Supporting all Learners in Mathematics through Universal Design for Learning

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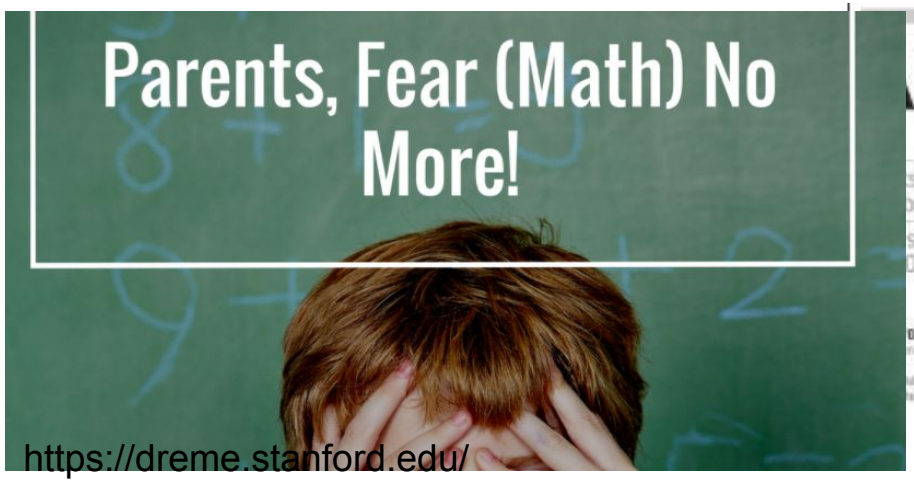
Overview of Presentation

- The Lie of the Land
  - Mathematics Achievement
  - Changing Context of Learning Support

- Introduction to Universal Design for Learning
  - Multiple Means of **Engagement**
  - Multiple Means of **Representation**
  - Multiple Means of **Action and Expression**

Negative views of maths



https://dreme.stanford.edu/

Almost 4,000 Leaving Cert students fail maths

s bonus for record numbers who
bled on sitting higher level papers

seven students secure top grades of
00 per cent across all eight subjects

Editorial comment: page 13

Call for reform as maths and science grades drop yet again

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Irish teachers are doing a great job!

Trends in International Mathematics and Science Study (TIMSS) 2015

- At both 4th class and second year, Irish children achieved mean mathematics and science scores that were significantly above the international average
- Tracking achievement over a number of years (1999- 2015) shows that performance has improved among both lower- and higher-achieving pupils, but improvements in lower achieving students most marked.

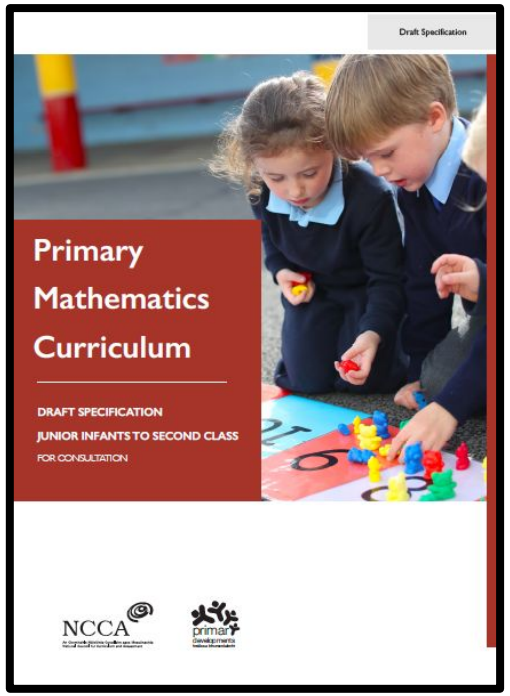
Areas for improvement

- Relative weakness in Geometric Shapes and Measures (4th class and 2nd year)
- Gender
  - Boys significantly outperform girls at 4th class in Geometric Shapes and Measures
  - Boys significantly outperform girls at 2nd year in Number
- Relative weakness in Reasoning tasks (4th Class)

National Assessments of Mathematics and English Reading

- Also show improvements but stubborn gap between DEIS and non-DEIS schools persists.

Forthcoming primary curriculum



Full specification to be published Autumn 2021

- Foregrounds the **processes** of mathematisation: communicating, reasoning,argumentation, justifying, generalising, representing, problem-solving, and connecting.

-Presents **learning paths** which serve as reference points for planning and assessment

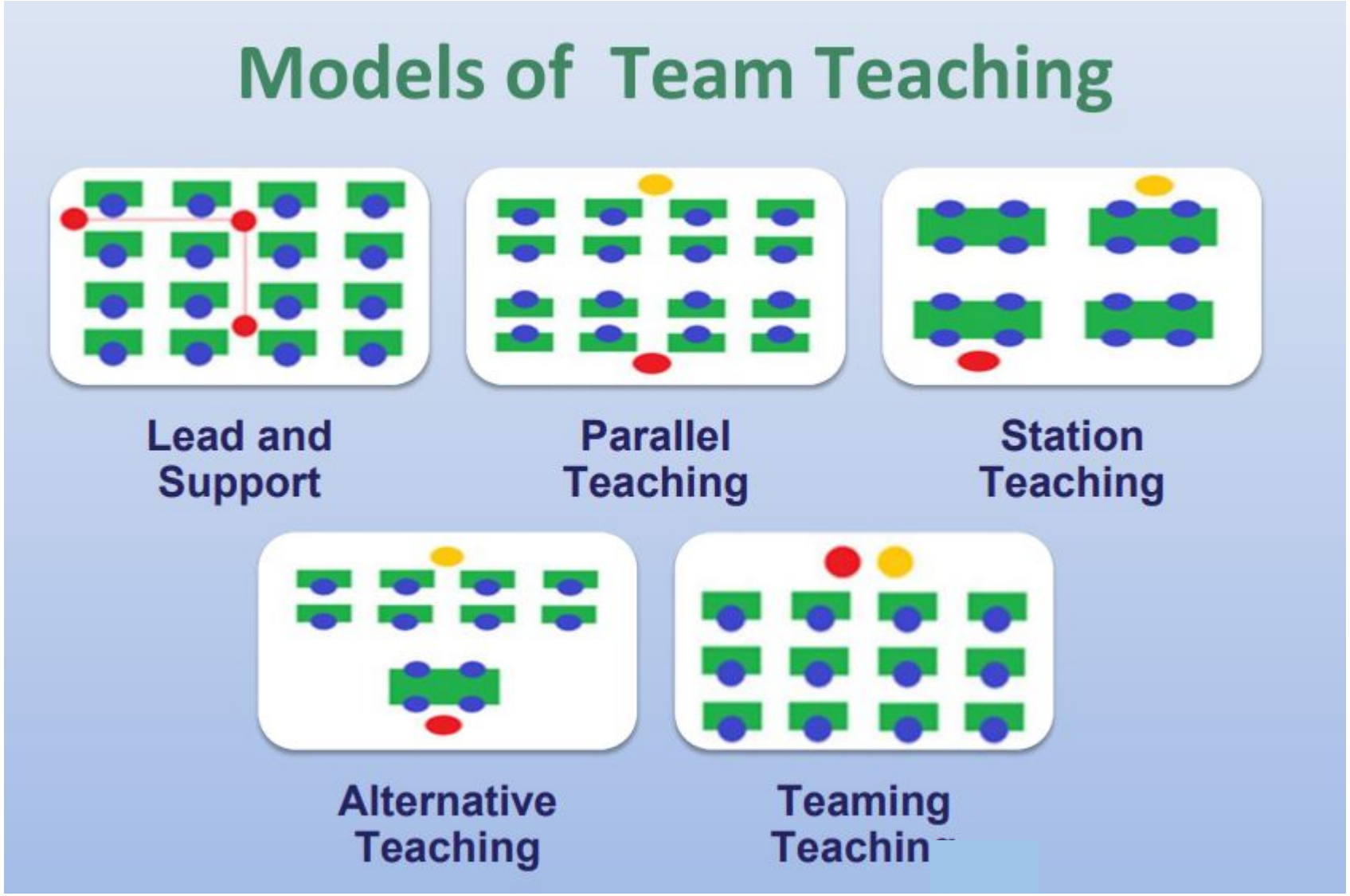
-Promotes the principles of **equity and access** for all children

Changing Nature of Learning Support

- Team Teaching: A group of two or more teachers working together to plan, conduct and evaluate the learning activities for the same group of learners (Goetz, 2000)

- This aligns with recommendations from NCSE which identifies **co-teaching, heterogeneous grouping, collaborative learning and problem-solving, and differentiation** as teaching strategies with the potential for inclusion (NCSE, 2010)

How to plan for and support mixed ability groups?



Vahey & Slevin (2018)

Inclusive rather than differentiated approaches

- Most, if not all teachers, are familiar with the concept of '*differentiation'*.
- However, reducing the complexity of the curriculum or setting easier objectives for certain children is not an optimal strategy.
- Similarly, if advanced learners are merely assigned tasks to 'keep them busy', they will continue to relearn known material.
- The challenge that teachers face is designing and structuring tasks that will cater for the diverse range of abilities within a given class.

‘Universal Design’: Cultivating Inclusive Environments

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What is ‘Universal Design’?

- ‘Universal Design’ strives to benefit the many, not just the few, i.e.
- It could be described as **“a process that enables and empowers a diverse population by improving human performance, health and wellness and social participation”** (Steinfeld & Maisel, 2012).

- It is an overarching belief that we should endeavour to make everything we design and produce, useable by everyone to the greatest extent possible.

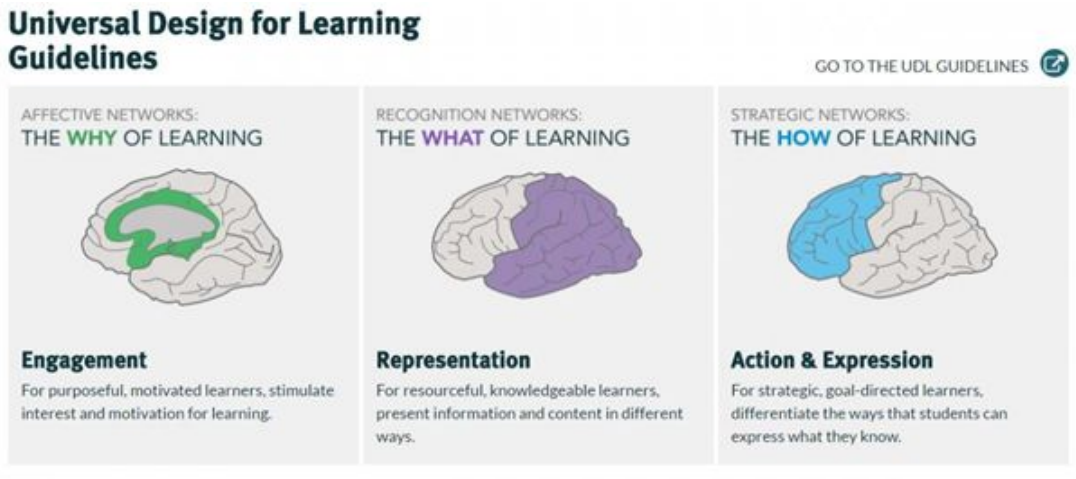
Universal Design for Learning (UDL)

- The principles of Universal Design can also be applied in an educational context. This is known as Universal Design for Learning (UDL).
- UDL guidelines that every teacher can draw upon to frame and direct their instructional learning approaches.
- Based on research into how humans learn, the UDL guidelines are very useful for all teachers who are interested in promoting and maximising inclusion in his/her classroom.
- It is unlikely that a teacher would try to implement all of these into his/her practice at once. The advice is to get to know them over time and implement them gradually.

UDL Guidelines

In order to maximise inclusion of all students, UDL guidelines suggest that we teachers should provide:

1. Multiple Means of **Engagement**
2. Multiple Means of **Representation**
3. Multiple Means of **Action and Expression**



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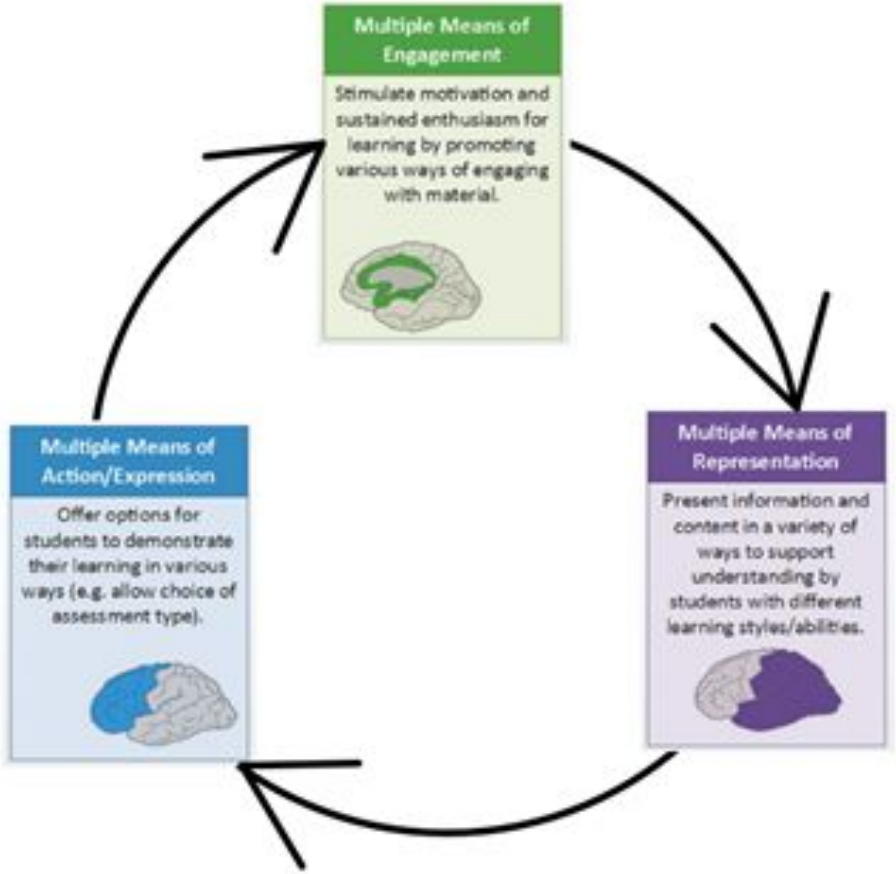

The synergy that exists between all three dimensions of the UDL means that **inclusive teaching** is best achieved if elements of each dimension are present in our teaching.

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Multiple Means of Engagement

- In choosing and designing activities, and in launching these activities, teachers should try to provide multiple access points to the relevant material, supporting the expectation that *all* children are able and expected to participate.
- Where possible, teachers should use open-ended questions or tasks that allow children to approach it by using different processes or strategies. This, in turn, affords children at different stages of mathematical development, the opportunity to offer responses.

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Multiple Means of Engagement

Checklist for Providing Multiple Means of Engagement

<u>Where possible, mathematics tasks should:</u>

- Be framed in a manner that is relevant and authentic to the learner
- Present minimal anxiety or threat to students in the launching of the task i.e. is *accessible* to all pupils
- Contain a variety of open-ended and “I wonder” questions
- Include opportunity for individual choice and autonomy in how students might approach the task
- Vary demands and resources to optimise challenge
- Foster collaboration and community

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Tasks to Promote Engagement

- What questions come to mind for you when you see this image?
- How many Skittles will fit inside the empty light bulb? Estimate.
- Write an estimate that you know is too high. Write an estimate that you know is too low.

- Now how many Skittles do you think are inside?
- I wonder how many purple / green / yellow / orange there are?

Source:
https://gfletchy.com/bright-idea/

Tasks to Promote Engagement

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Multiple Means of Representation

- Learning occurs best when multiple representations are used, because they allow students to make connections within, as well as between concepts. Too often, an over-reliance on textbook material means that teachers are delivering content in a manner that is repetitive and in some case, of little relevance to pupils who benefit from alternative representation.
- Similar to engagement, there is not one means of representation that will be optimal for all learners, therefore, providing a number of means of representation is essential.

Multiple Means of Representation

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Checklist for Providing Multiple Means of Representation

Where possible, mathematics tasks should:

- Have content that does not depend on a single sense like sight, hearing, movement or touch
- Illustrate through multiple media
- Activate or supply background knowledge
- Highlight previously learned skills that can be used to solve unfamiliar problems
- Provide multiple entry points to a lesson and optional pathways through the content
- Offer ways of customising the display of information to the pupils, if required e.g. magnifying text, the font and colour of text and backgrounds, the volume or rate of speech

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Multiple Means of Representation

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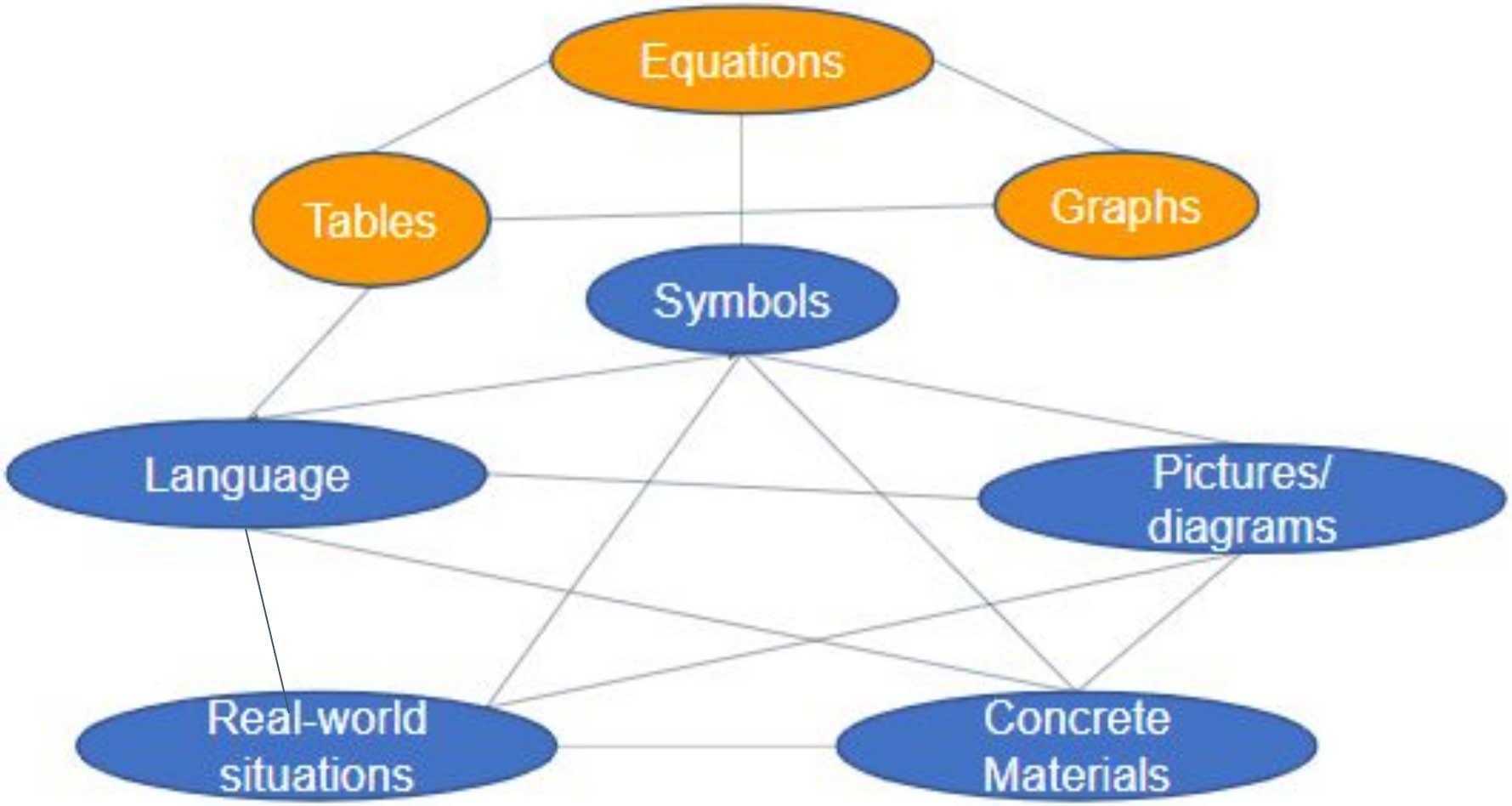

Ways of representing multiplication

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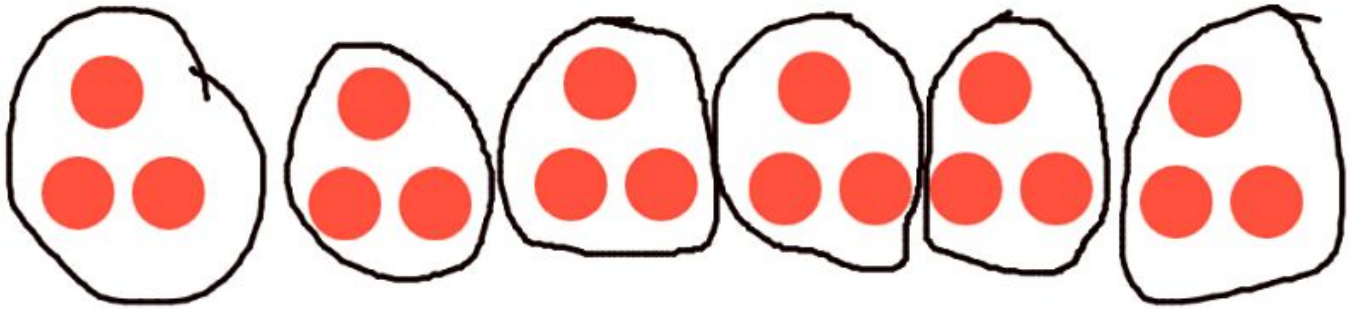
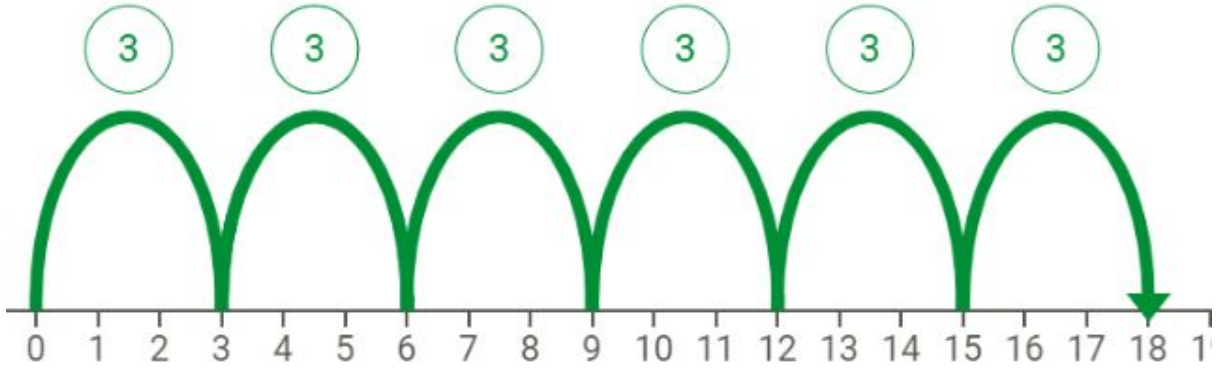
Equal Groups



Skip Counting



Repeated Addition

3 + 3 + 3 + 3 + 3 + 3 = 18

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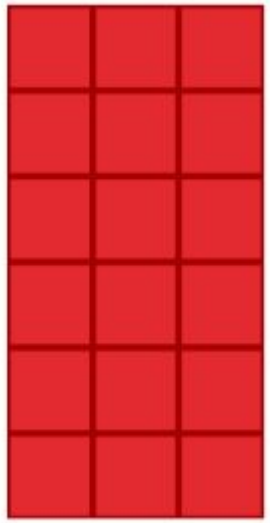
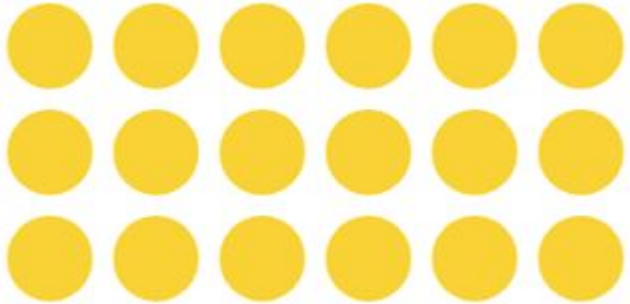
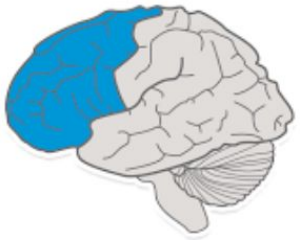


Area Model (6 rows, 3 columns)

Array Model
(3 rows, 6 columns)



Action and Expression



Inclusive approaches respect difference and do not force all children to use the same method.

Enabling students to use a variety of methods for responding to and navigating tasks helps to develop a sense of ownership and *agency.*

Children should have access to a wide variety of suitable resources which they may use to guide their thinking if they wish.

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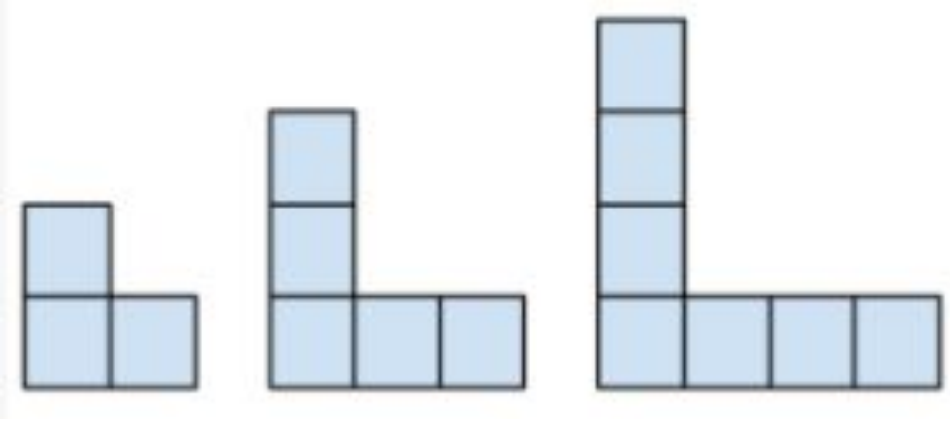
Action and Expression

Checklist for Providing Multiple Means of Action and Expression

Where possible, mathematics tasks should:

- ✓ Encourage a variety of methods for pupils to respond and navigate through tasks
- ✓ Provide access to assistive tools and resources for pupils to use if needed
- ✓ Provide scaffolds that can gradually be released with increasing independence and skill
- ✓ Provide differentiated feedback
- ✓ Provide multiple examples of solutions to authentic problems i.e. sharing of ideas

Patterns in 2nd/3rd Class



Questions

What would the next figure look like?

How many squares in the 10th term?

How many squares in the 100th term?

[See Maths4All.ie]

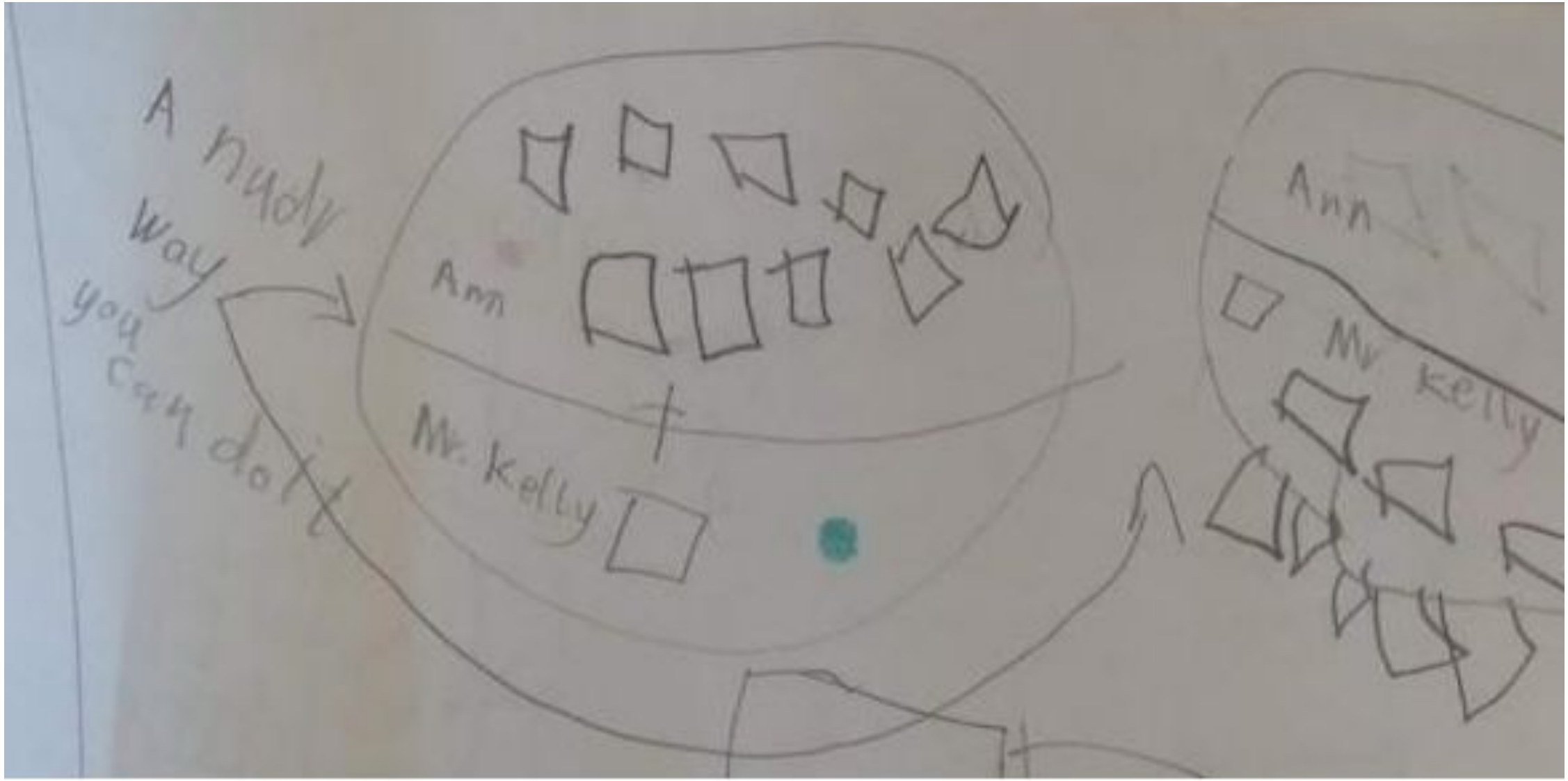

03:29

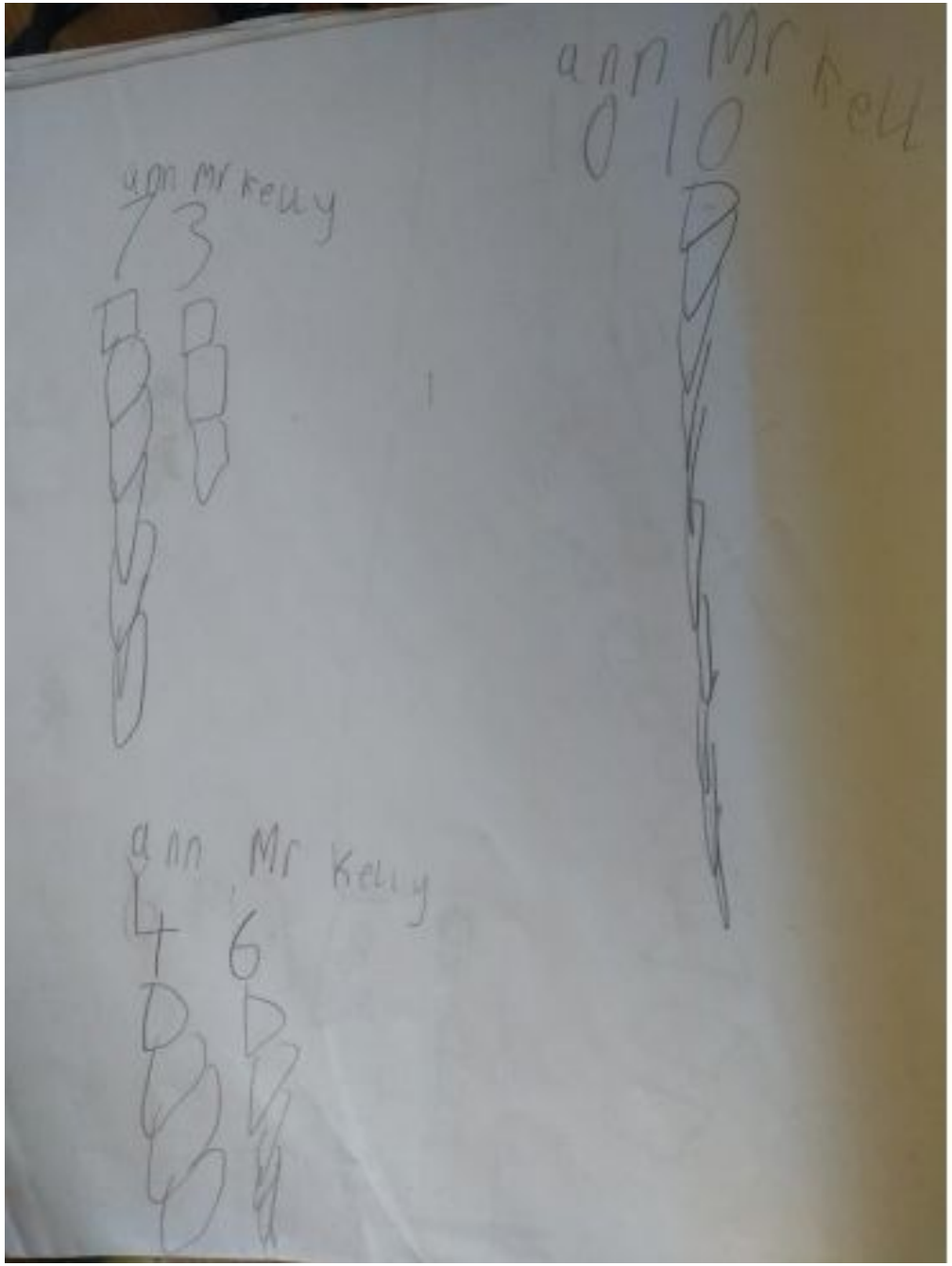
Problem Solving in Senior Infants/ First Class

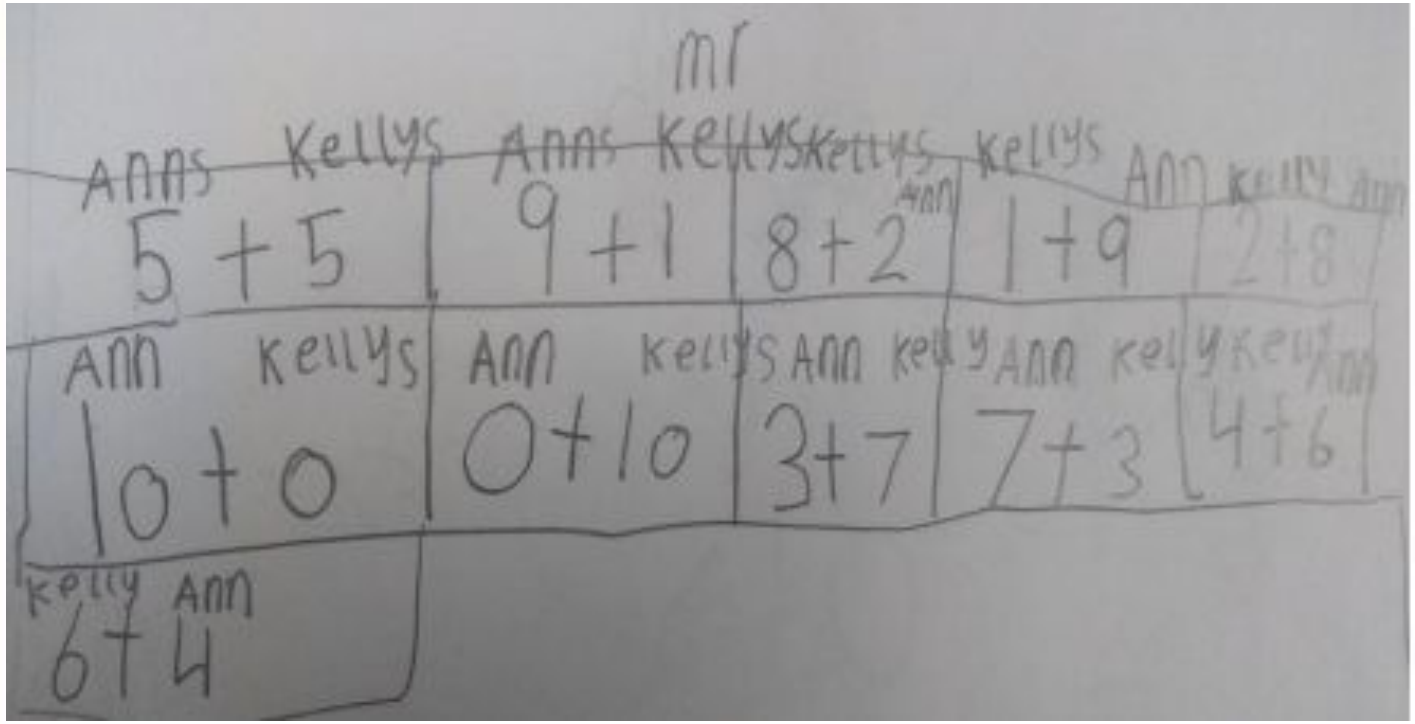
The school principal Mr Kelly needs some help. He is expecting a delivery of ten packages. He can stack some of the boxes in his office and some in Ann's office (the secretary).

How many different ways can he share the boxes between his office and the secretary's office?

See Maths4All.ie


A study
way
you
can do it
Ann
Mr. Kelly
Ann
Mr Kelly


ann Mr Kelly
10 10
ann Mr Kelly
3
ann Mr Kelly
4 6


mr
Anns Kellys
5+5
Anns Kellys
9+1
Kellys Kellys
8+2
Kellys Ann
1+9
Ann Kelly Ann
2+8
Ann Kellys
10+0
Ann Kellys
0+10
Ann Kellys
3+7
Ann Kelly
7+3
Kelly Ann
4+6
Kelly Ann
6+4

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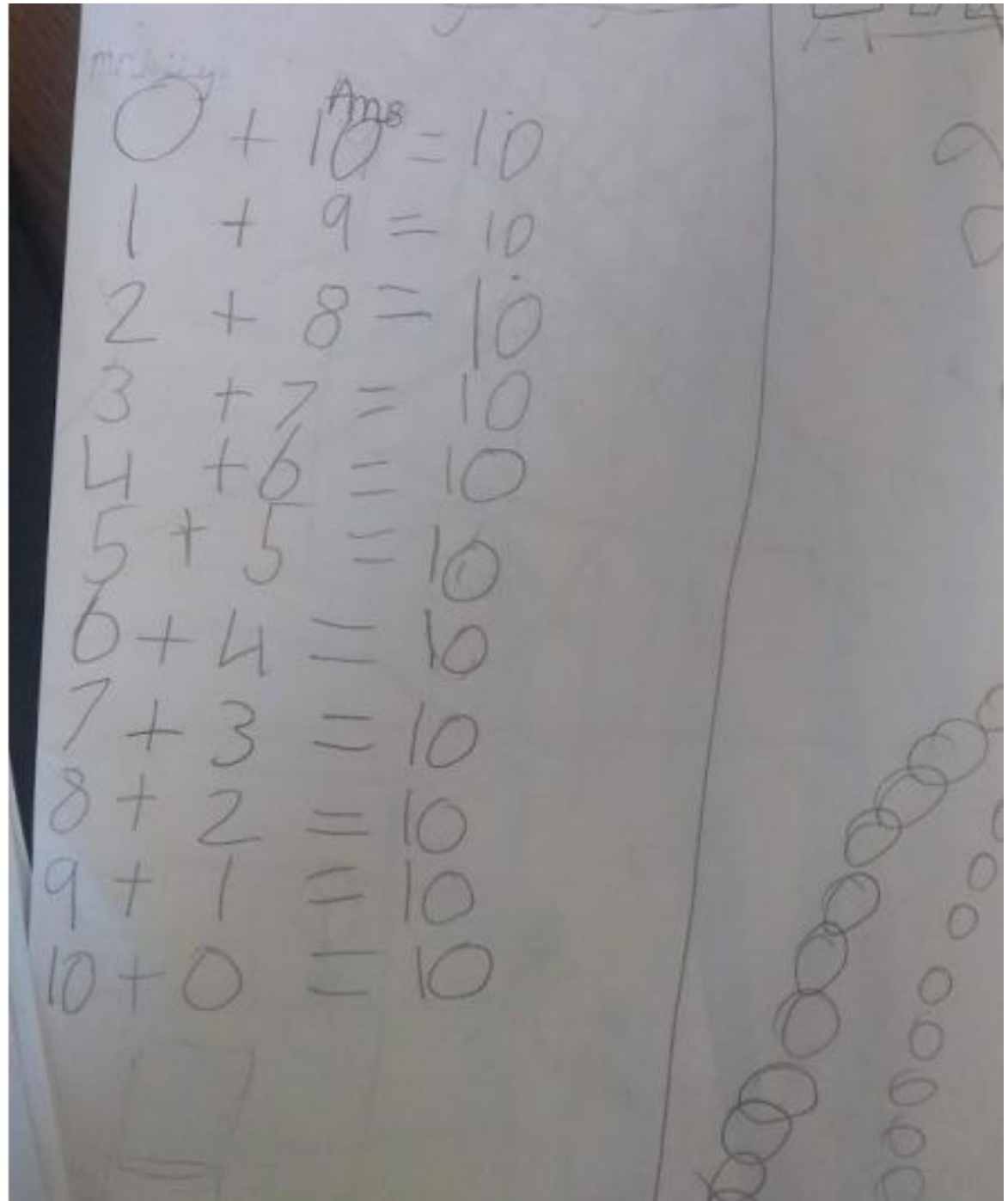

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UDL in action

- **Pose a problem that children can engage with.**
- **Class discusses estimates or solutions done mentally and these are recorded on the board.**
- **Students work in pairs or independently.**
- **Familiar materials should be available but never required for a solution.**
- **Students are helped to describe/write about solution methods and encouraged to question each other.**

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Things to consider when planning for inclusion

- Identify lesson goals
- Select **engaging** task (*accessible, spark motivation, relevant, opportunities for open-ended questions/discussion*)
- Consider how the mathematics in the task will be **represented** (*multisensory, link to relevant prior knowledge, offer multiple entry points for all learners)*
- Consider how children **act to express** their mathematical thinking (*enabling choice of methods for responding to tasks*, *providing differentiated feedback*)

What next?

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Team Teaching:

Explanatory and support materials available from a number of sources: **PDST**, **NCSE**, **Slevin & Vahey 2018**

High Threshold Low-Ceiling Tasks:

See Nrich for overview and examples

Three Act Tasks:

See GFletchy.com

Draft Curriculum

See **NCCA**

NEPS Maths Support Guidelines

See here

Junior Cycle for Teachers

https://www.jct.ie/maths/resources

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