- Visually represent relationships between ideas, notation, pictures, and words differently from the textbook's presentation.

24

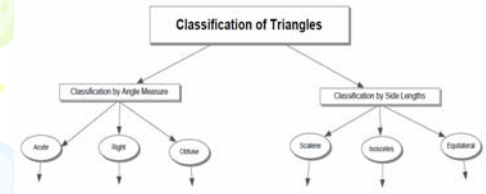
Concept Maps

- Show in a single picture large amounts of information which is great for visual learners.
- "Increases the odds that a student can find a format and medium that are accessible and useful….Even students for whom access is not a problem will benefit from the redundancy of mixed media and formats, which can foster deeper understanding" (Strangman, Hall, & Meyer, 2003, p. 13).

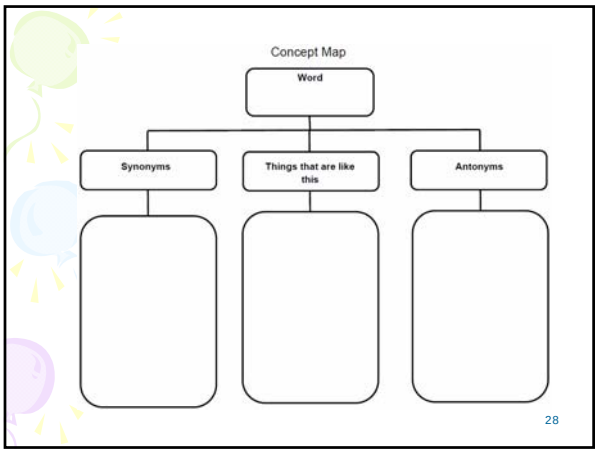
25



26

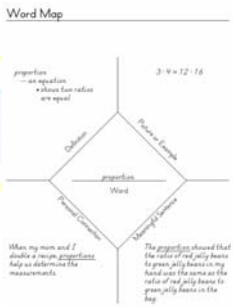


27



28

Word Map



- Become better at learning and retaining words outside of mathematics classroom.
- They make connections between their lives and mathematics.
- Improves reading comprehension – they understand the words and connected concepts better.

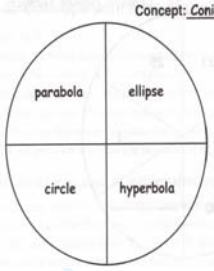
29

Concept Circles

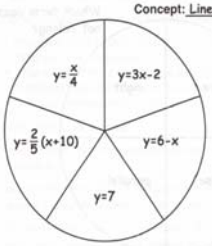
- Students study words critically, relating them conceptually to other words.
- Students identify common attributes or a concept relationship.

30

Concept: Conic Sections

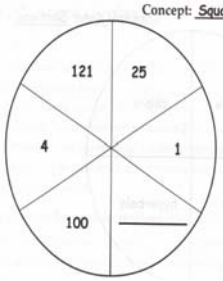


Concept: Linear Equations

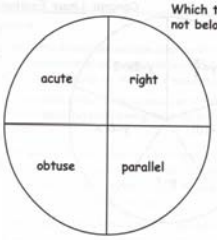


31

Concept: Square Numbers

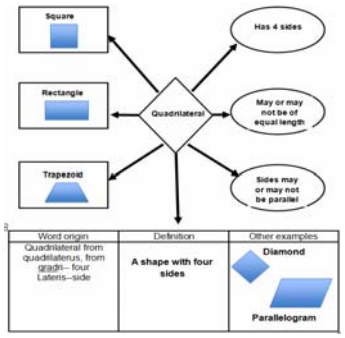


Which term does not belong?



32

Vocabulary Clusters



33

Knowledge Rating Templates

Directions: In the space provided, write the words your teacher has chosen. Respond individually to each category by placing an X in the appropriate boxes. Be ready to explain or illustrate your responses.

Word	Have Seen or Heard	Can Say	Can Define	Can Spell	Can Use in a Sentence	Don't Know at All

Topics	A lot!	Some	Not much

34

Knowledge Rating Examples

How much do you know about the equations listed below? Place an X in the spaces that signal your knowledge.

	Can define	Can give an example	Can sketch basic graph	Am totally lost
Linear equation				
Identity equation				
Constant equation				
Quadratic equation				
Polynomial equation				
Rational equation				
Logarithmic equation				
Exponential equation				

Place an X in the spaces for which you agree.

	I can define	I can give an example of	I can graph or find on the graph	I can graph or find on the graph using my graphing calculator
Rational function				
x-intercept				
y-intercept				
Vertical asymptote				
Horizontal asymptote				
Extrema				

35

Modified Tic-Tac-Toe

- This strategy can assess students' understanding and uncover possible misconceptions.
- Give students 2-4 vocabulary words and ask them to write one sentence properly relating all the given words.

36

Modified Tic-Tac-Toe Example

- Given: *Treatment group, control group, randomization*
- Excellent response: *A control group* is used as a baseline for comparison with the *treatment group* and *randomization* is used to put people into the groups without bias.
- Poor response: When you do research you have the *treatment group* you reserve a fake pill and the *control group* you receive the treatment also known as *randomization.*

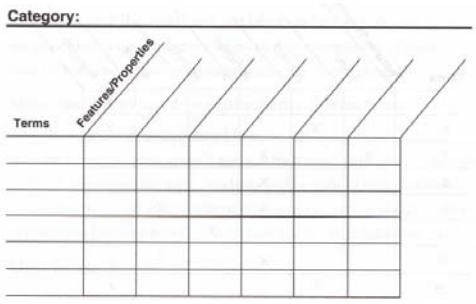
37

Typical to Technical

Word	It usually means…	In math it means…
Mean		
Median		
Plane		
Power		
Rate		
Similar		

38

Semantic Feature Analysis Template



39

Semantic Feature Analysis Examples

Category: Polygons

Terms	Features/Properties: closed	regular	rectangle	4-sided	3-sided	opposite sides parallel
square	X	X	X	X		X
rectangle	X		X	X		X
triangle	X				X	
quadrilateral				X		
regular polygon	X	X	X			
rhombus	X	X		X		X
trapezoid	X			X		

Quadrilateral	4-sided polygon	Opposite sides are congruent	Opposite sides are parallel	Exactly one pair of parallel sides	Vertex angles are congruent
Square	X	X	X		X
Rectangle	X	X	X		X
Parallelogram	X	X	X		
Rhombus	X	X	X		
Trapezoid	X			X	

40

Semantic Feature Analysis Example

Functions	Number of zeros possible	Describe general shape of graph	Sketch general shape of graph	Number of extrema possible
Linear function				
Constant function				
Quadratic function				
Cubic function				
Polynomial function				

41

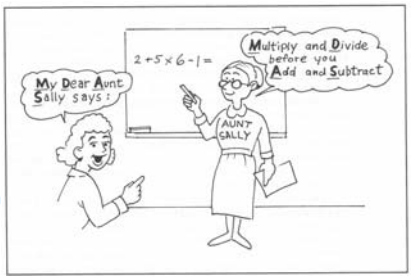
Semantic Feature Analysis Example

Fill in each cell with the correct answer, if one exists. If there is not a correct answer, write NA.

Graph of given equation	Give the max, if it exists	Give the min, if it exists	List all zeros	Give the y intercept	Give all intervals where y is increasing	Give all intervals where y is decreasing
$y = x^2 - 9$						
$y = x^2 + 9$						
$y = x^2 + 2x + 1$						
$y = x^2 - 2x - 24$						
$y = x^2 + 7x + 12$						

42

Mnemonics
(A method for improving memory)



Mnemonics

- Definition: process of forming mental connections or bonds between sensations, ideas, or memories (Holliman, 2009).
- They
  - assist with cueing and recalling information.
  - take concrete associations and links them with abstract symbols.
  - help organize and summarize processes.
  - are superior to rote memorization.

Mnemonic Examples

- **ROY G BIV** (Red, Orange, Yellow, Green, Blue, Indigo, Violet)
- **Dead Mice Smell Bad** for long division - divide, multiply, subtract, bring down.
- **Every Good Boy Does Fine** for the musical notes on a treble cleft.
- **Listen** and **Silent** are anagrams.

Gesturing (aka, Motor Imaging)

- Gesturing connects the meaning of a word with a relevant movement (e.g., hands, face, body). Gesturing is a natural part of life.
- They
  - enhance memory and facilitate learning.
  - concepts are learned with durability.
  - engage the spatial, visual, and kinesthetic neural pathways.
  - can represent abstract ideas.
  - are good for ELL students.

Word	Gesture Examples
polygon	Elbows out – hands in – middle fingers of hands touching in front of body.
convex	Straight hands, middle fingers touching and pointing away from the body like an arrow.
concave	Opposite of convex. Straight hands, middle fingers touching and pointing in towards the body like an arrow.
vertex	Hold up index finger of left hand and the index and middle finger of right hand. Bring all three fingers together.
edges	Hold left hand vertically, fingers pointing away from body. Hold right hand horizontally, fingers pointing away from the body. Bring the edges of hands together to form what resembles a shelf.

In Conclusion

- Research shows…
  - explicit instruction of vocabulary is highly related to reading comprehension.
  - connecting new material to students' prior knowledge increases understanding.
- Reading strategies are
  - versatile.
  - modifiable.
  - useful as formative and summative assessments.
- ***Have fun and experiment!***

Thanks for attending!

If you would like more information please email:

Dr. Amber Rust
arust1@aacc.edu