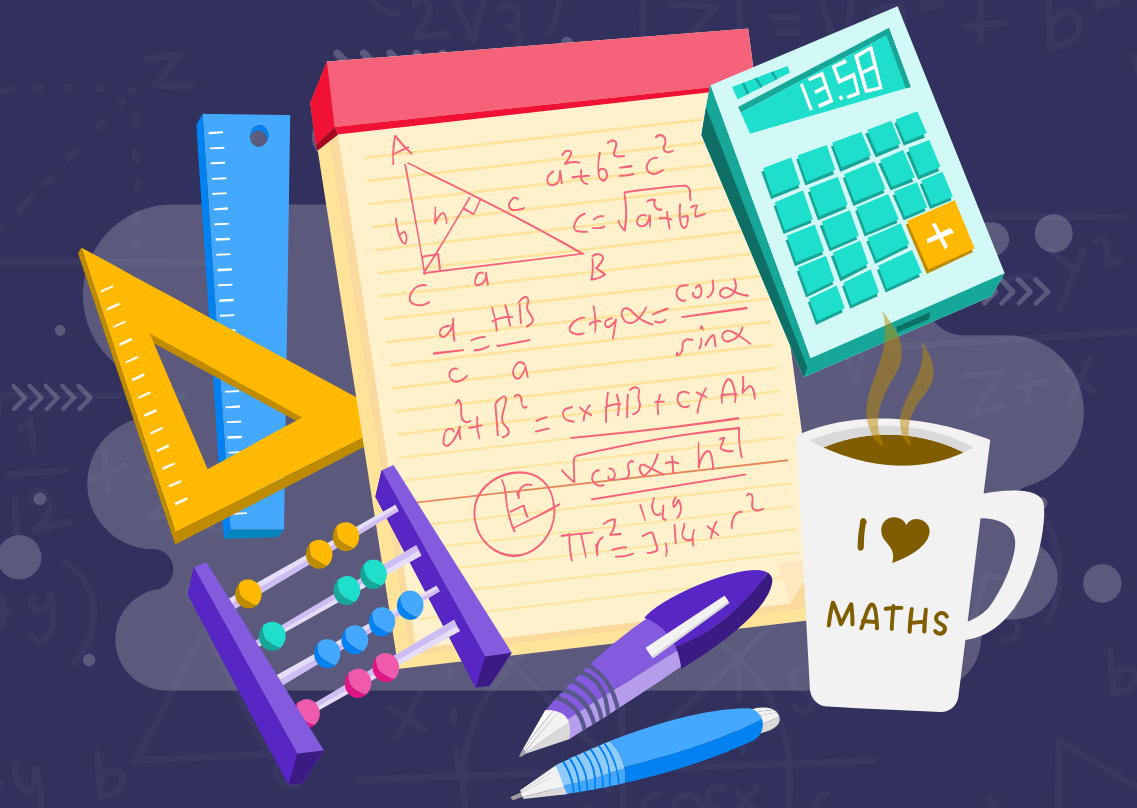
Manipulatives

Using pedagogy to drive practice



BSRLM June 2025

Simon Sheard

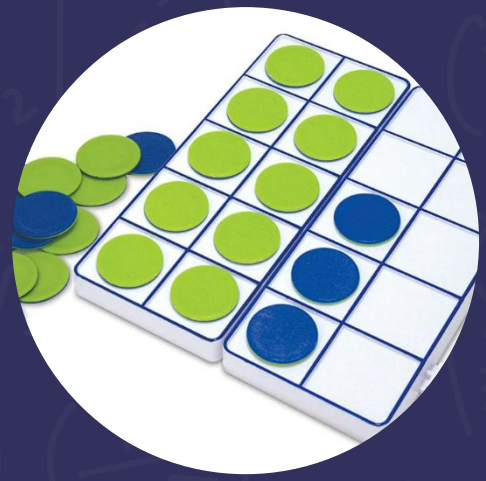
Senior Lecturer in Education

University of Sunderland

Programme Leader for ITT Distance Learning (Primary)

- iQTS
- Over 60 countries
- Community, State and International Schools
- Every curriculum going
- Confers QTS to our graduates

Fifth year of part-time PhD:
How do primary mathematics teachers' perceptions of Teaching for Mastery (TfM) inform their choices when selecting and using manipulatives (concrete resources) within their lessons?



MY RESEARCH

AIMS TO:

- document which manipulatives are used in primary classrooms
- record teachers' rationale for their selection and deployment
- establish the extent to which these decisions are informed by pedagogical content knowledge and continuing professional development

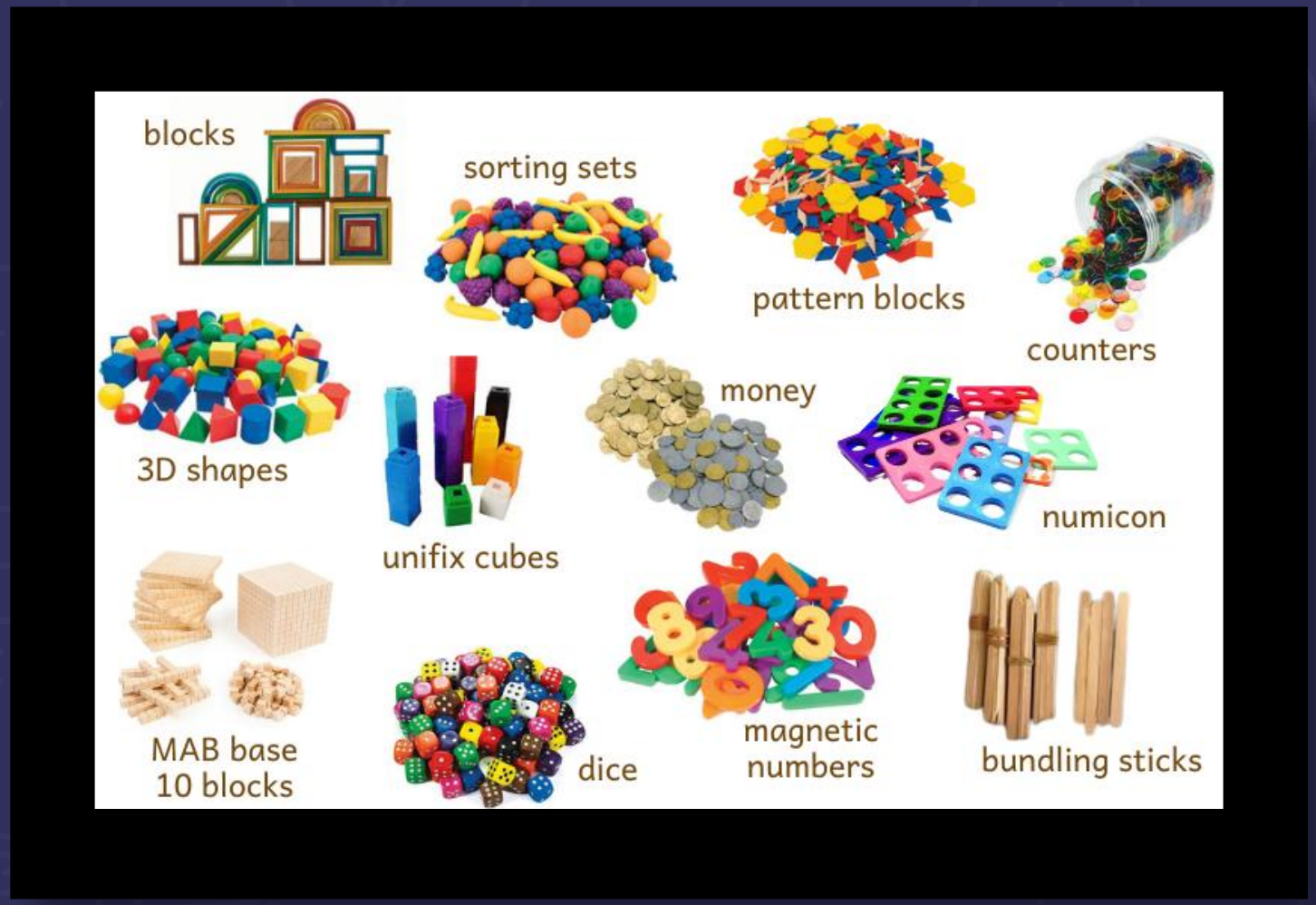
IS IMPORTANT BECAUSE:

- The Education Endowment Foundation states that "practitioners' understanding of mathematical concepts needs to be strong in order to use manipulatives and representations effectively" (EEF, 2020, p.21)
- Whilst the Nuffield Report found that "teachers' choice of manipulatives was subject to disparate factors rather than pedagogical principles" (Griffiths, Back & Gifford, 2017, p.5)

- Carbonneau, *Marley & Selig* (2013) highlight the importance of effective instructional strategy in the use of manipulatives to improve achievement.

- Success is dependent upon:
  - ✓ The level of instructional guidance
  - ✓ The type of manipulative
  - ✓ The age of the learners
  - ✓ The learning environment

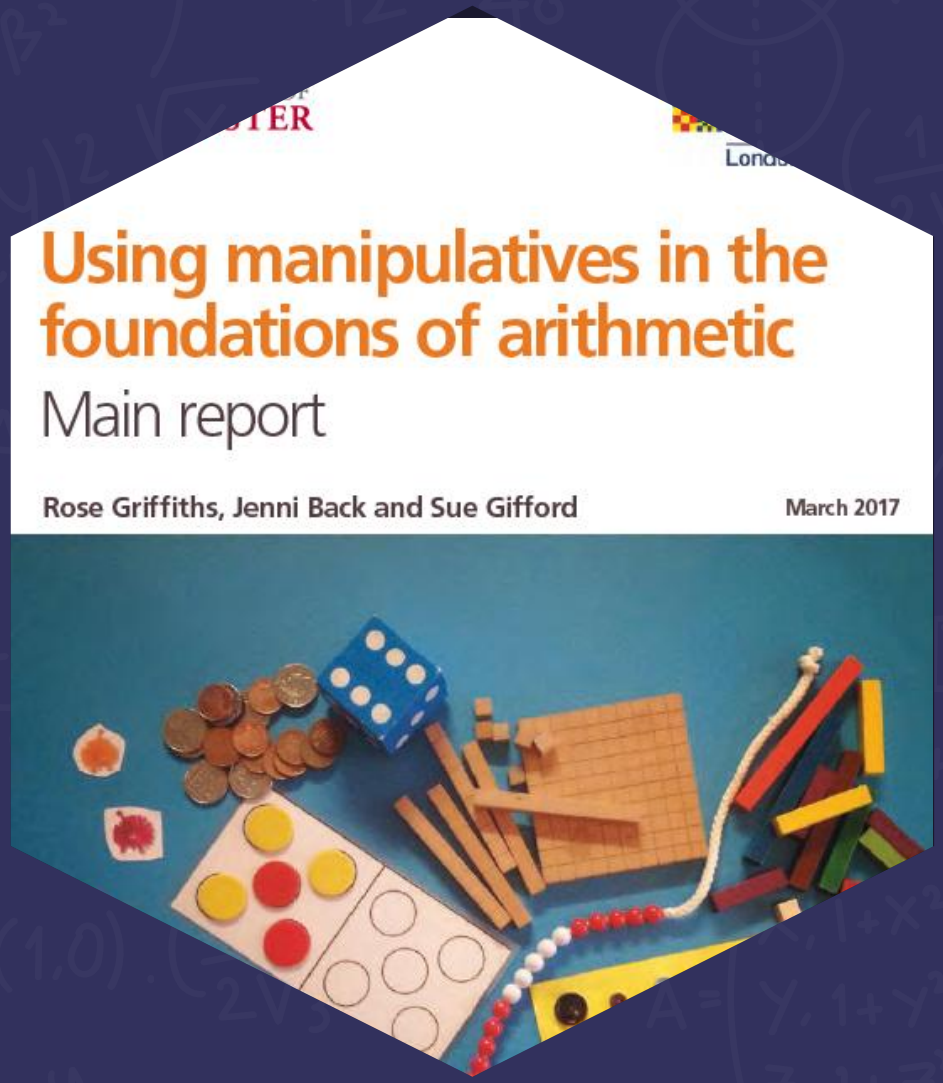
- 'Manipulatives are not magic… [they] are not, of themselves, carriers of meaning or insight' (Moyer, 2001, p. 176).



Carbonneau, K.J., Marley, S.C. and Selig, J.P. (2013). A meta-analysis of the efficacy of teaching mathematics with concrete manipulatives. Journal of Educational Psychology, 105(2), pp.380–400.

Manipulatives work because they:

- ✓ Help children make sense of arithmetic
- ✓ Help teachers see what children understand
- ✓ Increase children's engagement and enjoyment
- ✓ Develop visual images and understanding
- ✓ Help children to work together and share ideas
- ✓ Are tools to help children solve problems; investigate patterns and relationships; demonstrate and explain results and reasoning
- ✓ Provide a bridge to abstract thinking



Griffiths, R., Back, J. and Gifford, S. (2017) Using manipulatives in the foundations of arithmetic: main report. University of Leicester.

What does the literature tell us?

PEDAGOGICAL CONSIDERATIONS:

1. a clear **rationale** for manipulative use in the context of the mathematical content being delivered
2. the appropriate level of **guidance** is provided
3. allow sufficient **time**
4. the perceptual **richness** or **blandness** of the manipulative is considered
5. manipulative use is linked to the **abstract** ideas being represented

PRACTICAL CONSIDERATIONS:

6. practical **organisation** and preparation

Practicality vs. Pedagogy

AVAILABILITY

What is available in my classroom? Are there sufficient sets for the groups/class? Is it cheap or expensive?

VERSATILITY

Can this manipulative be used for multiple applications? Or is it topic/task specific?

LOGISTICS

Is it 'easy' to administer and oversee?

Is it explained in the scheme of work?

CONTENT KNOWLEDGE

Do I understand how to use this manipulative?

PEDAGOGICAL CONTENT KNOWLEDGE

Am I confident instructing others how to use this manipulative for this task?

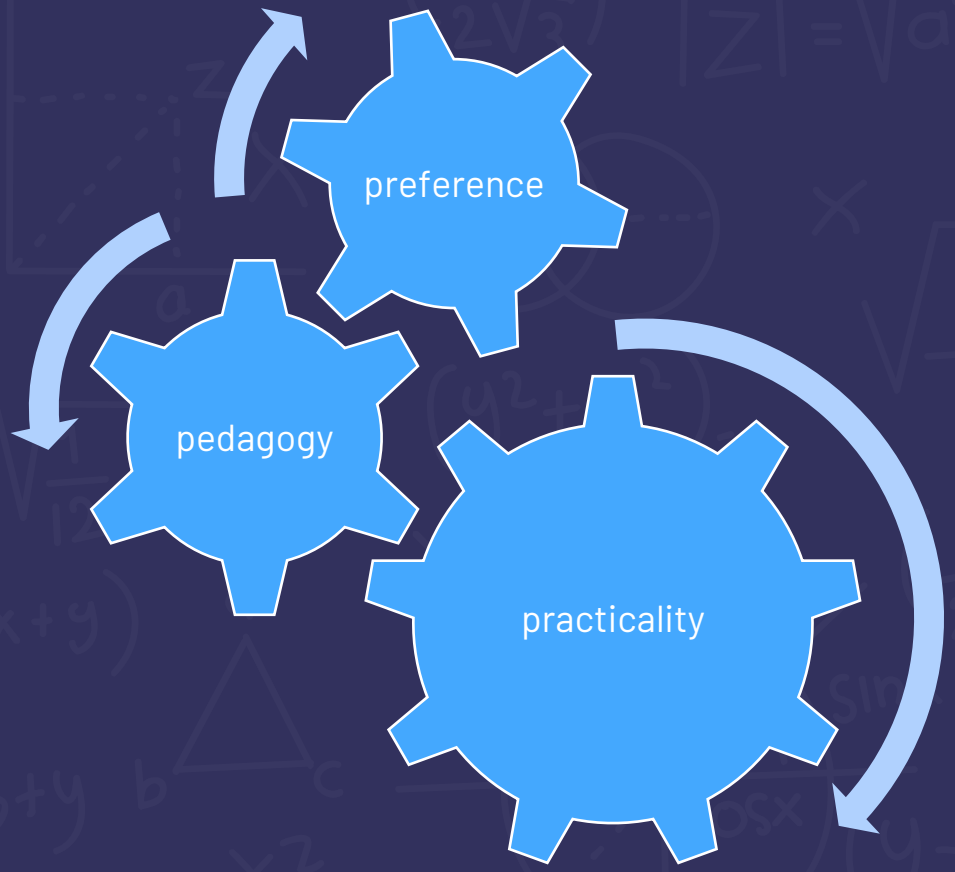
KNOWLEDGE CREATION

Is the manipulative driving the task?

Is the task driving the manipulative?

Preference?

Discussion topic 1: Where do you stand on practicality – pedagogy – preference?



Preliminary findings

Completed so far:

- 113 questionnaire responses
- 12 interviews

Participant recruitment:

North-East Primary teachers

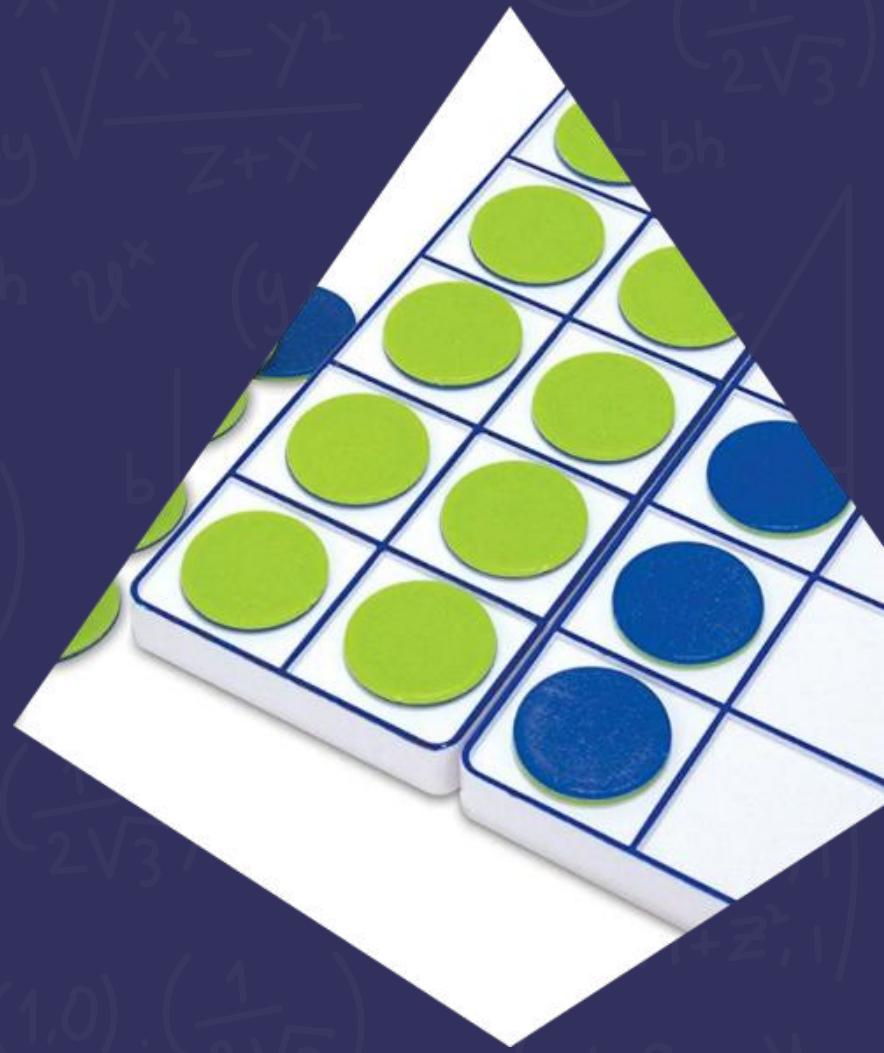
All state-maintained Primary Schools in the North East Combined Authority contacted (7 Local Authorities; 732 schools)

Mentors in Primary ITT partner schools

Mentors supporting our BEd and PGCE students in partner schools (502 teachers)

Facebook

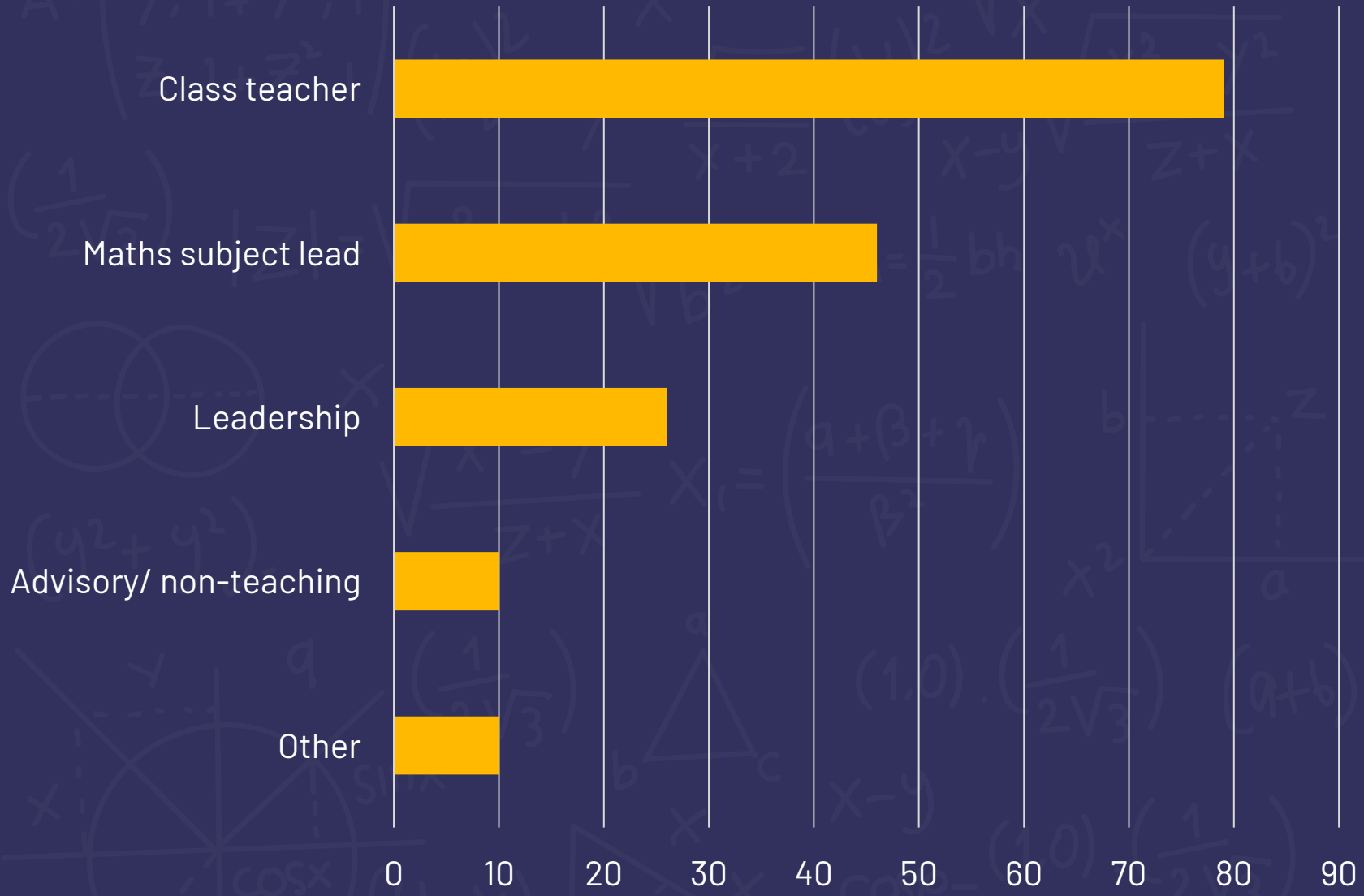
Members of Facebook groups relating to Primary Maths Mastery (7 groups; 130k members)



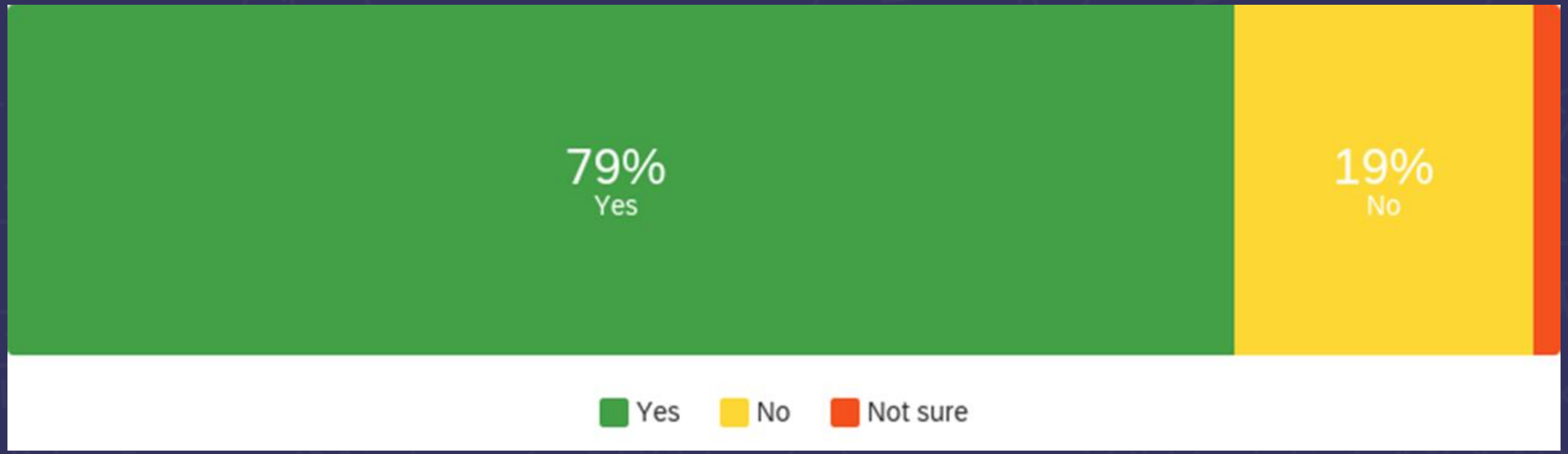
Recruitment: theoretical ideal to messy reality

- Maths Hub work groups (around 20 individuals)
- Primary schools in Maths Hub area (412 schools)
- Promotional posters delivered to local primary schools
- Maths Hub session: delegates complete the questionnaire before it starts
- All primary schools in the wider Combined Authority (a further 320 schools)
- 7 Facebook groups for primary maths teachers (130,000 combined members)
- Interview bookings with a financial incentive
- Mentors of Primary ITT students contacted (502 teachers)

Describe your role



Have you attended Maths Hub training?



9% of respondents said they do not use manipulatives

Not encouraged to do so by curriculum lead

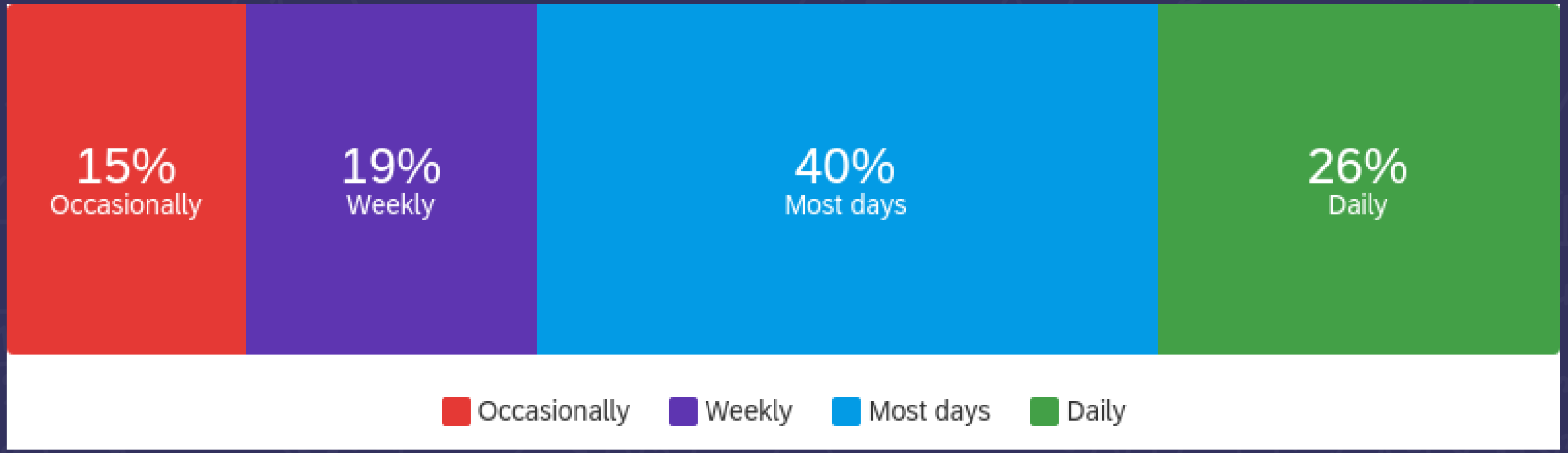
I teach Y6, so I generally use visual to support learning

I do use some but usually for demonstration purposes

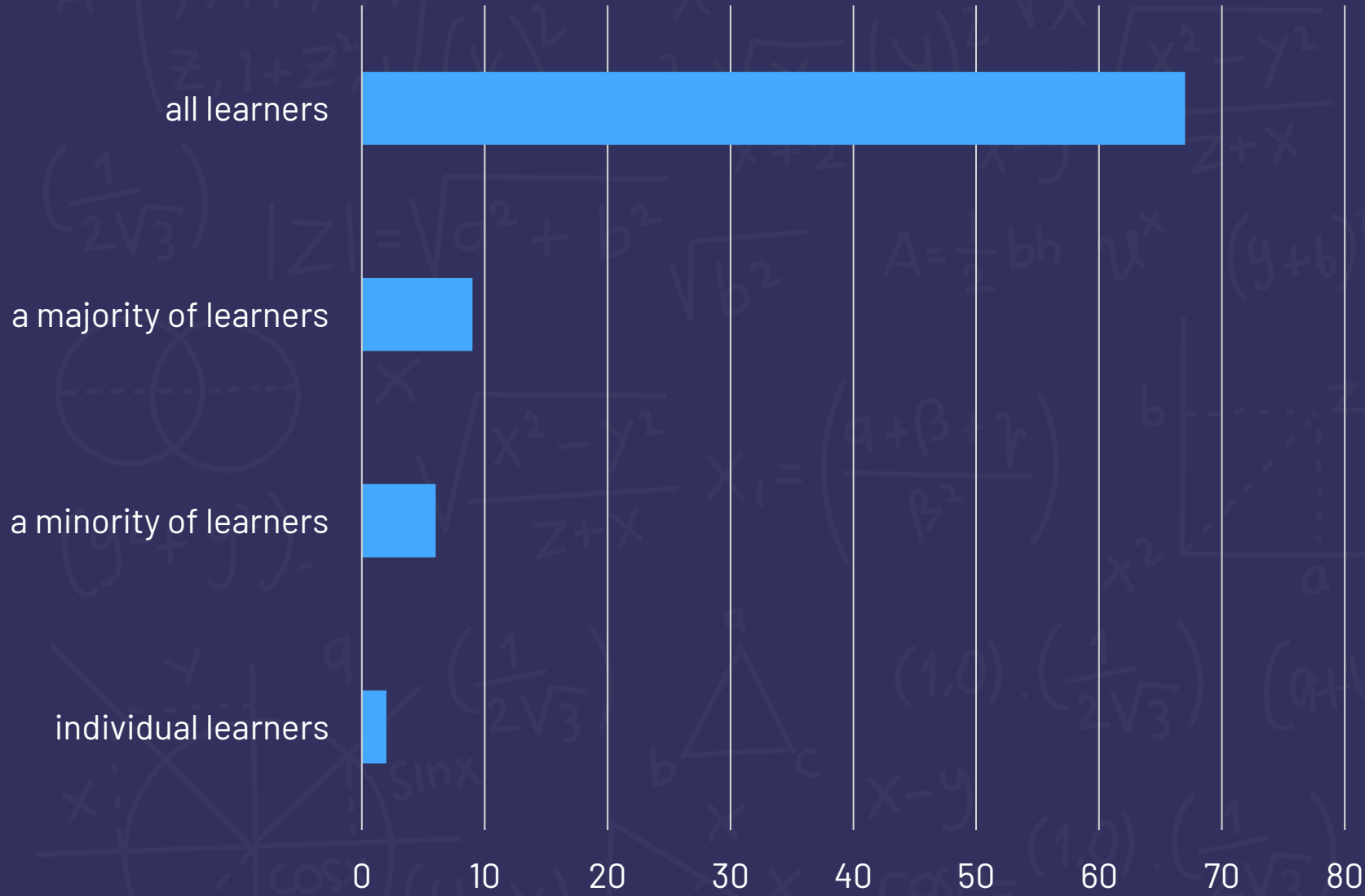
There is an issue of resources

I do demonstrate with manipulations but I do not give them out to the pupils. The pupils tend to get distracted

On average how often would you say manipulatives are used in your lessons?

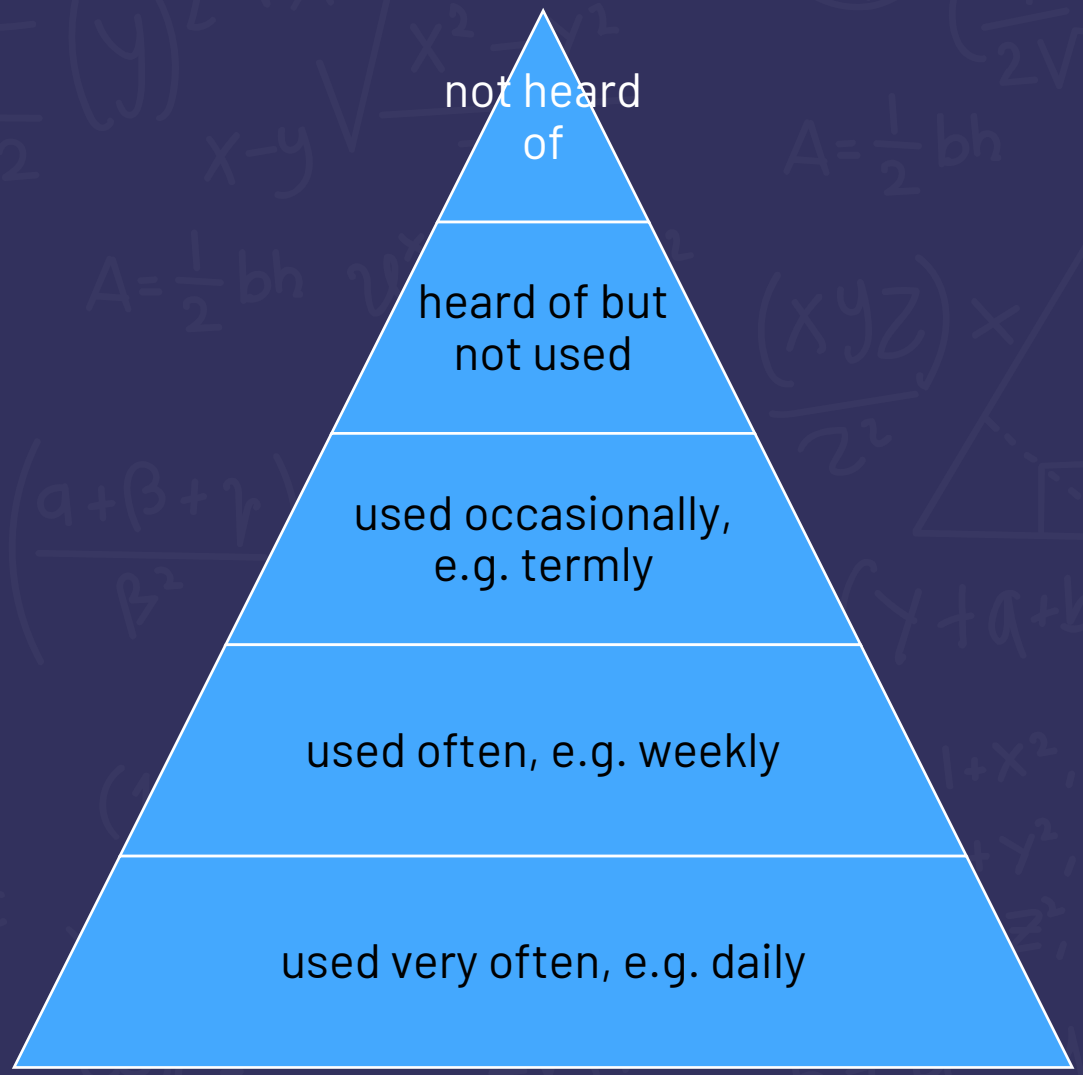


I usually use manipulatives with...



Which manipulatives are used and how often?

Manipulative	Mean
interlocking cubes, e.g. multilink	4.14
two-sided counters	4.11
Dienes/base ten	3.76
Numicon	3.67
place value counters	3.66
Rekenrek/abacus	3.15
bead strings	3.04
sticks, e.g. lolly sticks	3.01
Cuisenaire rods	2.68
fraction tiles	2.32
algebra tiles	1.94



I use manipulatives in my maths lessons because...

it helps children ‘see’ the structure of the mathematics

it allows all learners to support their learning and check their work

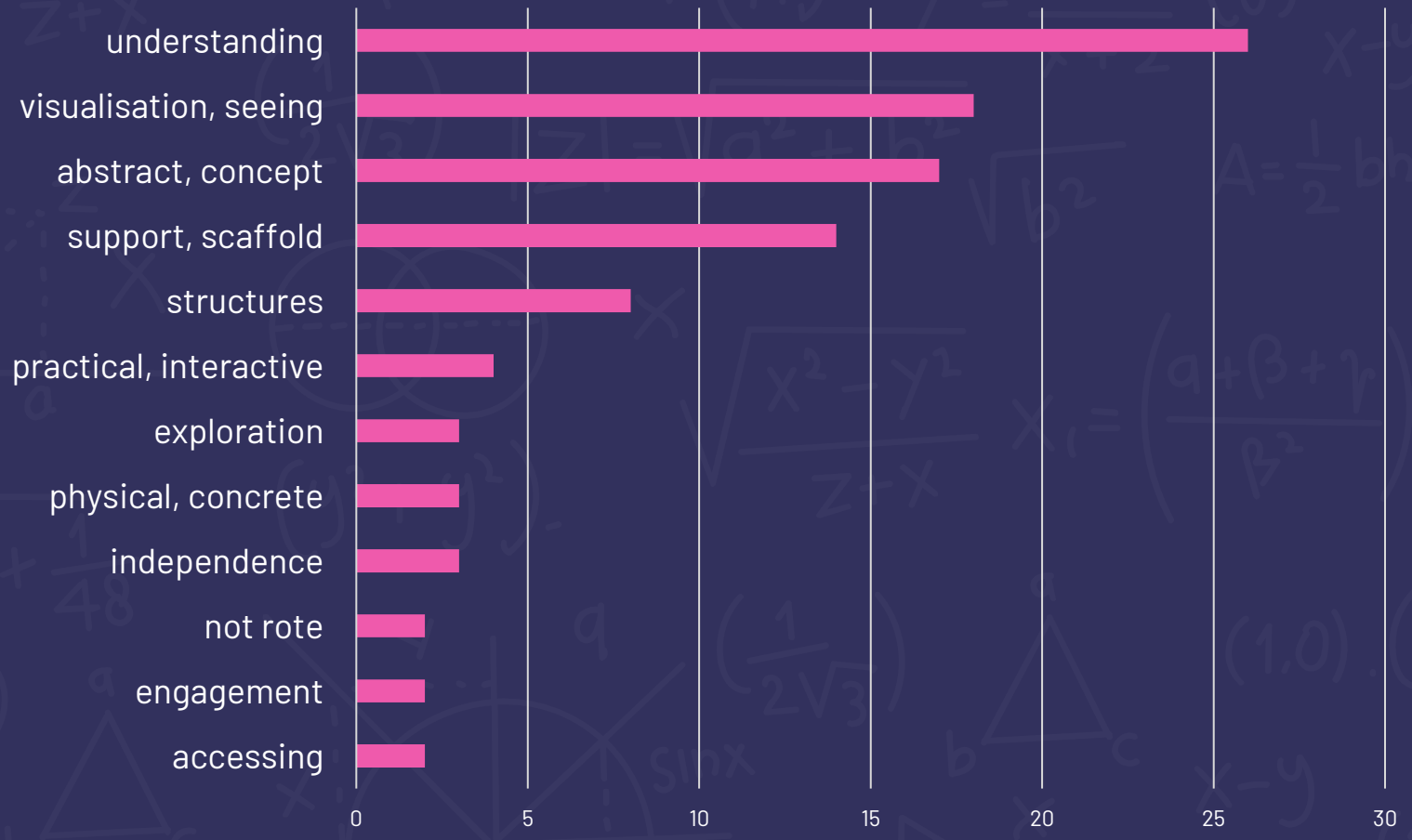
I think it gives students a way in

it provides scaffolding for all learners

they help to give a physical thing to attach an abstract concept to

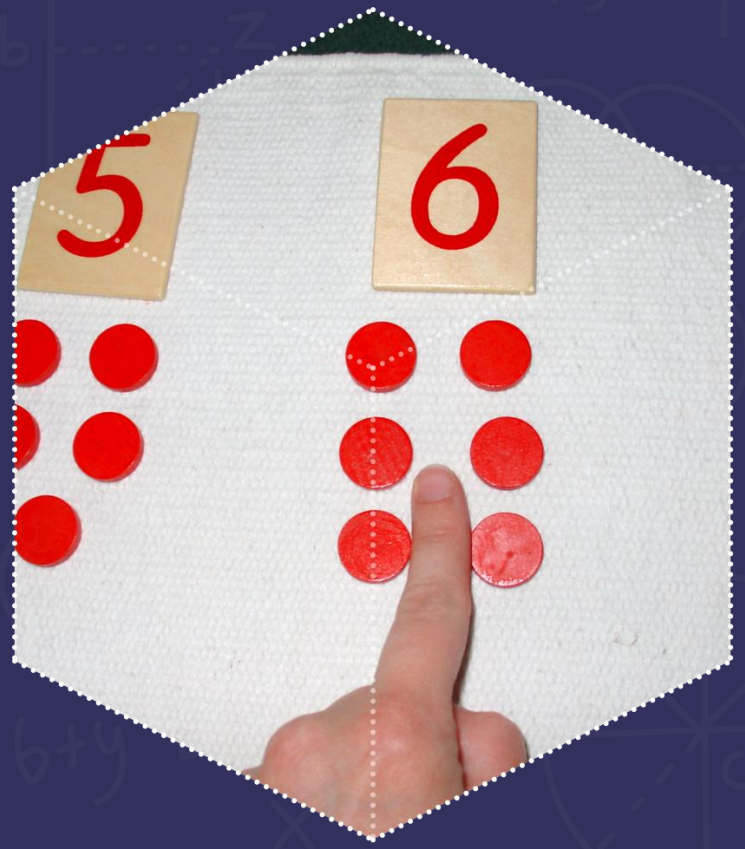
children are able to lead their own learning

I use manipulatives in my maths lessons because...



single references:
problem solving; assessment; modelling; progress; inclusion; communication; connections; knowledge; demonstrate

Three emerging interview themes

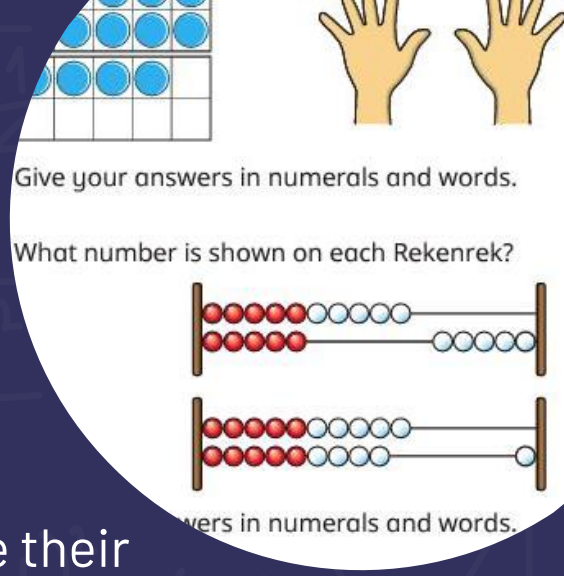


the scheme is king

stigma of age or ability

blurred lines: pictorial≈concrete

Theme: the scheme is king



That's quite an easy answer. It's directed by the by the Maths No Problem programme. It's quite precise. You know, you'll need this for this lesson.

We use the resources from White Rose. We use their examples and their worksheets

the White Rose resources, the PowerPoints and things like that, they'll often have visuals of particular manipulatives as well so.

So with the scheme that we have, every child has like a pouch of resources that they use.

But not always...

On the Maths No Problem, they give you a recommended list of this would really benefit the children in this area.

I think some of it just comes from my own judgement

Theme: stigma

it has really helped, especially those children, like with special education needs or EAL they can see it's more easy for them

They're such a benefit for any SEN learners who just need that much more physical concrete style of learning.

it’s still very much something that might be a support for a child who's struggling rather than just like a standard thing

But not always...

I just think that the stigma of they’re only for lower attaining children is starting to go and I think people have realised like actually these have a place for everyone.

Theme: blurred lines

yes they make reference to bar models

we use part-whole models all the time

I'm sorry. Are you classing representations like bar models as manipulatives or not?

I use Polypad on my board as well where I can get the manipulatives up on my board

Preference?

they're just easy. They're there. They can grab them

they’re very small, easy to use, they’re easily accessible for the children

I think I use them most of the time just because they’re so versatile.

Flexibility

You know it's there, it's quite vivid

I just think they’re so visual

Discussion topic 2: Your thoughts, opinions & questions

What does *maths mastery* look like in UK schools currently?

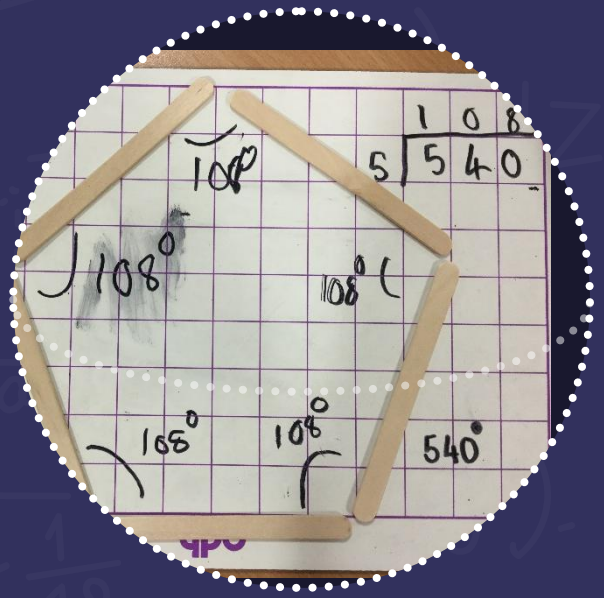
What are the opportunities and threats?

Where next for manipulatives in schools?

Fashion: What's in? What's out?

How could the curriculum and/or commercial schemes best support manipulative use?

Why do I think it's important?



COLLABORATION

Sharing best practice with the many, not the few

CREATIVITY

Teaching mathematics in a way that inspires children

CONSISTENCY

Ensuring each child gets the same opportunities to enjoy mathematics

Thank you

Simon Sheard

simon.sheard@sunderland.ac.uk

@sheard_simon