IPPN Conference 2012

Principals Leading Numeracy

Seán Delaney Marino Institute of Education

Getting to Know You!

- Who is a teaching principal?
- Who is a mostly administrative principal?
- Who is not a principal?
- Who was appointed principal in the last 3 years?
- Who attended this workshop last year?

Overview of Presentation

- 1. Brief review of last year's presentation
- 2. Look at a video clip of some mathematics teaching
- 3. 6 ways to change maths teaching in your school
- 4. Discussion about maths teaching

From Principals Leading Numeracy 2011

Assumption 1

Teaching Maths is skillful, complex work for which many teachers received little preparation



Professor Deborah Loewenberg Ball

Mathematical Knowledge for Teaching

35 x 2 5 875

How Did this Student Get this Answer?

Assumption 2

The key to improving mathematics teaching is...









BUT...

...getting children to think and talk mathematically

Asking questions such as...





Assumption 3

Our current textbooks do little to help us teach maths in a way that gets children thinking

Worked Example in a Textbook from Taiwan

How many fewer meters of colorful belts did Gi-Wen use compared to Wen-Ting? Write the corresponding mathematical expression and then find the answer

2



Worked Examples in 2 Textbooks from Ireland **Example 2:** $4\frac{1}{6} - 2\frac{3}{4}$ $\frac{2}{12}$ -6 34 6 8 $\frac{9}{12}$ = $= 4\frac{2}{12} = 3\frac{14}{12}$ (by renaming) $-2\frac{3}{4}$ $= -2\frac{9}{12} = -2\frac{9}{12}$ $1\frac{5}{12}$



Piaget's Theory of Mathematical Knowledge

- Physical knowledge
- Social Conventional Knowledge
- Logico-Mathematical Knowledge

2012

Video Clip to Provide Context for Presentation

- 20 Fifth class children
- Recruited from 11 different schools (4 DEIS), mostly around Marino area
- Topic: Area
- After school on a Friday afternoon in May 2011
- Maths Laboratory: Goal is not to offer model teaching, but public teaching
- Observed by 20 educators
- Amplified and video recorded
- Children have been working on area task on geoboards

(Ref. Time Code 11, 47'32" to 51'44")

Patterns of maths lessons

Α

Review homework or remind children of accomplishments so far

Present the topic and problems for the day

Students or teachers develop procedures to solve the problem(s) at the board, taking suggestions from other students and the teacher

Practise doing problems similar to those worked on above

GERMANY

В

Review the previous lesson with a brief teacher lecture or summary by students

Present the problem for the day. One problem only.

Students work individually on problems first and then in groups for 5-10 minutes

Students (selected by teacher) present and discuss one or more solution methods.

Highlight and summarise major points JAPAN www.seandelaney.com

С

Review previous material: Check homework or engage in warm-up activity

Demonstrate how to solve problems for the day by presenting a few sample problems and demonstrating how to solve them

Practise problems similar to those for which solutions were demonstrated

Correct class work and assign homework UNITED STATES

"Teaching is a Cultural Activity"



"Some people think that teaching is an innate skill, something you're born with. Others think that teachers learn to teach by enrolling in college teacher-training programmes. Neither is the best description. Teaching, like other cultural activities is learning through informal participation over long periods of time. It is something one learns to do more by growing up in a culture than by studying it formally."

JAMES HIEBERT

"If you always do what you've always done, you'll always get what you've always got."

If what you're doing isn't working, try something new.

6 Ways You Can Make a Difference in Maths Learning

- 1. Get children to talk about maths in maths class
- 2. Use mistakes as a teaching resource
- 3. Learn problem solving by solving problems
- 4. Explain and encourage explanations
- 5. Discuss differentiation
- Develop children's persistence
 and one bonus way



1.Getting Children to Talk A about Maths in Maths Class



Think about the Classroom Culture You Create

How We Work in This Class

- 1. I can learn a lot from my classmates
- 2. If I understand something, I can help others to understand it too
- It's good to ask questions or say "I'm not sure" if you don't understand

Engage with Children's Mathematical Thinking

- How did you get your answer?
- How can you be sure that's the correct answer?
- Why might someone think that the answer is?
- Why did you?
- How does that answer/method compare to what did?
- Could you put what said into your own words?
- Could you do it another way?
- Estimate

Help Children Develop their Mathematical Language

- Factor
- Odd
- Share
- Difference
- Product
- Sum
- Prime
- Face
- Improper ...

And Children can Write about Maths

Prompts

- Write down everything you know about...
- Write down what you learned in class today
- Write down one question you still have about...
- After our discussion, write down what you think...
- What would you say to some who thinks that ...?
- Write down what you would like to learn about in maths next week

Some Samples of Children's Writing about Maths











2.Using Mistakes as a Teaching Resource



Common misconceptions/errors in maths 1

• 46 – 28 = 22

• $50\% > 4/_{5}$

• 8.35 > 8.5

• 20 minutes less than an hour is 80 minutes

Common misconceptions/errors in maths 2





1/3 is shaded

9 minutes to 1
Common misconceptions/errors in maths 3



Parcel B is heavier than parcel A

Principles

- Making errors is a natural part of learning mathematics
- Errors provide insights into children's understanding of mathematical ideas
- If errors are not made visible, a teacher cannot address them
- Children don't get "confused" by talking about mistakes

Strategies for Responding to Errors

- Encourage language of agreeing and disagreeing with ideas rather than saying that someone is right or wrong
- Thank children for bringing up something that is potentially confusing for others
- If children don't raise potential errors, refer to another class you taught where some children thought that.... Ask: Why might someone think that
- Follow up by discussing "how can we help the children in this class to remember that...?"

3. Improve problem solving by solving problems



Problem Solving Strategy 1

RUDE

- Read the problem
- Underline the key words
- Draw a diagram of the problem
- Estimate your answer and then solve the problem

Problem Solving Strategy 2

STAR

- Search the word problem (info)
- Translate the words into an equation or picture (plan)
- Answer the problem (solve)
- Review the solution (check)

Problem Solving Strategy 3

LUV2C

- Look
- Underline
- Visualise
- Choose Numbers
- Calculate

Problem Solving in Maths

- Little evidence that such strategies work
- Some evidence that classifying problems into problem-types can be helpful for children with learning disabilities
- Best way to learn problem solving is to practise solving problems
- Skill in problem solving develops slowly over time
- Many textbooks have too many problems, and many of the problems are of poor quality

A Good Problem

- Should leave the solver feeling "stuck" at first
- The maths is what makes the problem problematic
- Relates to the children's experience
- Connects different maths topics
- Allows children with different attainment levels to achieve success with it
- May take time, even days, to complete
- Requires children to justify and explain their answers and methods

Sample Problem

 I have 10-cent, 5-cent and 1-cent coins in my money box. If I open the box and take out three coins, how much money could I have? How can you be sure that you have found all the possible amounts?

Other Sample Problems

Donal has 6 jelly tots, Diana has 2 and Enda has 4. They want to share them equally. How will they do it? Draw a picture to help explain your answer.

If you did not know the answer to 12 – 7, what are some ways you could find the answer?

Explain two different ways to multiply 4 x 276 in your head. Which way is easier to use? Would you use a different way to multiply 5 x 98? Explain why you would use the same or different methods.

Source: Van de Walle

Sources of Good Problems??

- Good problems can be difficult to come by. Possibly set up a forum on the IPPN website for compiling them
- Internet, maths books for teachers and student teachers
- Some on my website (Resources for Teachers section)

4. Explain and Encourage Explanations



Explanations are Central to Teaching

- Is 1/5 equivalent to 2/10?
- Is 5/10 equivalent to 5/20?
- Why does length by breadth give you the area?
- Why do you "add a zero" to multiply a whole number by ten but you "move the point one place to the right when you multiply a decimal number"?
- Why do you get 2 r 3 when you do 11 ÷ 4 on paper but you get 2.75 when you do it on a calculator?
- Why do you invert the divisor and multiply to divide by fractions?

What makes a good explanation?

- Meaningful and easy to understand
- Defines key terms and concepts appropriately
- Draws on and highlights key mathematical ideas
- Explains the thought process step-by-step without skipping steps
- Makes the transitions between successive steps clear
- Uses appropriate language for the audience
- Uses suitable examples and representations, if possible

(Charalambous, 2011)

5. Discuss differentiation



Children Differ in Many Ways

- Within maths (from strand to strand)
- Within maths skills
- How they learn
- Motivation
- Learning disabilities
- Giftedness

Generic labels, such as weak, bright, lazy, clever, etc., can disguise children's specific talents and shortcomings

Differentiation Strategies

 Encourage all children to work together to help the class as a whole to learn maths – learning maths through talking through ideas

Use problems that children can approach at different levels

Skills Children Need in Order to Succeed in Maths

- Conceptual processing (e.g. identifying and extending patterns)
- Language (e.g. reading a word problem)
- Visual-spatial processing (e.g. working with 2-d and 3-d representations)
- Organisation (e.g. collecting and recording data)
- Memory (e.g. remembering number facts; remembering the steps of a mathematical procedure)
- Attention (e.g. focusing on the details in a maths problem)
- Psycho-social (e.g. working with a partner or in a group)
- Fine-motor skills (e.g. drawing geometric figures)

(Brodesky, 2002)

Analyse Learning Difficulties Using these Skills

Possible learner strengths	Possible learner difficulties	Possible teacher responses
Estimation		
Subitising		
Place value		
	Language comprehension impairment	Use vocabulary that is familiar to the student Explain new vocabulary carefully Monitor and vary the level of text learners are expected to read in mathematics problems Highlight words that have different meanings in different contexts (e.g. third, prime, factor)
	Counting speed is slower than in other learners	Provide more time in table and other maths tests to allow students to use strategies when they can't recall number facts
	Memory problems	Give short instructions Recap at end of lesson and revisit topics frequently Monitor early work on new topics carefully so that incorrect strategies are not practised. Use concrete materials (including fingers or pictures)
	Number fact recall	Teach strategies to use when a child forgets number facts
	Phonological (speech sounds) processing	Exaggerate difference between words that sound similar (e.g. ten and tenth; fifteen and fifty)
	Difficulty with decimal places	Highlight the decimal point (possibly by using a different colour for it)
	Directional confusion in writing digits and doing algorithms	Work on the concepts first and on recording later
ww.seandelane	Omissions of digits and numbers	Encourage learners to compare answers to estimates

6. Develop Children's Persistence





Student Task Persistence

- (a) Ability to perform a task (read the questions, understand the task, place marks on the answer sheet)
- (b) Motivation to work hard at a task (follow instructions, stay focused, identify the best answer)
- (c) Willingness to estimate or guess correct answers (without being certain of correct answer)

(Boe et al, 2002)

Strategies??

Bonus Strategy

- Meet with parents in the school and talk to them about what they can do to support the school's work in promoting mathematics learning
- Use this PowerPoint presentation as a start

10 Ways to Help Your Child Learn Maths

Seán Delaney Marino Institute of Education

2. Look at Tables Differently

	JPL		
1 × 1 = 1 2 × 1 = 2 3 × 1 = 3 4 × 1 = 4 5 × 1 = 5 6 × 1 = 6 6 × 1 = 6 0 × 1 = 6 10 × 1 = 10 11 × 1 = 11 12 × 1 = 12	$1 \times 2 = 2$ $2 \times 2 = 4$ $3 \times 2 = 8$ $5 \times 2 = 10$ $8 \times 2 = 10$ $10 \times 2 = 20$ $11 \times 2 = 22$ $11 \times 2 = 24$	$1 \times 3 = 3$ $2 \times 3 = 6$ $3 \times 3 = 0$ $4 \times 3 = 12$ $6 \times 3 = 16$ $7 \times 3 = 21$ $6 \times 3 = 27$ $10 \times 3 = 30$ $11 \times 3 = 35$ $12 \times 3 = 36$	$1 \times 4 = 4$ $2 \times 4 = 8$ $3 \times 4 = 12$ $4 \times 4 = 16$ $5 \times 4 = 20$ $8 \times 4 = 28$ $8 \times 4 = 32$ $8 \times 4 = 32$ $8 \times 4 = 36$ $10 \times 4 = 40$ $11 \times 4 = 44$ $12 \times 4 = 48$
$\begin{array}{c} 1 \times 5 = 5 \\ 2 \times 5 5 = 10 \\ 3 \times 5 5 = 25 \\ 6 \times 5 5 = 35 \\ 6 \times 5 5 = 35 \\ 7 \times 5 5 = 35 \\ 8 \times 5 5 = 45 \\ 10 \times 5 5 = 50 \\ 111 \times 5 = 55 \\ 12 \times 5 = 60 \end{array}$	$1 \times 0 = 0$ $2 \times 0 = 12$ $3 \times 0 = 18$ $4 \times 0 = 24$ $5 \times 0 = 30$ $0 \times 0 = 30$ $7 \times 6 = 42$ $8 \times 0 = 54$ $10 \times 0 = 54$ $10 \times 0 = 50$ $11 \times 0 = 60$ $12 \times 0 = 72$	$1 \times 7 = 7$ $2 \times 7 = 14$ $3 \times 7 = 28$ $5 \times 7 = 35$ $6 \times 7 = 42$ $7 \times 7 = 49$ $8 \times 7 = 56$ $9 \times 7 = 03$ $10 \times 7 = 70$ $11 \times 7 = 77$ $12 \times 7 = 84$	$ \begin{array}{r} 1 \times 8 = 8 \\ 2 \times 8 = 10 \\ 3 \times 8 = 24 \\ 4 \times 8 = 32 \\ 5 \times 8 = 40 \\ 0 \times 8 = 46 \\ 7 \times 8 = 50 \\ 6 \times 8 = 50 \\ 6 \times 8 = 50 \\ 6 \times 8 = 64 \\ 9 \times 8 = 72 \\ 10 \times 8 = 80 \\ 11 \times 8 = 80 \\ 12 \times 8 = 96 \end{array} $
$\begin{array}{c} 1 \times 0 = 0 \\ 2 \times 0 = 18 \\ 3 \times 0 = 27 \\ 4 \times 0 = 38 \\ 5 \times 0 = 45 \\ 6 \times 0 = 54 \\ 7 \times 0 = 63 \\ 8 \times 0 = 72 \\ 0 \times 0 = 61 \\ 10 \times 0 = 00 \\ 11 \times 0 = 00 \\ 12 \times 0 = 108 \end{array}$	$1 \times 10 = 10$ $2 \times 10 = 20$ $3 \times 10 = 30$ $4 \times 10 = 40$ $5 \times 10 = 50$ $6 \times 10 = 60$ $7 \times 10 = 70$ $8 \times 10 = 80$ $9 \times 10 = 90$ $10 \times 10 = 100$ $11 \times 10 = 110$ $12 \times 10 = 120$	$1 \times 11 = 11$ $2 \times 11 = 22$ $3 \times 11 = 33$ $4 \times 11 = 44$ $5 \times 11 = 55$ $6 \times 11 = 66$ $7 \times 11 = 77$ $8 \times 11 = 66$ $9 \times 11 = 66$ $10 \times 11 = 100$ $10 \times 11 = 100$ $11 \times 11 = 121$ $12 \times 11 = 132$	$1 \times 12 = 12$ $2 \times 12 = 24$ $3 \times 12 = 30$ $4 \times 12 = 48$ $5 \times 12 = 60$ $8 \times 12 = 72$ $7 \times 12 = 84$ $8 \times 12 = 96$ $8 \times 12 = 108$ $10 \times 12 = 120$ $11 \times 12 = 132$ $12 \times 12 = 144$
TIA	Rean	delaney.com	PLE

Learn Related Facts Together:

- 6 + 7 = 13
- 7 + 6 = 13
- 13 7 = 6
- 13 6 = 7

Addition Table

+	0	1	2	3	4	5	6	7	8	9	10
0	0	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10	11
2	2	3	4	5	6	7	8	9	10	11	12
3	3	4	5	6	7	8	9	10	11	12	13
4	4	5	6	7	8	9	10	11	12	13	14
5	5	6	7	8	9	10	11	12	13	14	15
6	6	7	8	9	10	11	12	13	14	15	16
7	7	8	9	10	11	12	13	14	15	16	17
8	8	9	10	11	12	13	14	15	16	17	18
9	9	10	11	12	13	14	15	16	17	18	19
10	10	11	12	13	14	15	16	17	18	19	20

Hundred Square

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Multiplication Table

х	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	40	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

3. Ask Your Child to Teach You Maths

5 - 1

72 – 48

1 1/2 + 3 1/4

148 ÷ 7

Find 10 % of 76

4. Encourage Your Child to be Independent in Maths

http://blogs.psychcentral.com/always-learning/files/2010/05/math-mistakes-May-5-2010-003.jpg

Some people complained that there was not enough apple in the tarts so the baker decided to use three-quarters of an apple for each small tart. Today the baker has 6 apples. How many small apple tarts can the baker make? Because you just have to do 6 x 3: Draw a little pitchur 1.2.11 +0 Show 400

From Maths Lab 2007

5. Use Maths with your Child in Daily Life

6. Display Maths Work at Home

7. Communicate with your Child's Teacher



http://www.ncca.ie/uploadedfiles/G.5.%20Test%20results1.jpg

8. Be Realistic about Textbooks















9. Challenge a High-Achieving Child

MSW Logo









Websites

- Logo: <u>http://www.softronix.com/logo.html</u>
- Geogebra: <u>http://www.geogebra.org/cms/</u>
- Geogebra (Primary School Version): <u>http://www.geogebra.org/en/wiki/index.php/</u> <u>Release Notes GeoGebra 4.0#GeoGebraPrim</u>

10. Play Games that Encourage Mathematical Thinking





Discussion

Notes to accompany this presentation are available at <u>http://seandelaney.com/2011/11/15/how-</u> <u>parents-can-help-their-child-learn-maths/</u>.

6 Ways You Can Make a Difference in Maths Learning

- 1. Get children to talk about maths in maths class
- 2. Use mistakes as a teaching resource
- 3. Improve problem solving by solving problems
- 4. Explain and encourage explanations
- 5. Discuss differentiation
- Develop children's persistence
 and one bonus way

Discussion on Leading Maths Teaching in School

Buíochas

www.seandelaney.com

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DEPARTMENT OF EDUCATION AND SKILLS An Roinn Oideachais Agus Scileanna

Thanks to principals and teachers around the country who participated in my study into teachers' mathematical knowledge

