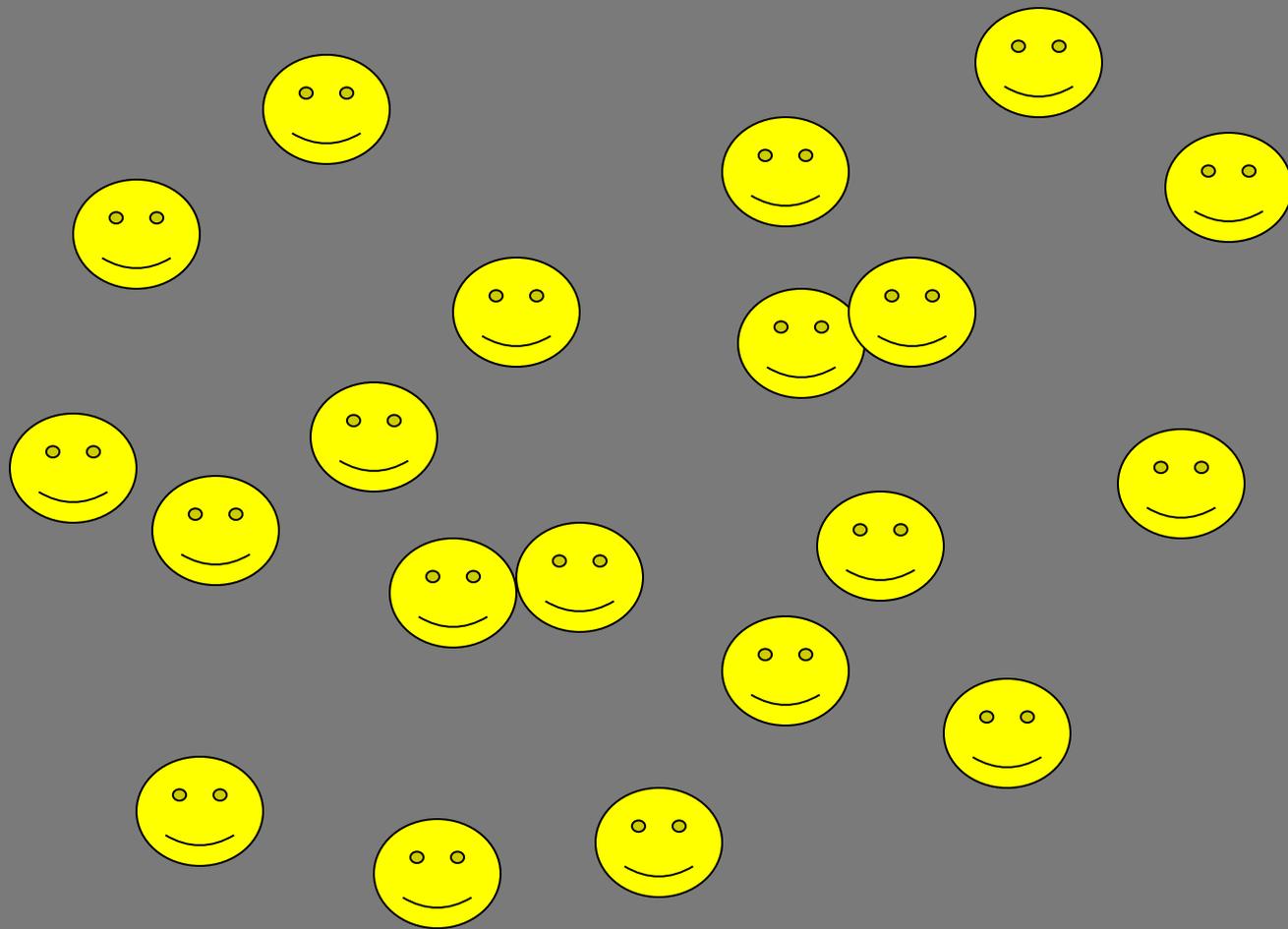
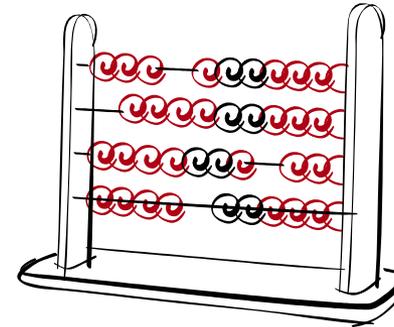


ESTIMATION:

BERNIE SMYTH



MATHEMATICS



Is an intellectual pursuit in its own right, a source of fascination, challenge and enjoyment (Primary School Curriculum, 1999)



MATHEMATICS

Science of magnitude, number, shape, space, and their relationships,

A universal language based on symbols and diagrams

Involves the handling (arrangement, analysis, manipulation and communication) of information, the making of predictions and the solving of problems through the use of a language that is both concise and accurate

MATHEMATICS EDUCATION

Fosters creative and aesthetic development

Enhances the growth of reasoning

Helps to convey and clarify meaning

Its language provides a powerful and concise means by which information may be organised, manipulated and communicated.

(Primary School Curriculum, 1999, p.2)

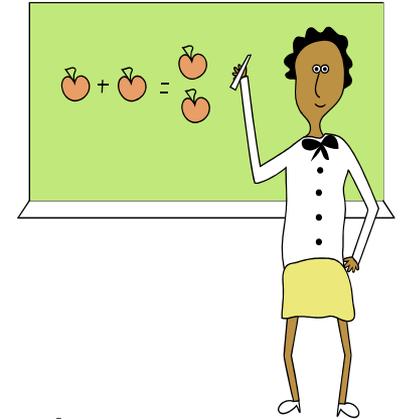
THE IMPORTANCE OF 'MATHEMATICS FOR LIFE'

A teacher must

value mathematics as a subject that is

- essential to school and
- to life success for students with learning difficulties and

value teaching of mathematics as an important instructional area for professional development (Alsopp, Kyger and Lovin, (2007) p.35)



WHAT? WHO?

Are you good at Maths?

When did you decide to be good/no good?

What are your strengths in this area?

What are your weaknesses?

What are your key areas of concerns?

Who are the students you teach?

What areas of learning are represented in *your* group?

NUMERACY IN IRELAND

Definition offered by the '*National Strategy to Improve Literacy and Numeracy among Children and Young People 2011-2020*'

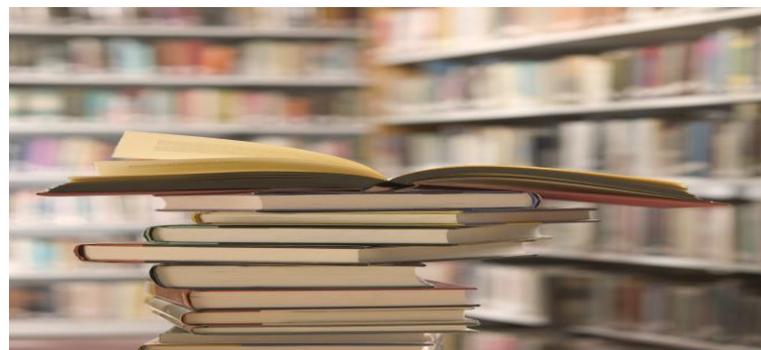
“It is not limited to the ability to use numbers, to add, subtract, multiply and divide. Numeracy encompasses the ability to use mathematical understanding and skills to solve problems and meet the demands of day-to-day living in complex social settings. To have this ability, a young person needs to be able to think and communicate quantitatively, to make sense of data, to have a spatial awareness, to understand patterns and sequences, and to recognise situations where mathematical reasoning can be applied to solve problems”.p8

NUMERACY AND RESEARCH IN IRELAND

The PISA Report defined math literacy as

‘ an individuals capacity to identify and understand the role mathematics plays in the world, to make well founded mathematical judgements and to engage in mathematics, in ways that met the needs of that individuals’ current and future life as a constructive, concerned and reflective citizen’

In 2013 Ireland ranked 20th in Math, 14th in Science and 7th in reading out of 65.



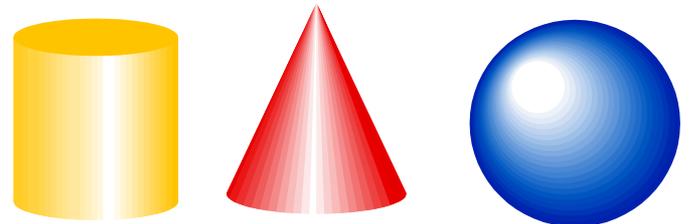
NUMERACY IN THE CLASSROOM

All students should be provided with a wide range of knowledge and skills that help them to develop an understanding of the physical world and social interactions.

a variety of experiences and opportunities for all students to develop their sensory awareness and their ability to reach out, to explore and to solve problems and in this way comprehend basic mathematical concepts.

multi-sensory exploration of a wide range of three-dimensional materials.

opportunities to develop the communication skills necessary for understanding mathematical concepts and using mathematical language accurately



THE LANGUAGE OF MATHEMATICS

**Mathematics education should... enable the child to think
and communicate (Primary School Curriculum,1999 p.2)**

IS IT IMPORTANT IN THE REAL WORLD?

Why it is important?

Is everything Mathematics?

OR does literacy have priority?

In order to function as a 'normal' adult how much Mathematics do you need?



CURRICULUM STRANDS

Early Mathematical Activities: (Classifying, Matching, Comparing, Ordering)

Number

Algebra (Patterns and sequence)

Shape and Space

Measures (length, weight, capacity, area, time, money)

Data (Interpreting and understanding visual representation)

ACTIVITY

Using your worksheet, on your own, and then in pairs/groups, can you discuss the main strands of the Maths Curriculum and identify where you use estimation in each?

EARLY MATHEMATICS IN PRIMARY SCHOOL

- **Children come to school with a variety of learning experiences in maths**
- **May have some experience in rote counting**
- **In identifying differences in quantity**

However the logic of number is limited...

- **We can build on this with early mathematical activities**
- **Building on rote to develop acquisition of number concept,**
- **And to promote a problem-solving approach**

EMERGENT MATHEMATICS

**be aware that we can build on knowledge (counting)
improving acquisition**

**make explicit links between children rote counting and the
adult purpose of counting in terms of problem solving**

**note the difference between rote counting and awareness of
number (as part of assessment)**

THE ABILITY TO ESTIMATE

What is it?

How do we acquire this skill?

Is it important?

How can we examine the teaching/learning process to develop student confidence in problem solving?

GUESSTIMATION?

What is a guess?

An opinion formed without evidence to support it

What is Estimation?

An informed rational judgement about 'how much', 'how long' or 'how many' that is made based on prior knowledge and experience in the real world (Colmer, 2006)

WHAT IS IT?

A skill; Involving higher order thinking

When we don't have all the data....

A form of problem-solving, often used unconsciously by 'experts'

Uses the language of comparison

MY COLLEAGUES SAID...

Can I set my alarm 10 minutes later and still get to work on time?

How much milk do I need in my tea?

Is the bus late? Am I late?

If I cross the road here, with that car coming towards me, will I get across safely?

Did I put too much butter on the knife for my slice of bread?

Is there enough paper in the photocopier for what I need?

BUT...

Mathematics means the right answer....

WHAT IS INVOLVED?

Estimation problems should "draw upon a deep understanding of the world, everyday experience, and the ability to make rough approximations, inspired guesses, and statistical estimates from very little data"(Morrison, 1963, p. 627).

ESTIMATION (NCCA GUIDELINES P.32,33)

- Risk take; mental number lines; make choices
- Rounding to the nearest
- Identify patterns
- Front-end estimation (the lead digit e.g. the T in the TU algorithm) 42
- +36 about 70
- Developing an awareness of when an estimation is *good enough* and when one is *not* good enough
- Developing an awareness of an answer that is reasonable
- (Bley and Thornton, 2001)

WHAT ARE WE DOING?

We estimate parameters within which to work

Then we look at the consequences...

Why is this important in education:

Thinking about and doing a problem is as important in learning as the final result... (Fermi)

NOTE:

An estimate is NEVER wrong...

Estimation should be useful, practical and relevant

Reasonable answers involve intuition about number

NUMBER SENSE

- **The ability to compare numerical magnitudes, to count, and to comprehend simple arithmetic operations**
- **Understanding of mathematical principles and relationships,**
- **Fluency and flexibility with operations and procedures**
- **Recognition of and appreciation for the consistency and regularity of maths**
- **Facility in working with numerical expressions (Berch, 2005)**
- **A mental number line**

CHARACTERISTICS

Fluency in estimating and judging magnitude

Ability to recognise unreasonable results

Flexibility when mentally computing

Ability to move among different representations and to use the most appropriate representation

(Kalchman, Moss and Case, in Faulkner, 2009, p.25)

THREE QUESTIONS, THREE ANSWERS

How far is it from Maynooth to this hotel?

How high is Mount Everest?

How old am I?

THREE QUESTIONS, THREE ANSWERS

What constitutes a reasonable answer? How did you arrive at your answer? What benchmark did you use to get your answer?

Does the 'unit of measurement' make a difference?

Does being 'correct' make a difference?

ACTIVITY

While you were working....

You have a question on your back which you cannot see.

You must approach three people and let them read the question and give you their best estimate as to a possible answer... This gives you three possible answers to this question. Your mission is to try to 'guess' what the question is....

When estimating the answers to the questions, please give your answers in the appropriate form, so as to 'help' your colleague, without giving them any clue as to the question:

Q: How many digits in a Visa card Number?

A: Sixteen digits (NB no further information is given...)

Q & A

How many breaths do you take every day? 23,000

How many steps in the Eiffel Tower? 1,792

What is a shark's top speed? 70 km/h

What is the mass of a blue whale? 140,000 kg

How far is it from the Earth to the sun? 149,600, 000 km or 1 astronomical unit

What is the record for holding your breath? 22 minutes

How many seconds in a year? 31,536,000 (31,557,600)

How many points are on the Statue of Liberty's crown? 7

How tall is the world's tallest man? 251 cm

Q&A

How long is the Great Wall of China? 6,430 km approx.

What is the average height of the smallest species of penguin? 33 cm.

How many copies need to be sold for a song to top the Irish music Charts? 5,000

How many people have been in space? 554

How many hours sleep does a koala need? 22 hours

How many bones in your foot? 26

What height is the tallest person in the world? 8'1" 246.5 cm

**In 1878, how many names were in the first telephone book?
50 names**

Q&A

What length is a Great White Shark? 5 metres

What percentage of the Irish population are natural redheads? 9%

How many letters in the Hawaiian alphabet? 13

How many teeth does a bear have? 42

THE VALUE OF ESTIMATION

It is practical...

Collecting accurate results would be too time consuming

It focuses attention on understanding behind the problem

Develops logical sequences to solutions

Breaks down boundaries between subjects

Increases confidence in problem solving (Zadnik and Loss, 1995)

WHEN DO WE USE IT?

Where measurement is difficult, dangerous or impossible

When we need to cross-check viability of answers

Testing for uncertainty

Experimental design

Estimating results before performance

Establishing limits

THE BENEFITS

Sense of achievement

Group work

Much more than rote learning

Allows for integration and transfer of knowledge

Teaches students to continually review their knowledge, and adapt their parameters and processes.

THE RISKS

We assume a level of general knowledge

Limited student life experiences

Problems with language

Students' difficulties with the 'lack of accuracy'

Difficult and time consuming to teach

ATTITUDE

The world is messy: do what you can

You know more than you think

Use whatever tools you can to do the job

KEYS

Number Sense

Benchmarks

Partitioning

Developing a sense of the different units: metres, kilometres, kilogrammes, days,

LANGUAGE OF ESTIMATION

Enough

More

Less

How many?

How much?

How far?

How long?

KNOWN TO UNKNOWN

Using counting strategies: known to unknown

Two stacks of cards: tell how many are in one stack – estimate how many are in the other;

Close your eyes, and raise your hand when you think one minute has elapsed. Repeat, only this time tell when a half minute has elapsed...

Fractions: estimate what fraction of the group is left-handed

What fraction is wearing glasses?

PARTITIONING

Paper clip chain

Rice

Jar of cent

Ream of paper

ESTIMATION STATIONS

Straw Olympics: Place a marker where you estimate your 'javelin will land'

Long jump: Place a marker where the 2m, 5m, and 10m flags will be

Smarties: estimating fractions

Money: can you find the right amount?

Square rice: How many grains of rice in this bag?

Real Life estimation

SUMMARY

Incorporate estimation into your thinking and questioning

Provide problems with the possibility of solution

Structure questions so that, at first sight, they seem impossible without more information

Encourage multi-path solutions (emphasising the solution process rather than the answer)