Inquiry Based Approaches to Measures Seminar 2018
Key Messages

**Proficiencies**
Mathematical Proficiencies encompasses conceptual understanding, procedural fluency, adaptive reasoning, strategic competence, and productive disposition and are an essential part of pupil learning and develop through choice of task and classroom climate.

**Inquiry Based Learning**
Pupils’ mathematical skills, language and conceptual understanding are enhanced when they engage in Measures through Inquiry Based tasks.

**STEM**
Purposefully planned integration allows pupils to apply learning in Measures to real-life Scientific contexts.

**Misconceptions**
Pupil misconceptions can prohibit their conceptual understanding of Measures.
Rationale for Measures

TIMMS 2015 in Ireland: Mathematics and Science in Primary and Post-Primary schools
Clerkin, Perkins & Cunningham (2016)
<table>
<thead>
<tr>
<th>Table 6.1: Scale scores (SE) on mathematics content domains – Fourth grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Singapore</td>
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<tr>
<td>Hong Kong SAR</td>
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<tr>
<td>Korea, Rep. of</td>
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<tr>
<td>Northern Ireland</td>
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<td>Russian Fed.</td>
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<td>United States</td>
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<td>Finland</td>
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<td>Slovenia</td>
</tr>
<tr>
<td>Australia</td>
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<tr>
<td>New Zealand</td>
</tr>
</tbody>
</table>

Light shading indicates that the subscale score is significantly lower than the country's overall mathematics scale score.

Dark shading indicates that the subscale score is significantly higher than the country's overall mathematics scale score.
### Table 6.3: Scale scores (SE) on mathematics cognitive domains – Fourth grade

<table>
<thead>
<tr>
<th>Country</th>
<th>Overall</th>
<th>Knowing</th>
<th>Applying</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>618</td>
<td>631 (4.0)</td>
<td>619 (4.0)</td>
<td>603 (4.5)</td>
</tr>
<tr>
<td>Hong Kong SAR</td>
<td>615</td>
<td>618 (3.1)</td>
<td>621 (3.1)</td>
<td>600 (3.2)</td>
</tr>
<tr>
<td>Korea, Rep. of</td>
<td>608</td>
<td>627 (2.9)</td>
<td>595 (2.1)</td>
<td>619 (2.6)</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>570</td>
<td>582 (3.9)</td>
<td>575 (3.2)</td>
<td>568 (0.6)</td>
</tr>
<tr>
<td>Russian Fed.</td>
<td>564</td>
<td>556 (3.4)</td>
<td>566 (3.7)</td>
<td>570 (4.0)</td>
</tr>
<tr>
<td>Ireland</td>
<td>547</td>
<td>554 (2.9)</td>
<td>549 (2.2)</td>
<td>536 (2.7)</td>
</tr>
<tr>
<td>England</td>
<td>546</td>
<td>554 (3.3)</td>
<td>544 (3.2)</td>
<td>546 (3.3)</td>
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<tr>
<td>United States</td>
<td>539</td>
<td>547 (2.3)</td>
<td>537 (2.4)</td>
<td>531 (2.5)</td>
</tr>
<tr>
<td>Finland</td>
<td>535</td>
<td>530 (2.2)</td>
<td>536 (2.1)</td>
<td>540 (3.1)</td>
</tr>
<tr>
<td>Slovenia</td>
<td>520</td>
<td>517 (1.9)</td>
<td>521 (2.1)</td>
<td>524 (2.2)</td>
</tr>
<tr>
<td>Australia</td>
<td>517</td>
<td>509 (3.5)</td>
<td>521 (3.0)</td>
<td>523 (3.0)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>491</td>
<td>475 (2.6)</td>
<td>497 (2.5)</td>
<td>504 (2.7)</td>
</tr>
</tbody>
</table>

Light shading indicates that the subscale score is significantly lower than the country's overall mathematics scale score. Dark shading indicates that the subscale score is significantly higher than the country's overall mathematics scale score.

### Table 6.2: Mean scores of girls and boys on mathematics content domains – Fourth grade

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Geometric Shapes &amp; Measures</th>
<th>Data Display</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>Singapore</td>
<td>632</td>
<td>628</td>
<td>610</td>
</tr>
<tr>
<td>Hong Kong SAR</td>
<td>610</td>
<td>621</td>
<td>611</td>
</tr>
<tr>
<td>Korea, Rep. of</td>
<td>605</td>
<td>664</td>
<td>608</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>573</td>
<td>576</td>
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</tr>
<tr>
<td>Russian Fed.</td>
<td>567</td>
<td>567</td>
<td>558</td>
</tr>
<tr>
<td>Ireland</td>
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<td>553</td>
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<td>England</td>
<td>542</td>
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<td>Australia</td>
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<td>515</td>
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</tr>
<tr>
<td>New Zealand</td>
<td>483</td>
<td>488</td>
<td>487</td>
</tr>
</tbody>
</table>

Shading indicates that the subscale score is significantly higher than for the other gender on that subscale. Standard errors for the data in this table can be found in Table B.1 in Appendix B.
“...measurement should not be taught as a simple skill; instead it is a complex combination of concepts and skills that develops slowly over years...”

Clements & Stephan, 2001

“...likely a function of how the subject is taught – too much reliance on pictures and worksheets rather than hands-on experiences and a focus on skills...”

Van de Walle, 2013

Tom’s house is 5km from the school. The bus brings him 4km 300m and he walks the rest of the way. How far does he walk?

Textbook Problem
TIMSS 2011

If the string in the diagram above is pulled straight, which of these is closest to its length?

A. 5 cm
B. 7 cm
C. 8 cm
D. 9 cm

Correct: Ireland: 16%  International: 28%

Figure 3: Sample TIMSS 2011 (Grade 4) Item
Investigating Slopes

Set Up
Set up the half-tube on the floor with some blocks underneath one end.

Predict
Predict how far the toy car will roll along the ground. Then let it go.

Measure
Measure how far the car travels using a broken ruler. Repeat a number of times, changing the angle of the slope.

Graph
Make a graph of your results. Did the angle of the slope make any difference to the distance the car travelled?
Mathematical Proficiencies

- Content
- Skills
- Strategic Competence
- Conceptual Understanding

- Procedural Fluency
- Adaptive Reasoning
- Productive Disposition
Measures and the Wider Maths Curriculum

**Number and Place Value**
Measuring familiar objects connects ideas of number to the real world, enhancing number sense. The metric system of measurement is built on the base-ten system of numeration.

**Geometry**
Developing perimeter, area and volume formulae requires understanding shapes and their relationships. Measures help describe shapes and angular measures play a significant role in the properties of shapes.

**Data**
Statistics and graphs help describe and answer questions about our world. Often this description is in terms of measures.

*Van de Walle, Karp and Bay-Williams (2013) p.375*
Inquiry Based Learning

...involves going beyond information to search for an explanation. It involves posing thoughtful questions to help understand the “why” behind the information.

*Teaching Council, Ezine, December 2017*

“Inquiry Based Learning puts the emphasis initially on curiosity and observation, which are then followed by problem solving and experiments.”

*STEM Education in the Irish School, p.35*
Continuum of Assessment

Child leads the assessment

- KWL
- Two Stars & a Wish
- PMI
- Rubric
- Learning Log

Teacher leads the assessment

- Concept Maps
- Mind maps
- Tree Diagrams
- Minimal Defining Lists

- Instructional Framework
- Pupil Questioning

- Rubric
- Checklist
- Target Child
- Time sample
- Shadow study

- Drumcondra
- Sigma T
- Ballard Westwood
Which tablets would you buy?
Inquiry Based Learning

Capacity
Who can hold the most?
p.174

Money
Coins in my pocket
p.287

Weight
Marbles in a cup
p.155

Time
Just a minute
p.237
Concept Cartoons

Which response is right? Why?

How could this concept cartoon be used for IBL in STEM?

What possible misconceptions could this concept cartoon reveal?
Integrated Nature of STEM

An integrated approach to STEM enables learners to build and apply knowledge, deepen their understanding and develop creative and critical thinking skills within authentic contexts.

(DES, 2017)

Science needs mathematics or other abstract symbols when it reaches the limit of what can be expressed using everyday language.

(Fibonacci Project, 2013)

Digital technology is crucial in supporting teaching, learning and assessment.

(DES, 2017)
Build a Bridge

Plan to build a freestanding bridge using:
- Newspaper Sheets x10
- Sticky tape

Must hold manual 30cm over table for at least 5 seconds

One Group: Photo documents their investigative journey for Adobe Spark

Plan to develop both maths and science skills using pages 2-5 in your booklet for guidance

Carry out the plan and share your findings and results through a mini-plenary

www.pdst.ie
Linkage and Integration

Mathematical Skills
- Implementing
- Understanding and Recalling
- Applying and Problem-Solving
- Communicating and Expressing
- Integrating and Connecting
- Reasoning

Science Skills
- Designing and Making
- Exploring
- Planning
- Making
- Evaluating
- Working Scientifically
- Questioning
- Observing
- Predicting
- Investigating and experimenting
- Estimating and measuring
- Analysing:
  - Sorting and classifying
  - Recognising patterns
  - Interpreting
- Recording and communicating

Mathematics
- Number
- Algebra
- Measures
- Shape and Space
- Data

Measures
- Weight
- Length
- Area
- Time

Build a Bridge
Further Integration Opportunities

**Weight**
- Tom’s challenge p.156
- Tin foil boats p.151
- Investigating food packaging & contents p.158
- Recipes p.159
- The perfect suitcase project p.161

**Capacity**
- Class lunch p.188
- Popcorn project p.189
- Displacement p.190
- Puddles p.193
- Density tower p. 192
- Design a cereal box p.202-203

**Time**
- Candle clock p. 226
- Bike ride problem p.263
- Running a kilometre p.263
- Just a minute p.237
- Seasons p.232

**Area**
- Garden challenge p.102
- Design a bedroom project p.113

**Length**
- Tracking growth p.50
- Tayto Park Map p.78
- Desks over horizon p.69
- Room for elbows p.67
- Going the distance p.63
- Any three items p.61
- Trundle wheel activities p.59
- Using centimetres for measuring p.55
References


References


