CURRICULUM, PEDAGOGY AND BEYOND



THE MATHEMATICAL ASSOCIATION OF VICTORIA



2024 MAV State Conference

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Mastering Geometry: Overcoming Misconceptions with Effective Teaching and Learning

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Quick Introduction

- Maths Learning Specialist for 7 years.
- Presenter at AAMT, MAV, MAT, QAMT and MAWA Conferences 2017-2024
- Lesson Writer MAV/DET Victorian Curriculum 2.0
- Creator of activities with Dr Paul Swan and Maths300
- Contributor for Prime Number, Common Denominator and ATM (UK)
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Geometry in the wider curriculum

- Problem solving from Michael Minas
- 23 students were lined up outside the classroom. Their shirts went in a pattern – Blue, Blue, Green, Green, Red, Blue, Blue, Green, Green, Red…
- What colour is the last person? How many people are wearing red?
- Alter to:
- Each colour had a shape. What pattern could they have made? How many are triangles?
- Lots of possibilities regular v irregular, objects v shapes, right angles v no right angles, parallel lines v no parallel lines

Geometry in the wider curriculum

- I grabbed a handful of 3D objects that had 30 faces in total. What are they?
- Alter to:
- I grabbed a handful of 2D shapes that had 30 sides in total. What are they?
- Lots of possibilities Set types of shape (must have/don't have), multiplicative (2 types – differences between 6x5 and 5x6)

Why do we have such difficulty with shape?

- Four main barriers to developing strong understanding of Geometry:
- Defining shapes on their appearance rather than their properties
- One name for one shape
- 'Model poor' students rely on the visual rather than the structure
- Languages



Which of these are shapes

- The use of nonexamples helps prevent misconceptions.
- Which of these are not shapes? How do you know?



Which of these are shapes

- When creating these tasks, look for three things:
 - Regular shapes students would be likely to know
 - Irregular shapes students might potentially confuse
 - Non-shapes to help develop the definition of 'shape'

Which of these are rectangles?

Reframing Mathematical Framework II

<u>https://www.mathseducation.org.au/online-resources/introducing-the-rmfii-resources/</u>







Let's draw some shapes

- Can you draw a rectangle
- Can you draw a square
- Can you draw a rhombus
- Can you draw a shape that is all 3



When a student outwits the teacher...

Geometry Name the Jade	Shape se 2d shapes charlot	te charlie	sophia
Har	Piet Er	nily m	aria
	\rangle	7	

The problem with naming shapes

- A major misconception develops –
- That the shape is named based on what it looks like:
- Draw a rhombus
- Slowly turn it. At what point do students name it a diamond?
- Continue turning it, what has it become now?

How do students name these shapes



Right-angled triangle



Upside down triangle





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Shape in the curriculum

Foundation

- sort, name and create familiar shapes; recognise and describe familiar shapes within objects in the environment, giving reasons
- VC2MFSP01

Level 1

- make, compare and classify familiar shapes; recognise familiar shapes and objects in the environment, identifying the similarities and differences between them
- VC2M1SP01

Level 2

- recognise, compare and classify shapes, referencing the number of sides and using spatial terms such as 'opposite', 'parallel', 'curved' and 'straight'
- VC2M2SP01



What features are important

This information is crucial! Understanding these four features (and be fluent in Greek and latin) and you can name every shape

- 1) The number of sides
- 2) The length of the sides
- 3) The types of corners
- 4) Presence of parallel lines



What does the term 'dimension' mean

- Dimension means an attribute we can measure:
- 0D A dot
- 1D (not the band) A line
- 2D Shape length and width
- 3D Object length, width and depth

The problem with commercial texts

- Commercial texts, either created by companies or teachers (such as TPT), have limitations when it comes to geometry.
- Often, a narrow definition is used to define shapes to allow everyone to use the text
- Posters and classroom displays usually use a singular model for each shape
- Create co-constructed anchor charts



Not to be confused with 1 sided shapes – sides require corners

These are not polygons because they don't have many angles

Circle Ellipses Oval







2 sided shapes

Semi Circle





3-sided shapes

Triangles Equilateral triangle





Right Angle Triangle

Isosceles Triangles

Scalene Triangle





Square

4-sided shapeFour equal sides4 right angles2 sets of parallel line:





Oblong

4-sided shape

2 sets of equal sized sides4 right angles2 sets of parallel lines





Rectangle

4-sided shape

2 sets of parallel lines4 right angles

Can be either a square or oblong







Rhombus

4-sided shape

- 4 equal sides
- 2 sets of parallel lines







Kite

4 sided shape

No right angles 2 sets of equal sized lines





Trapezium

4-sided shape

1 or no right angles
1 set of parallel lines







One shape – One name

Renaming in Place Value and Equivalent Fractions

Name this shape

Polygon, Quadrilateral, Rectangle, Square, Rhombus, Parallelogram



Snap / Memory

• Match definition, shape and name.



Guess Who

- Best if created with students.
- The shapes become the characters. Students use the features to eliminate characters.
- Extending what is the least amount of questions that is needed to find any character?



-agon

5 sides or more

Any shape that has the required number of sides

Can take a regular (all sides/angles the same) or irregular (different sides/angles)











Is language a problem?

We need to separate 'not knowing how to draw shapes' to 'not recognizing the mathematical term used'



Is the problem the language of shape? Similar to time – past/to "I don't know what an 11-sided shape looks like" May still think shapes look a particular way



Model Poor

- Especially if relying on commercial displays.
- Create displays that prioritise irregular representations an octagon is ANY 8-sided shape.
- Display Idea Spy Shapes
- Spies need disguises to hide their appearance, shapes can do the same! Create a display with the –agon shapes, showing their regular form. Assign students a shape who then need to draw a disguise the shape might take (irregular form).

Make my shape (Barrier Game)

Make my shape (Barrier Game):

- Roll a dice (re-roll if you roll a 4). This is the number of sides the shape has.
- Each student draws a representation of that shape.
- The pair gets a point if both representation is different.
- If you roll a number more than once, you need to use different representations to originally
- Can be extended into area and perimeter



Make 3D easy

- 3D objects are easy to name IF 2D shapes are fully understood:
- Polyhedra only flat faces
- Prism The base names the shape. If the faces on the sides are 4 sided, it's a prism
- Pyramid The base names the shape. If the faces on the sides are triangles, it's a pyramid
- Platonic solid (regular polyhedron) all the same face (cube, dodecahedron)
- Non-polyhedral not all flat faces (note a face has to be flat because it is a shape)
- Cone, Sphere, cylinder



Make 3D easy

- Nets for polyhedra the 2D shapes that make up the polyhedral will only be 2.
- Prisms 2 more faces than edges on the base
- Pyramid 1 more face than edges on the base
- Non-polyhedra nets slightly more difficult

Moving beyond naming

- Other areas of geometry (sometimes known as Geometric Reasoning)
 - Angles
 - Transformation
 - Symmetry
- We can use our understandings of shape, so we are 'learning' angles/transformation/symmetry AND 'consolidating' shape



Angles

- identify angles as measures of turn and use right angles as a reference to compare angles in everyday situations (VC2M3M05) Y3
- Right angle to begin with. Shapes, rather than two lines, can be used as an introduction to angles – students are familiar with right angles from quadrilaterals
- Classifying and drawing shapes based on their angles
- "Can you draw a heptagon where more than half the angles are less than a right angle/acute/less than 90 degrees?"



Symmetry

- recognise line and rotational symmetry of shapes and create symmetrical patterns and pictures, using dynamic geometry software where appropriate (VC2M4SP04) Y4
- Exploring symmetry within regular and irregular shapes. Is there a connection between number of sides, angles used and symmetry?
- Exploring symmetry within quadrilaterals is there a connection between the features and symmetry?
- Drawing regular and irregular shapes with and without symmetry can an irregular shape have rotational symmetry?



Transformation

- When we explore orientation doesn't impact naming of the shapes, we can explore rotations/reflections
- describe and perform translations, reflections and rotations of shapes, using dynamic geometry software where appropriate; recognise what changes and what remains the same, and identify any symmetries (VC2M5SP03) Y5





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- Step 3: Enter the email you registered with
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