

Improve Fluency and Mental Strategies for Girls

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Women and Mathematics Education

Gender differences

Young girls are less likely to be fluent

Young girls are slower to move to mental math

Why?

Not emphasized in instruction

Differences in spatial ability

Fluency and achievement

Fluency means that students are both *fast* and *accurate* in retrieving or calculating

Fluency on basic math facts predicts improvement in strategy use and end of year math tests

Fluency frees up working memory so that students can focus on bigger/newer concepts

Mental math and achievement

Students who start second grade with more mental math learn more math through the next few years

Mental math connected to fluency – can't be very fluent if counting on fingers or counters

Mental math begins with mental number line and continues with mental computation

Links to spatial ability

Mental Number line



Where is 57?

The ability to estimate where a number is on the number line mentally is an important skill. Many students have considerable trouble doing this. Instead of estimating they typically count from the zero. This results in poor estimates.

Mental math, Arabic numbers and fluency

The better students understand Arabic numbers

the more fluent they become in computation.

They also use more advanced strategies sooner.

Need to focus on how Arabic numbers are connected on the number line.

(Vanbinst, Ghesquiere, Smedt; 2012)

Games

Fun ways to improve fluency
and mental math
at home and school

Skip-bo and other card games

Students pile numbers from 1 to 10 or 12.

Need to know the next number without
starting at 1

Wild cards that encourage acquisition of
number

Arabic numbers used

Card games: war

Teaches Number Magnitude

Basic or backwards

War with 2 cards

Highest sum (addition) or difference
(subtraction) wins

Highest multiple wins

This may need scaffolding by other
children or adults

Games with dice
encourage subitizing

Board Games

Use games with straight sides and have students count as they move along (e.g., monopoly). Avoid board games with curved patterns.

(see work by R. Siegler)

Other Activities

Team competition/ beat the teacher

Flash problem up and whole team or class
calls answer

Lots of stuff on websites!

[www.howtoforteachers.com/.../Maths-
Fluency-Games.pdf](http://www.howtoforteachers.com/.../Maths-Fluency-Games.pdf)

Up and down the river

Learning through testing

Student fluency improves through repeated “testing” or repeated problem solving

Testing is not studying

Even if students get the wrong answer the action of trying to remember improves performance next time.

3 ways to test or self-test

Massed, spaced, interleaving

OK-

Massed – solving the same type of problem again and again

Better

Spaced – periodically testing leaving gaps in time

Best

Interleaving of different types of problems
Add, subtract, add, add, subtract

Why interleaving?

Produces better conceptual understanding

Problems types are discriminated

Problem procedures are discriminated

Supports working memory and attention

Students require more working memory to do interleaving

Students require attention in deciding what the problem is and how it must be solved

What can it look like in your class?

Homework assignments – mix them up without pattern

Add, subtract, add, add, subtract

Result unknown, change unknown, start unknown

Division – measurement and partitive

Multiplication, division, addition...

Cumulative tests, reviews or quizzes

Drawbacks

Everybody thinks they do better following massed practice (not true)

You will see poorer performance when you first start interleaving

No getting around it.. It is a part of the process that pays off

Lower functioning students may have difficult time and will likely need direct instruction

Cover, copy, compare

(Poncy, Skinner, McCallum)

Fact family triangles given to students and then covered. Students then

write subtraction using numbers

write addition using numbers

Afterwards, students compare their answers to the fact triangle

Uses modeling with practice

Final points: younger students

Preschool and kindergarten – use numbers in language as often as possible

“Bring the 2 chairs over here”

Give verbal word problems without manipulatives

“You have 2 cookies. How many would you have if I gave you 1 more?”

Point out Arabic numbers and talk about them.

Encourage mental math once students have understanding of number.

Do they have cardinality?

Do they understand basic counting and what it means to add and subtract?

How to encourage mental math: Older students

Encourage students to calculate mentally

Cover manipulatives and have child image
them instead of counting them directly

For multiplication, have students mentally
skip along the number line when
counting

Final points

For fluency activities, try to make feedback and corrections soon after mistake.

Modeling combined with practice works best for low performing students

Ask students to write out the whole math fact so that they learn the whole fact.

Families of problems can be used to strengthen connections in memory

$$5+2=?$$

$$?+2=7$$

$$5+?=7$$

Last Point

5 minutes of speeded practice for each lesson can make a difference

Even for low performing students...

Thank You!

Questions?