Inquiry Mathematics in the Primary Classroom (ReSolve)

Duncan Symons
Duncan.symons@unimelb.edu.au

Aims of the Session

To discuss/ think about/ reflect/ participate in:

- The pedagogy of inquiry based (investigative) mathematics;
- An activity that you can use in class;
- The nexus between theory and practice

Problem Solving and Investigative (Inquiry driven Mathematics)

- Mathematical Investigations are contextualised problem-solving tasks that foster learning potential through open ended inquiry (Jaworski, 1996).
- In contrast to drills and workbook activities that provide practice of singular concepts or skills, an investigative approach is more holistic, complex and often interdisciplinary (Diezmann, Watters, & English, 2001)

The pedagogy of inquiry based (investigative) mathematics

The following questions/issues really need to be dealt with before you can consider taking a 'whole school approach' to this approach to mathematics instruction:

- Talk to the delegates around you about what an 'Inquiry based' or 'Investigative' approach to mathematics should look like.
- What (if anything) differentiates "inquiry mathematics" from other forms of inquiry?
- Barbara Jaworksi (1996) (a leading researcher in this area) states:
  - *Some teachers 'view mathematics as a field of enquiry, rather than a pre-existing subject to be learned'*
    - Where do you sit in terms of this dichotomy?

The pedagogy of inquiry based (investigative) mathematics

- Can you identify some principles that you think are important when taking this approach to mathematics teaching?
- When/if an investigative approach to mathematics teaching is taken how does it fit in to the timetable?
  - Is it supplementary/ additional work or should it be a core approach to teaching in the discipline?
- When/ if an investigative approach to mathematics teaching is taken how do we deal with issues of alignment with the mathematics curriculum?

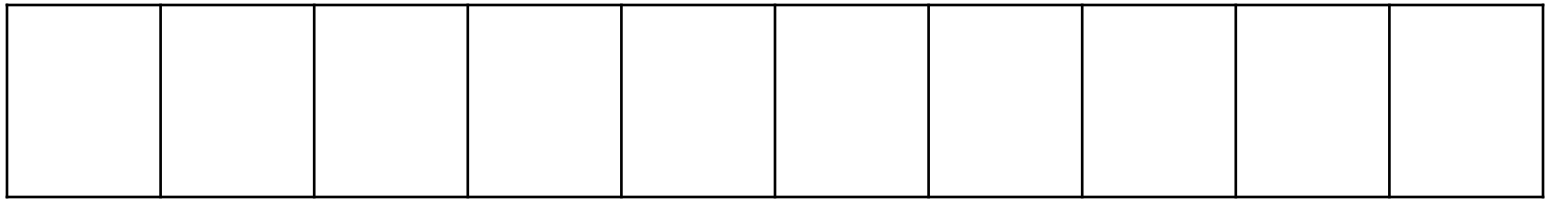
Maths Inquiry – Japanese Sleeping Capsules

In cities in Japan land is expensive. As such, inventive and creative approaches are needed to accommodate the population. With this in mind in various Japanese cities, 'sleeping capsules' (see below) are used as an 'ultra-high density' housing solution. These Capsules are simply a series of 'rectangular prisms arranged in an 'array'.

- Watch this video

Task 1 – Japanese Sleeping Capsules

- Consider the following diagram of the entrance to a top row of capsules:



- On your tables create a plain language statement describing a pattern related to the number of sides on each capsule entrance with reference to the total number of sides.
- Discuss: How do you anticipate year 5/6 students would approach this? What issues/ challenges would they have?

Task 1 – Japanese Sleeping Capsules

- Initially students will recognize that each square has 4 sides.
- They will then realize that each of the squares (after the first square ‘shares’ one side)
- A statement like the following will be generated:

The first capsule entrance has 4 sides. For each capsule entrance after that we add three sides.

- They will then usually come up with what we will call a ‘recursive’ equation. Something like:
- The number of sides = 4 + 3 + 3 + 3 + 3 + 3 + 3 ...
- Students should then be supported to see a more ‘efficient’ way of representing this

Task 1 – Japanese Sleeping Capsules

- With support they should be able to articulate the following:

  If we multiply the number of sleeping capsules by three and add one we will always be able to find the number of capsules entrance sides.

- Have the students look at the sentence and suggest single symbols that we might be able to use to replace the words in the sentence.
- With scaffolding they should arrive at the following 'explicit' equation:
  - C x 3 + 1 = S *or*
  - S = C x 3 + 1

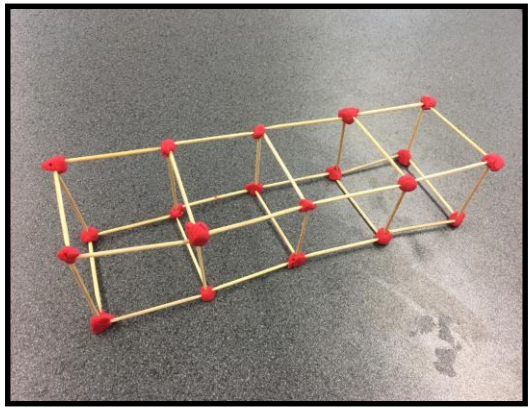
  (where 'c' is '*number of sleeping capsules*' and 's' is '*number of capsule entrance sides*')

Task 1 – Japanese Sleeping Capsules

- The lesson can be concluded by explicitly introducing the words ‘generalisation’ and ‘generalising’.
- Suggest to students that the first ‘equation’ would only work if we knew the number of sides in the previous sleeping capsules.
- The second equation helps us identify the number of sides needed whatever the number of sleeping capsules in the sequence.
- This process is called ‘generalising’.

Task 2 – Japanese Sleeping Capsules

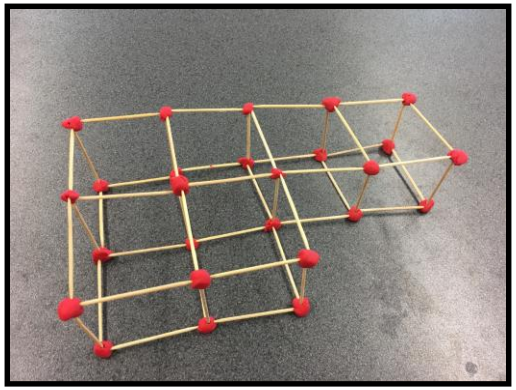
- You will now construct a 3D model of a 4 x 4 array of sleeping capsules (out of chickpeas and toothpicks).
- Before constructing the first row predict how many edges will be required for the first capsule and each subsequent capsule in the row.
- Begin by just constructing the first row.



- Can you describe the pattern – number of capsules vs number of edges?

Task 2 – Japanese Sleeping Capsules

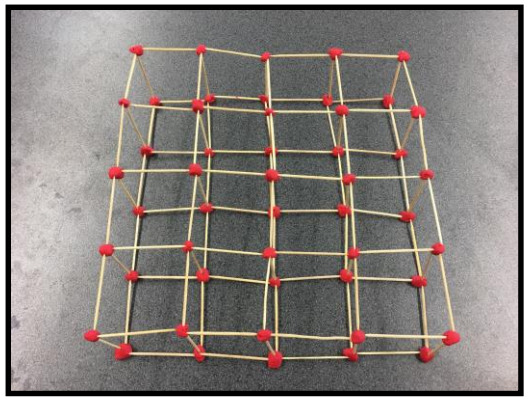
- Having constructed the first row consider the three subsequent rows of capsules.
- Before constructing, predict the pattern that will occur in the second and subsequent rows.
- Take a systematic – left to right approach to the addition of your second row.
- When you get to the point below consider how many edges you have added to the first capsule of row 2 and subsequent capsules.

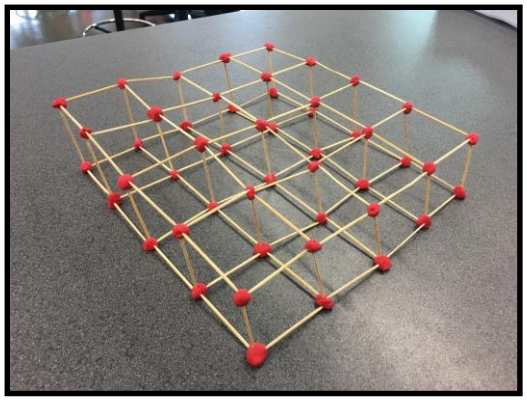


- Using the gathered evidence develop a conjecture that will allow you to calculate the total number of edges in your 4 x 4 array of capsules.

Task 2 – Japanese Sleeping Capsules

- Your completed array of capsules should look like:





- You can use the original formula (the formula for finding number of edged in the first row) combined with the new formula to work out the total number of edges in the 4 x 4 array.

Working for 4 x 4 Array of Sleeping Capsules

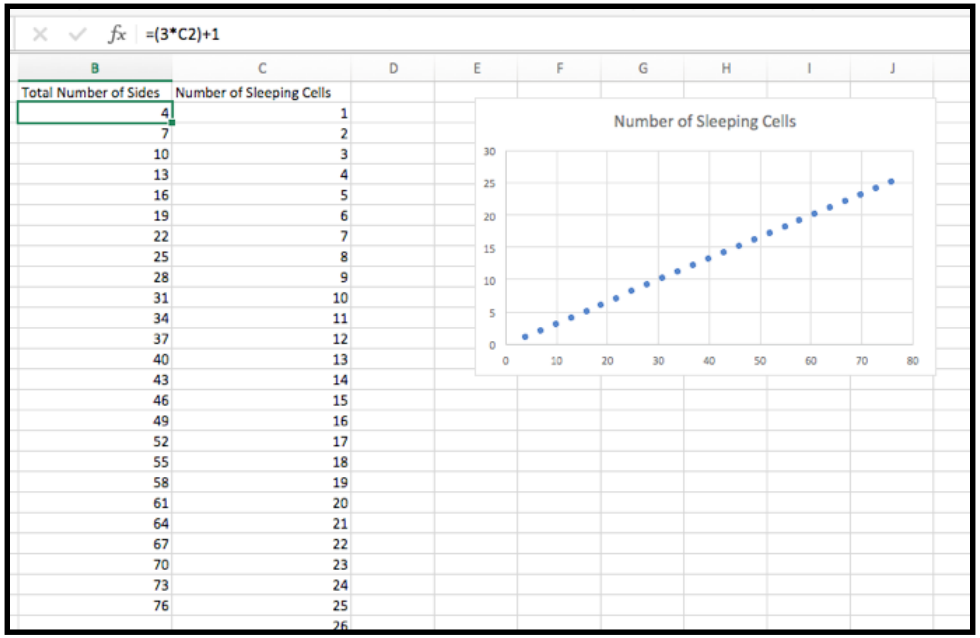
- **Equation for first row:** C x 8 + 4 = E
- 4 x 8 + 4 = E
- 36 = E or E = 36

- **Equation for subsequent rows:** C x 5 + 3 = E
- 4 x 5 + 3 = E
- 23 = E or E = 23
- We multiply 23 x 3 because in the example there are 3 subsequent rows
- 23 x 3 = 69

- If we add the 36 edges in the first row to the 69 edges in the three subsequent rows, we get 105 total edges in the 4 x 4 sleeping capsule array.

Some Considerations

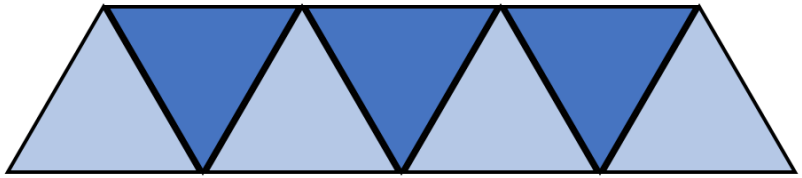
- Consider how digital technologies might be integrated..
- Here is an example:

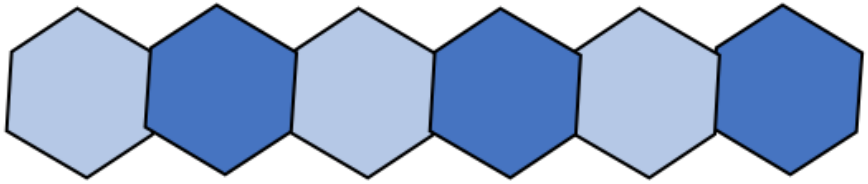


- Does anyone have any other suggestions?

Some Considerations

- You can consider allowing students to investigate non – rectangular prism based sleeping capsules:



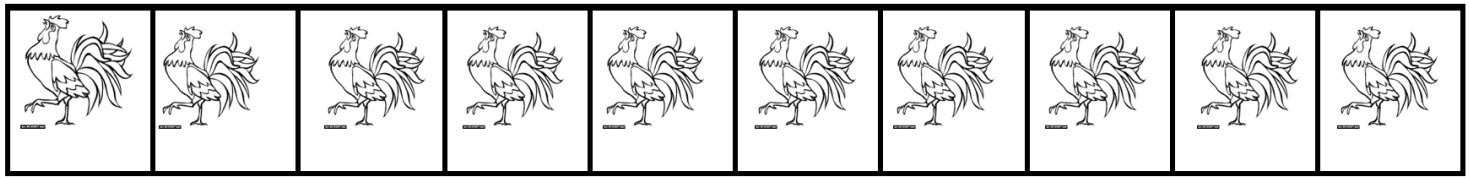


- How does this change the investigation? Issues/ opportunities?

Some Considerations

- Other contexts, E.g.

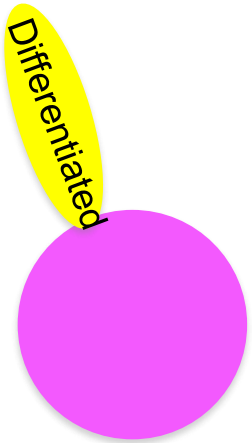
The organisers of the Royal (substitute Sydney, Melbourne, Ballarat etc etc) Show are considering 'accommodation' for the roosters entered within the 'best in show' category. They are attempting to determine the number of sides each entrance to a rooster enclosure will have if they are positioned in a row as follows:



Some Considerations

- Your thoughts?
- What are the ways you would adapt the inquiry for the classroom?

What does a ‘good’ investigative/ inquiry task look like?



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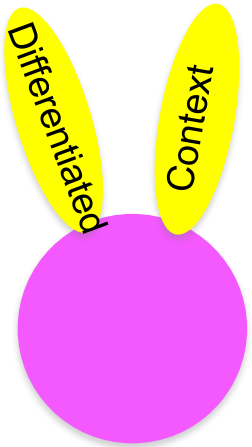

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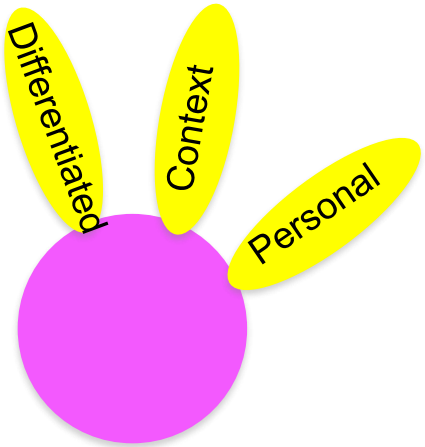

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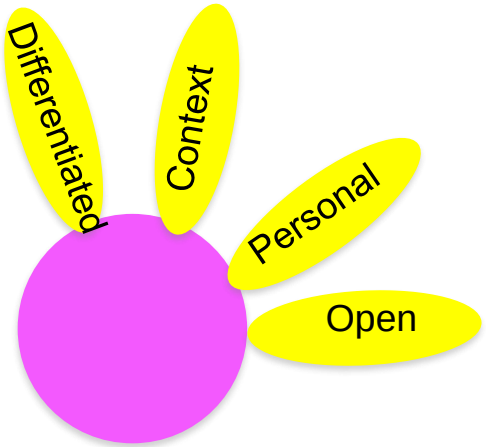

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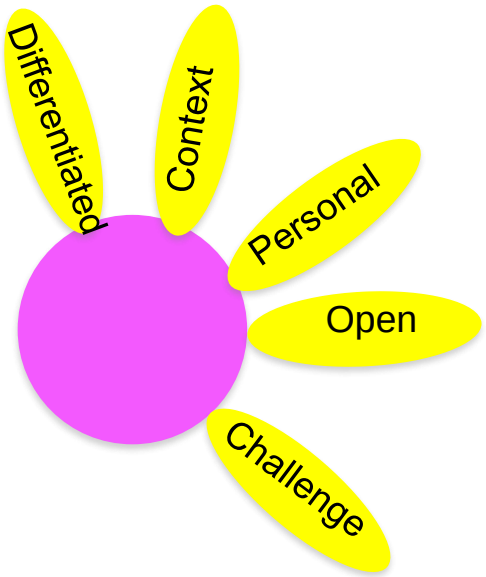

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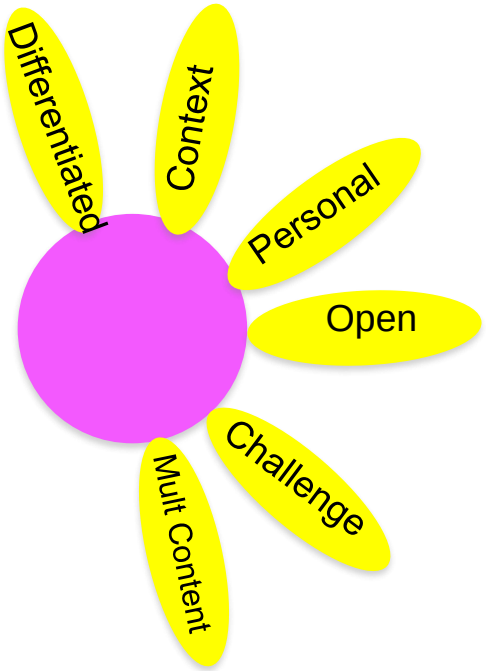

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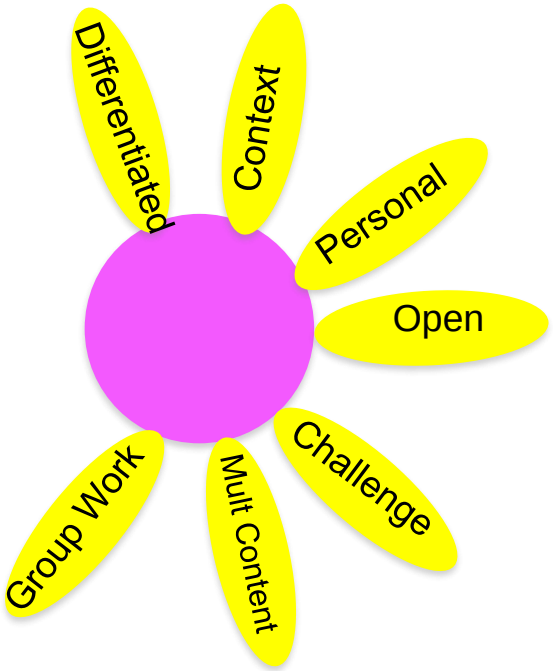

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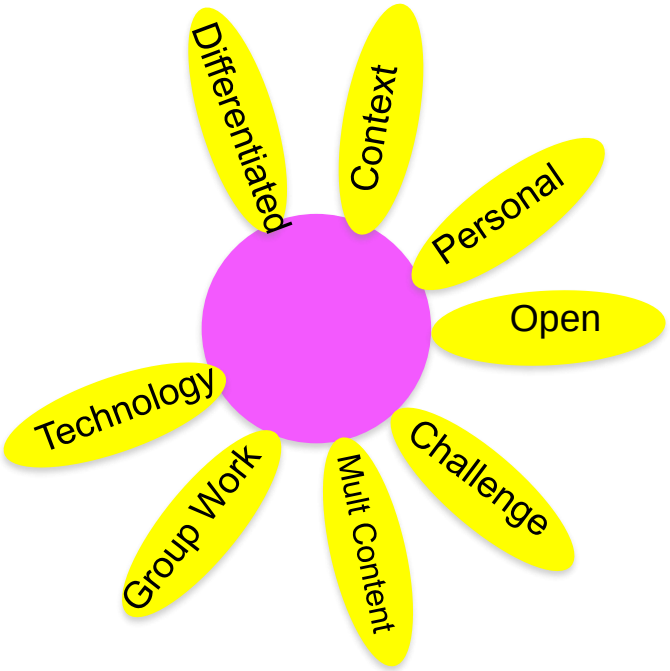

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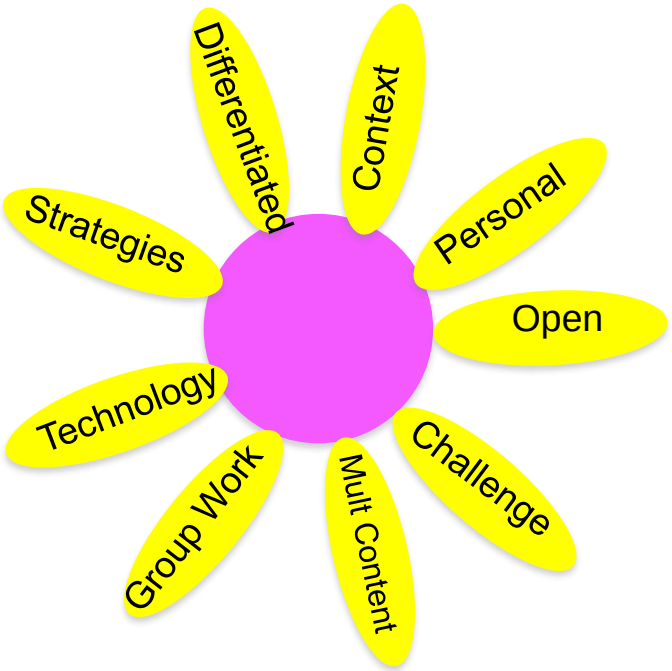

Questions/ Comments

- Thank you all very much for attending the session
- I hope that you enjoyed it and took something worthwhile away for your context.

- Questions?

- Contact:
  - Duncan Symons
  - Duncan.symons@unimelb.edu.au
  - Twitter: @dcsymons