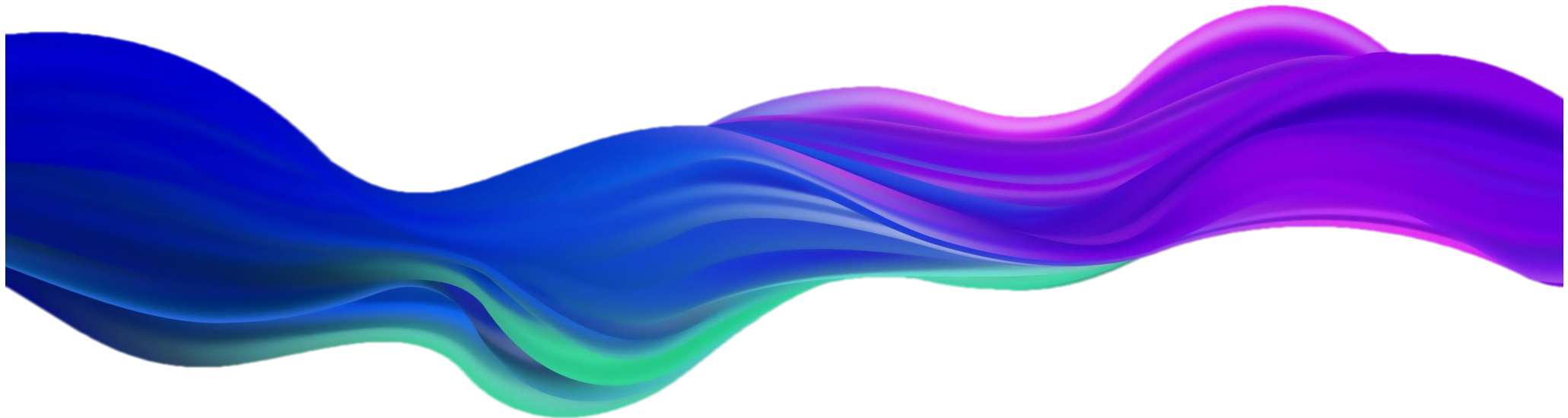


The Five Miscalculations In Math

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Based on work of Joan A. Cotter, Ph.D.



Do Your Children....

- Run and hide when you say “math time”?
- Whine “I don’t get it...”?
- Cry over worksheets and flashcards?
- Give you the deer-in-the-headlights look?
- Knew it yesterday and clueless today?

2

Math Education is Changing

- Math is more than just calculations.
- Increased emphasis on mathematical reasoning, less emphasis on rules and procedures.
- Math is used in many new ways. The workplace needs analytical thinkers and problem solvers.
- Geometry, algebra, probability, and statistics are beginning taught in the earliest grades.
- Brain research is providing clues on how to better facilitate learning, including math.

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Five Most Common Miscalculations in Math

1. Relying on Counting

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Adding by Counting

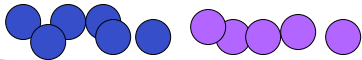
Because we’re so familiar with 1, 2, 3, we’ll use letters.

A = 1
B = 2
C = 3
D = 4
E = 5, and so forth

5

Adding by Counting

$$\begin{array}{r} F \\ + E \\ \hline \end{array}$$



6

Adding by Counting

$$\begin{array}{r} F \\ + E \\ \hline \end{array}$$



7

Adding by Counting

$$\begin{array}{r} F \\ + E \\ \hline K \end{array}$$

A B C D E F G H I J K

8

Adding by Counting

Now Memorize the Facts!!

9

Fundamentals to Math Success

1. Subitizing

10

Subitizing

- Subitizing is quick recognition of quantity without counting.

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Quantity Recognition

12

Quantity Recognition

13

Quantity Recognition

A ten-frame with 10 rows and 10 columns. The top row contains 7 blue beads followed by 3 yellow beads. The remaining 9 rows are filled with alternating blue and yellow beads in a checkerboard pattern.

14

Quantity Recognition

A ten-frame with 10 rows and 10 columns. The top row contains 10 blue beads. The remaining 9 rows are filled with alternating blue and yellow beads in a checkerboard pattern.

15

Adding

$5 + 4 = \underline{\quad}$

A ten-frame with 10 rows and 10 columns. The top row contains 5 blue beads followed by 4 yellow beads. The remaining 9 rows are filled with alternating blue and yellow beads in a checkerboard pattern.

16

Adding

$5 + 4 = \underline{9}$

A ten-frame with 10 rows and 10 columns. The top row contains 5 blue beads followed by 4 yellow beads. The remaining 9 rows are filled with alternating blue and yellow beads in a checkerboard pattern.

17

Adding

$4 + 3 = \underline{\quad}$

A ten-frame with 10 rows and 10 columns. The top row contains 4 blue beads followed by 3 yellow beads. The remaining 9 rows are filled with alternating blue and yellow beads in a checkerboard pattern.

18

Adding

$4 + 3 = \underline{7}$

A ten-frame with 10 rows and 10 columns. The top row contains 4 blue beads followed by 3 yellow beads. The remaining 9 rows are filled with alternating blue and yellow beads in a checkerboard pattern.

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Five Most Common Miscalculations in Math

1. Relying on Counting
2. Number Names

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Number Names

...
eight - miss the grouping of tens
nine
ten - “eleven” doesn’t identify ten and one more
eleven
twelve
thirteen - difficult to determine place value
fourteen
...

21

Fundamentals to Math Success

1. Subitizing
2. **Transparent Number Names**

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Transparent Number Naming

11 = ten 1	20 = 2-ten
12 = ten 2	21 = 2-ten 1
13 = ten 3	22 = 2-ten 2
14 = ten 4	23 = 2-ten 3
....
19 = ten 9
	99 = 9-ten 9

23

Transparent Number Naming

- Reciting the alphabet doesn’t teach reading, and counting doesn’t teach arithmetic.
- First teach the *sound* of the letters, so first teach the *name* of the quantity using transparent number names.
- This is the math way of saying the numbers.
- It is a temporary re-naming of the numbers.
- Makes the children “bilingual.”

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Transparent Number Naming

- Only 11 words are needed to count to 100 the math way, 28 in English.
- Asian languages use the transparent number names.
- These children understand place value in first grade; only half of U.S. children understand place value at the end of fourth grade.
- Mathematics is the science of patterns. The patterned math way of counting greatly helps children learn number sense.

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Place Value Cards

80
↑ ↑
8 - ten

800
↑ ↑ ↑
8 hun-dred

8000
↑ ↑ ↑ ↑
8 th-ou-sand

26

Place Value Cards

3000 3658
600
50
8

- Encourage reading numbers left to right.
- Help prevent reversals in writing numerals.
- Concretely relate place value to writing numbers.
- Directly relate to base-10 materials.

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Five Most Common Miscalculations in Math

1. Relying on Counting
2. Number Names
3. Rote Memorization

28

Rote Memorization

$$\begin{array}{r} 7 \\ + 6 \\ \hline \end{array}$$

29

Rote Memorization

$$\begin{array}{r} 7 \\ - 6 \\ \hline 1 \end{array}$$

30

Rote Memorization

$$\begin{array}{r} 7 \\ \times 6 \\ \hline 42 \end{array}$$

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Rote Memorization

- Based on behaviorism (stimulus and response).
- Lowest form of brain use.
- Needs frequent review: high maintenance.
- Impossible for many people with special needs.
- Inhibits independent learning.
- Makes applying learning more difficult.

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Time Needed to Memorize

According to a study, college students memorized:

- 200 nonsense syllables — 93 minutes
- 200 words of text — 24 minutes
- 200 words of poetry — 10 minutes

We must tell our children that they need to understand math.

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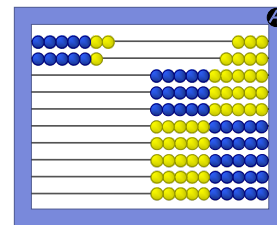
Fundamentals to Math Success

1. Subitizing
2. Transparent Number Names
3. **Strategies and Visualization**

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Strategy: Two Fives

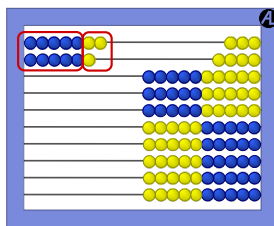
$$7 + 6 = \underline{\quad}$$



35

Strategy: Two Fives

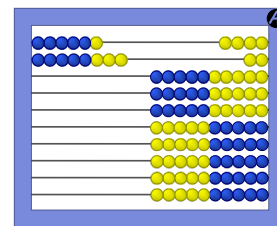
$$7 + 6 = \underline{13}$$



36

Strategy: Two Fives

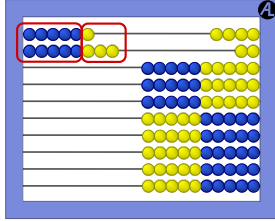
$$6 + 8 = \underline{\quad}$$



37

Strategy: Two Fives

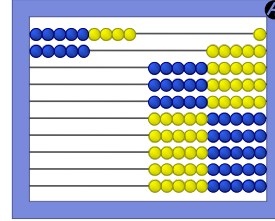
$$6 + 8 = \underline{14}$$



38

Strategy: Complete the Ten

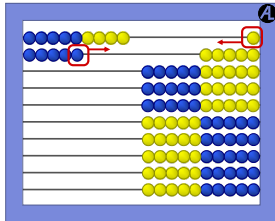
$$9 + 5 = \underline{\quad}$$



39

Strategy: Complete the Ten

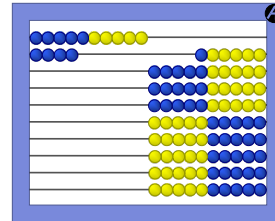
$$9 + 5 = \underline{\quad}$$



40

Strategy: Complete the Ten

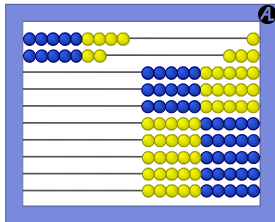
$$9 + 5 = \underline{14}$$



41

Strategy: Complete the Ten

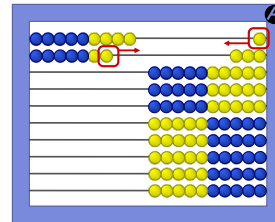
$$9 + 7 = \underline{\quad}$$



42

Strategy: Complete the Ten

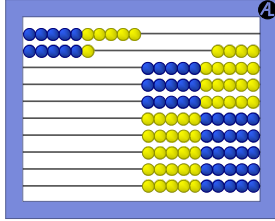
$$9 + 7 = \underline{\quad}$$



43

Strategy: Complete the Ten

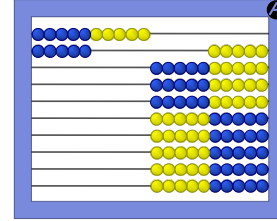
$$9 + 7 = \underline{16}$$



44

Strategy: Part from Ten

$$15 - 9 = \underline{\quad}$$

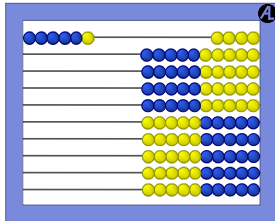


Subtract 5,
then 4

45

Strategy: Part from Ten

$$15 - 9 = \underline{6}$$

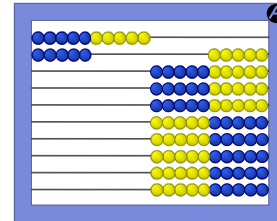


Subtract 5,
then 4

46

Strategy: All from Ten

$$15 - 9 = \underline{\quad}$$

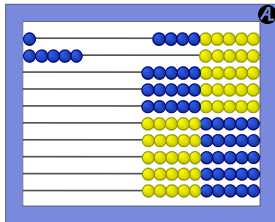


Subtract 9
from the 10

47

Strategy: All from Ten

$$15 - 9 = \underline{6}$$

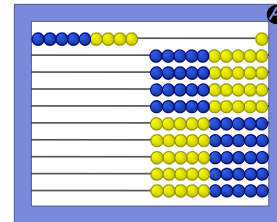


Subtract 9
from the 10

48

Strategy: Going Up

$$15 - 9 = \underline{\quad}$$



Start at 9;
go up to 15

49

Strategy: Going Up

$15 - 9 = \underline{6}$

Start at 9;
go up to 15

50

Base-10 Picture Cards

51

Four-Digit Addition

6	4	5	1				
---	---	---	---	--	--	--	--

52

Four-Digit Addition

6	4	5	1				
2	5	0	3				

53

Four-Digit Addition

6	4	5	1				
2	5	0	3				
8	9	5	4				

54

Four-Digit Addition

3	6	5	8				
2	7	3	6				

55

Four-Digit Addition

3	6	5	8
2	7	3	6

56

Four-Digit Addition

3	6	5	8
2	7	3	6

57

Four-Digit Addition

3	6	5	8
2	7	3	6

58

Four-Digit Addition

3	6	5	8
2	7	3	6

59

Four-Digit Addition

3	6	5	8
2	7	3	6

6	3	9	4
---	---	---	---

60

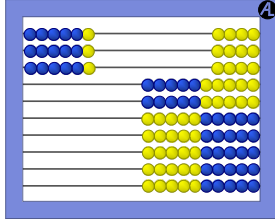
Multiplication

6 taken 2 times; 6×2

61

Multiplication

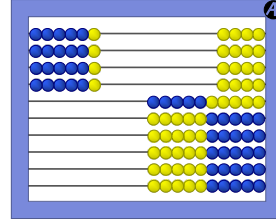
6 taken 3 times; 6×3



62

Multiplication

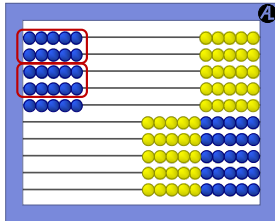
6 taken 4 times; $6 \times 4 = 24$



63

Multiplication

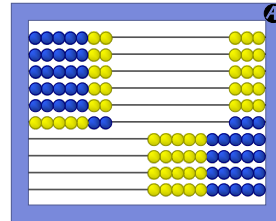
$5 \times 5 = 25$



64

Multiplication

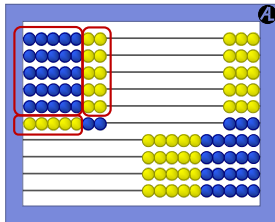
7×6



65

Multiplication

$7 \times 6 = 42$



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Memorizing Math

Math needs to be taught
so 95% is understood and
only 5% memorized.

Richard Skemp
major pioneer in Mathematics Education
who first integrated the disciplines
of mathematics, education and psychology

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Five Most Common Miscalculations in Math

1. Relying on Counting
2. Number Names
3. Rote Memorization
4. Flashcards and Timed Tests

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Flash Cards

- Often used to teach rote.
- The only students who like flash cards are those who don't need them.
- Flash cards give children the false impression that math isn't about thinking.
- Flash cards often produce stress. Children under stress stop learning.

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Timed Tests



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Fundamentals to Math Success

1. Subitizing
2. Transparent Number Names
3. Strategies and Visualization
4. **Math Card Games**

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Games to Learn Facts

$$\frac{\text{Games}}{\text{Math}} = \frac{\text{Books}}{\text{Reading}}$$

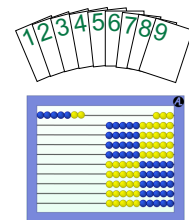
Games provide interesting repetition needed for automaticity.
More importantly, games provide an application!

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Go to the Dump Game

A "Go Fish" type of game where the pairs are:

- 1 & 9
- 2 & 8
- 3 & 7
- 4 & 6
- 5 & 5



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Action Subtraction Game

Objective: To complete the rows by solving equations.

Format is 2-digit number, a 1-digit number, and the difference.

Play: During a turn, play 1 or 2 cards on the same row to add to or complete an equation or to start another row.

Goal: To collect the most cards from the completed rows.

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Action Subtraction Game

5	7	8	4	9
2	7			

75

Action Subtraction Game

Level-Up Variation: Format is now 2-digit number minus another 2-digit number and the difference.

Play: During a turn, play up to 3 cards on the same row.

Goal: Again, to collect the most cards from the completed rows.

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Ring Around the Product Game

2	6	3	5	1
8	54	12	42	7
5	50	15	9	8
9	1	6	8	3

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Five Most Common Miscalculations in Math

1. Relying on Counting
2. Number Names
3. Rote Memorization
4. Flashcards and Timed Tests
5. Negative Attitude

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Attitude about Math

- Never tell your children that you are “bad” at math.
- Or that you dislike math.
- Especially mothers to daughters.
- Research shows that as soon as a mother shares her negative ideas with her daughter, the daughter’s achievements go down.
- The same does not hold as true with sons.

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Fundamentals to Math Success

1. Subitizing
2. Transparent Number Names
3. Strategies and Visualization
4. Math Card Games
5. **Share the Joy of Math**

80

Attitude about Math

- Math education will depend on what the teacher believes, knows, and does.
- Believe in the importance of math for daily, living, future careers, and understanding of our world.
- Know that the “math brain” is a myth.
- Radiate joy for math and help your child develop a love of math.

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Goal of Teaching Math

Not to turn students into \$10 calculators,
but thinking persons who can
apply math to new situations.

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