Shape and Space
Seminar 2019
Key Messages

Classroom climate and choice of task can enable all pupils to achieve success in Shape and Space.

An inquiry based approach allows pupils to engage with STEM in real-life contexts.

The development of spatial reasoning is dependent on meaningful planning, teaching and assessment.
Rationale behind Shape and Space

International Mathematics Achievement

East Asian Countries Top Achievers at Fourth Grade in Mathematics

TIMSS 2015 Mathematics has achievement results for 49 countries at the fourth grade.

The gap between the East Asian countries and the next highest country was 23 in 2015, unchanged from 2011.

- Singapore
- Hong Kong SAR
- Korea
- Chinese Taipei
- Japan

Northern Ireland
Russian Federation
Norway
Ireland
England
Belgium-Flemish
Kazakhstan
Portugal
United States
Denmark
Lithuania
Finland
Poland

Netherlands
Hungary
Czech Republic
Bulgaria
Cyprus
Germany
Slovenia
Sweden
Serbia
Australia
Canada
Italy

Spain
Croatia
Slovak Republic
New Zealand

France
Turkey
Georgia
Chile
United Arab Emirates
Bahrain
Qatar
Iran
Oman
Indonesia

Jordan
Saudi Arabia
Morocco
South Africa
Kuwait
Rationale behind Shape and Space

24% of the curriculum objectives are shape and space.

On average 8% of the content of textbooks pertains to shape and space.

11% questions related to shape and space on Sigma T 5th/6th class (9.3% Drumcondra).

Particular weakness in girls in relation to shape and space.
Geometry, spatial reasoning, and measurement are topics that connect to each other and to other mathematics, and that connect mathematics to real-world situations.

These core components are the foundations of number lines, arrays in multiplication, fractions, graphing, and topics beyond.

They also lie at the heart of physics, chemistry, biology, geology and geography, art and architecture.

Therefore, across many areas, we see that a picture/diagram/figure can be “worth a thousand words.”

(Adapted from: Fuson, Clements and Kazee, 2010; p57-63)
Gender and STEM

“Many students have a stereotypically masculine image of mathematics and science”
(Nosek, Banaji, & Greenwald, 2002; Smeding, 2012)

“...brief educational interventions can show marked improvements in the development of spatial ability in both genders”
(Uttal et al., 2013)

“Educational interventions... counteracting the tendency for initially small sex differences in achievement to be translated into larger sex differences in career choices is likely to require concerted and sustained efforts...”
(Reilley, Newman and Andrews, 2014)
Career Opportunities

Why teach Shape and Space?
Career Opportunities

- Architect
- Physicist
- Advertising and Marketing
- Astronomer
- Engineer
- Interior Designer
- Fashion Designer
- Pilot
- Surgeon
- Chef
- Architect
- Medical Imaging
- Builder
- CNC Programmer
How do pupils currently experience shape and space in your classroom?

What are the successes and challenges?
What are pupils’ prior or informal experiences?
Professional Reading
Odd One Out
On each of these grids the counters lie at the four corners of a square:

What is the greatest number of counters you can place on the grid provided, without four of them lying at the corners of a square?

Is it possible to predict the largest number of counters in any size grid?

https://nrich.maths.org/1142
Classroom Climate

Discussion

Success

Knowledge is shared

Mistakes are valued

Struggle is productive

Skills
‘Pupils need to hear the language of position and have an opportunity to respond to the language before they can begin to use the language for themselves...unless pupils are given a real purpose for using the appropriate language, they are unlikely to make it a useful part of their vocabulary.’

(First Steps, p.23)
What do you see?
What do you see?
Learning Trajectory

Informal Deduction

Analysis

Visualisation

Van Hiele Model, 1957
How many nets of a cube can you find?
A Puzzling Cube

Here are the six faces of a cube, in no particular order:

Here are three views of the cube:

Can you deduce where the faces are in relation to each other and record them on the net of the cube in your booklet?

https://nrich.maths.org/1140
Reflective Learning Logs

- Open ended questions
- Talk and discussion beforehand
- Writing should be in pupils’ own words but incorporate appropriate maths vocabulary
- Pupils need to know their audience
- Allow for a variation of responses
- Model the process and provide feedback
Developing and Assessing Skills

- Sorting Triangles (p.112)
  - Assessment Tool: Concept Mapping

- Pattern Block Symmetry (p.84)
  - Assessment Tool: Portfolio (Seesaw)

- Pentominoes (p.143)
  - Assessment Tool: Conferencing

- Constructing Triangles (p.160)
  - Assessment Tool: Self-Assessment
“Science helps provide relevance to math that is all too often abstract and isolated calculation operations. (Johnson, 2011)

“A child’s spatial skills level is a better predictor of STEM attainment than their maths skill level in 7th grade.” (Wai, Lubinski & Benbow, 2009)
Spaghetti Structures

Challenge: In groups, make the tallest, strongest tower using only spaghetti and marshmallows.
Linkage and Integration

What learning outcomes could this lesson target?
Linkage and Integration

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

Shape and Space
- Symmetry
- 2-D Shapes
- 3-D Shapes
- Lines and Angles
- Spatial Awareness

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

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

Spaghetti Structures
An Integrated Approach to Skill Development

Consider
- Content
- Skills
- Connections

Getting Started
- Prior knowledge
- Misconceptions

Working on the Problem
- Challenges
- Mistakes
- Successes

Digging Deeper
- Self-reflection
Foam Rocket Experiment

Circle, Square, Triangle

What is still going around in your head?

What is squared away?

What 3 activities will you use in your classroom?
Overview of PDST Primary Supports for Leading Learning in the 21st Century

School-Self Evaluation
Teaching & Learning Framework; 6 Step SSE Process; gathering, collating & analysing relevant data; implementing the SIP for literacy, numeracy and any other area of teaching & learning.

PDST Leadership Programmes
- Misneach.....New Principals
- Tánaiste......New Deputy Principals
- Tóraíocht.....Aspiring Leaders accredited by Maynooth University
- Forbairt.......Experienced Principals & ALNs
- Spreagadh...NAPD & PDST collaboration

PDST Websites
- www.pdst.ie
- pdsttechnologyineducation.ie
- scoilnet.ie (portal for resources)
- teachercpd.ie (on-line courses)
- ollscoil.net (ITE students awards)

www.pdst.ie/schoolsupport

PDST Primary Supports

PDST Websites

Literacy
SSE & strategies for improving oral language, writing, reading and the use of broadcast /digital media.

Numeracy
SSE & strategies for improving numeracy. Supporting the development of Mathematical thinking.

Gaeilge
Tacaíocht chun Curaclam na Gaeilge a chur i bhfeidhm i Scoileanna T1&T2, Féinmheastóireacht Scoile, chomh maith le tacaíocht lán Ghaeilge a sholáthar do Ghaelscoileanna agus scoileanna sa Ghaeltacht.

Health and Wellbeing
- SPHE including Child Protection and Stay Safe
- Relationships and Sexuality Education (RSE)
- Active Learning Methodologies
- Anti Bullying-Procedures and Policy, Awareness Raising, Prevention and Intervention Strategies
- PE
- Wellbeing for teachers

Integrating ICT - Primary
- Active Learning Methodologies- Key methodologies of the primary curriculum through the effective use of ICT.
- Literacy & Numeracy – Creating, developing and using ICT to create teaching resources in all areas of primary literacy and numeracy.
- SSE – Online tools for gathering, collating & analysing relevant data.
- eAssessment & ePortfolios – Assessment of / for learning with ICT.
- ePlanning & Collaboration – Google Apps for Education.
- Tablet Technology Integration – Pedagogy, Curriculum & SEN
- Virtual Learning Environments (VLEs) – Google Classroom, Edmodo

Models of support: in-school support (in-class modeling, meeting principal/groups of teachers, Croke Park hrs), seminars, workshops, clusters