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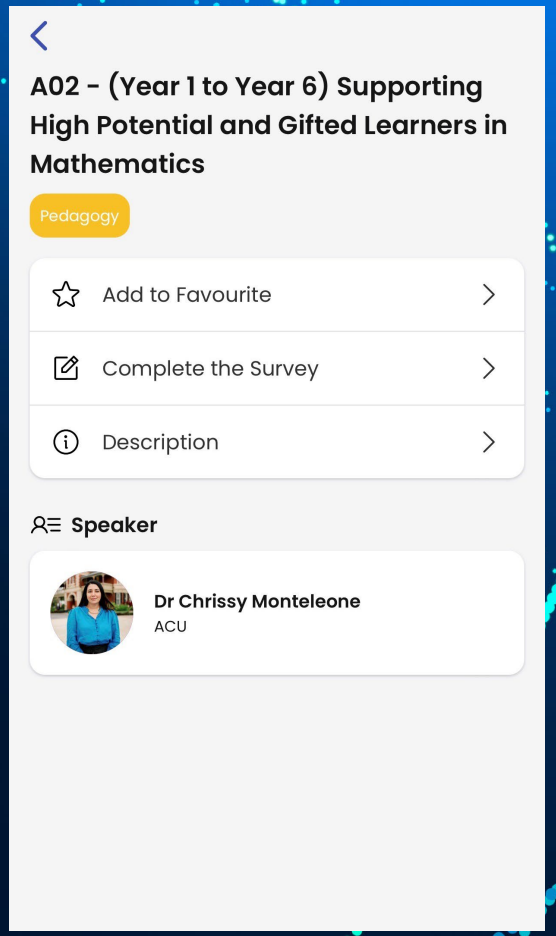

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Keynote

I think I already do some of that?
Noticing the now and framing the future of classroom pedagogy

Katherin Cartwright

THE UNIVERSITY OF SYDNEY

Embodied Learning in Early Mathematics & Science

‘I think I already do some of that?’: Noticing the now and framing the future of classroom pedagogy

Dr Katherin Cartwright

THE MATHEMATICAL ASSOCIATION OF VICTORIA

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What we already know

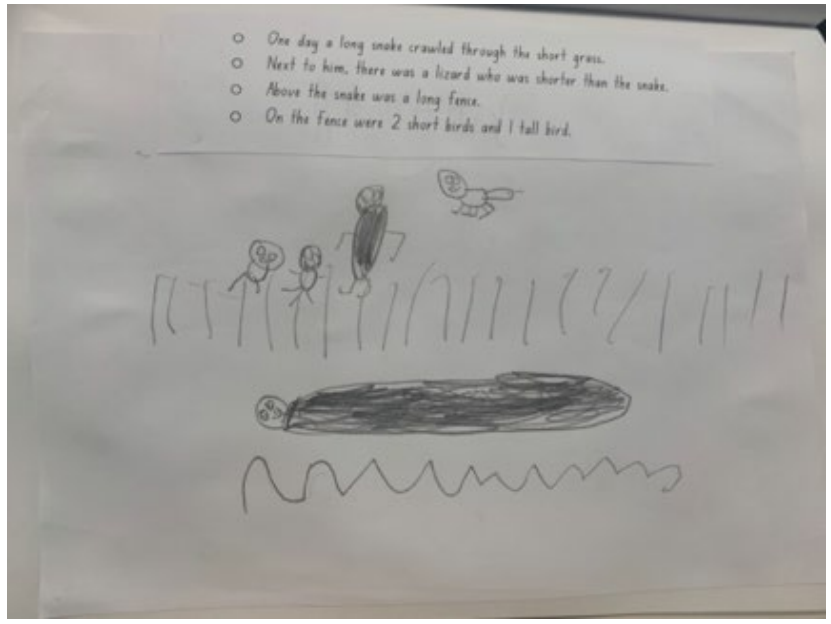
...

- Young children like getting up and moving and being active!
- Children like to learn in different ways
- As a teacher I have to use a range of representations
- Children are creative
- Mirroring and repetition are important for young learners (learning by doing)
- Meaning making is important in mathematics

Noticing the now … in the classroom

Identifying patterns using hands

Counting area using stepping



Drawing mathematical stories

Noticing the now … in the research

Way & Ginns, 2024

"While basic gestures come naturally and do not need to be taught (e.g., pointing), mathematics knowledge that requires explicit instruction can be supported by using planned accompanying gestures"
Martinez-Lincoln et al. (2019)

Identifying patterns using hands

"Early learning about aspects of the physical environment such as perspective, structures, measurable attributes, sequence, and position may be more effectively achieved through experiences that facilitate spatial exploration relative to the positioning of a child's own body" Dakermann et al. (2017)

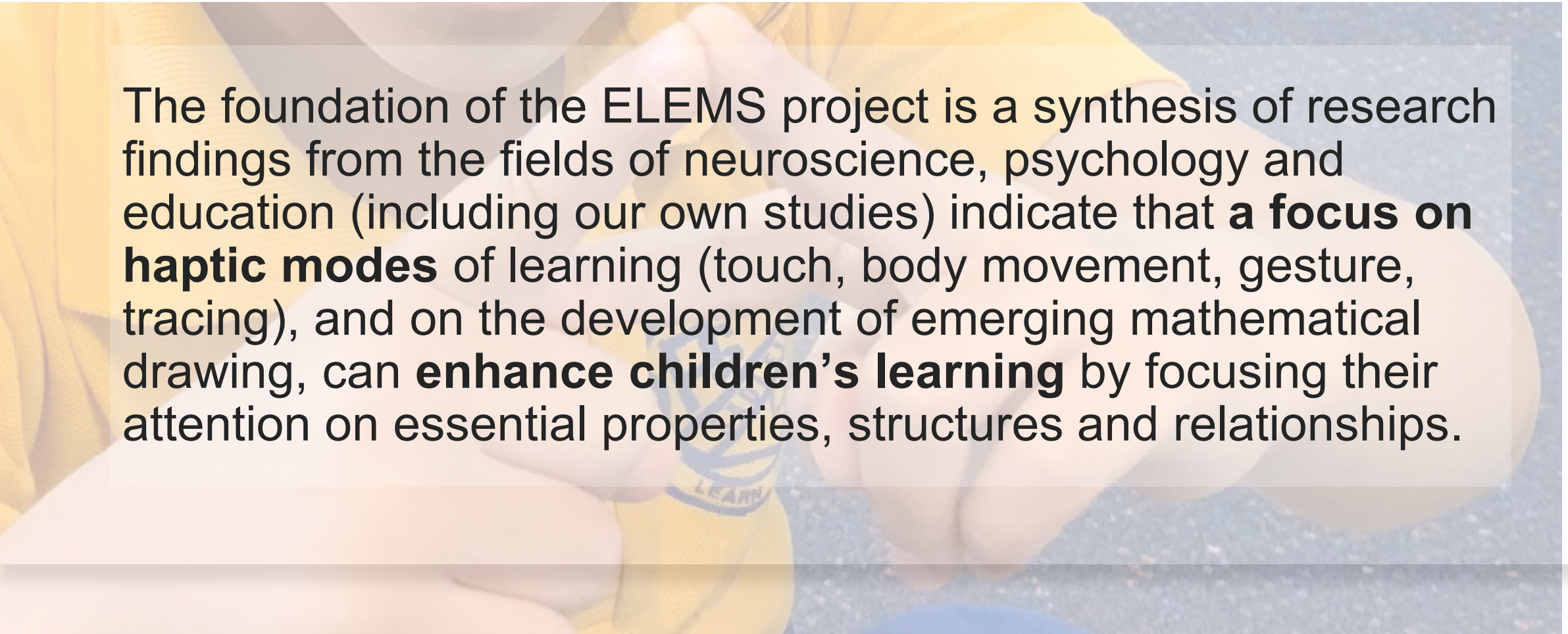
Counting area using stepping

"Although early drawing development comes naturally to children, applying drawing skills to self-created mathematical representations and to the production or interpretation of diagrams is not necessarily a natural extension of that development. Children need support to 'mathematise' their drawings"
Bobis & Way (2018), Ginsberg et al (2008)

Drawing mathematical stories

The ELEMS project

Embodied Learning in Early Mathematics & Science



The foundation of the ELEMS project is a synthesis of research findings from the fields of neuroscience, psychology and education (including our own studies) indicate that **a focus on haptic modes** of learning (touch, body movement, gesture, tracing), and on the development of emerging mathematical drawing, can **enhance children's learning** by focusing their attention on essential properties, structures and relationships.

Embodied modes of representation

Embodied Learning in Early Mathematics & Science

Conceptual Body Movement

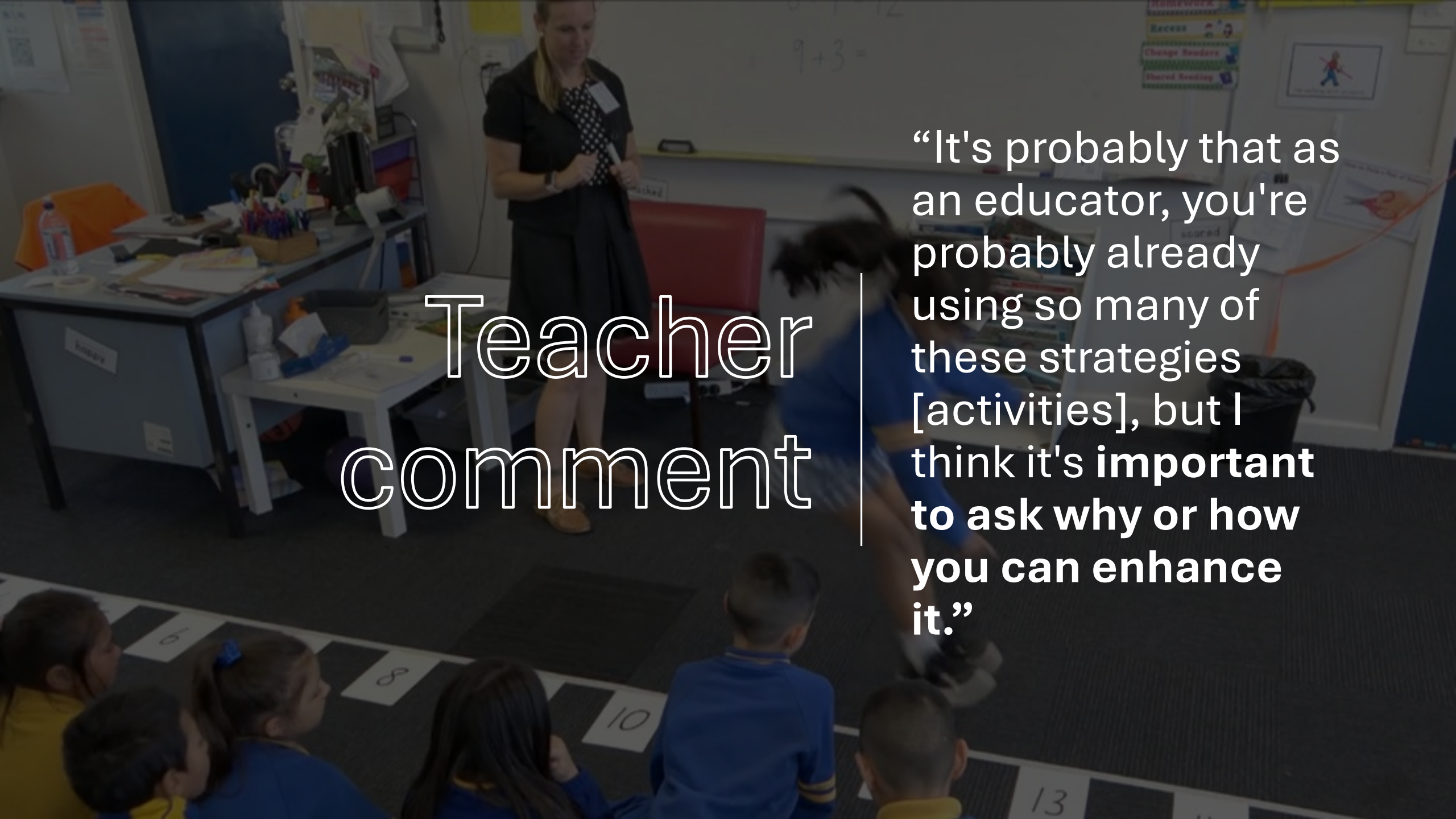
Scaling-up the size so children become actors in the representation.

Gesture & Tracing

In-air co-speech gesture by teacher and children.
Touch-tracing to activate sense of touch.

Drawing

Ensuring natural drawing development and supporting transition to mathematical drawing.



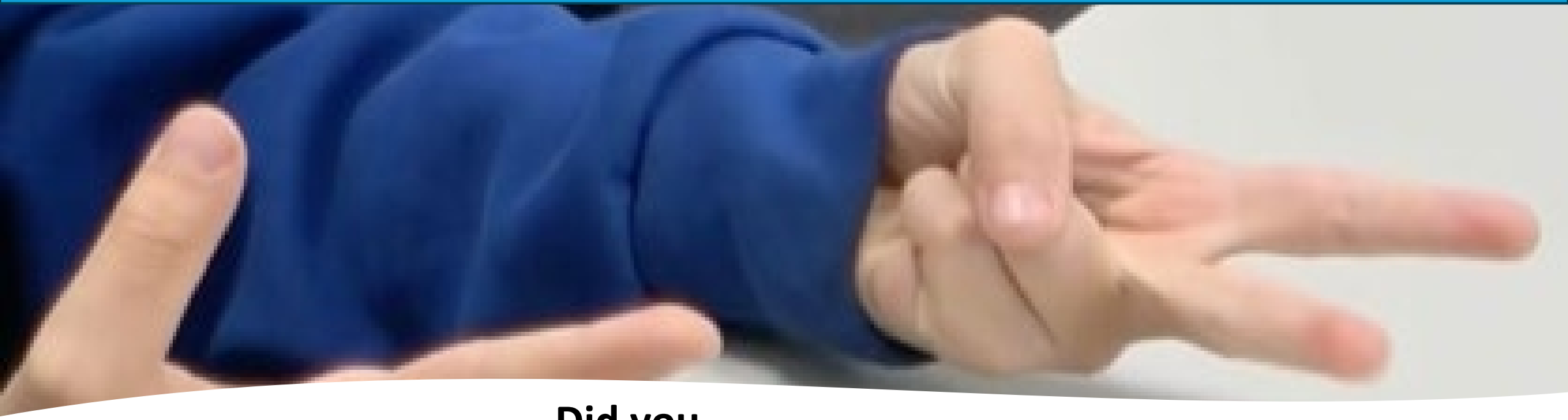
Teacher comment

“It's probably that as an educator, you're probably already using so many of these strategies [activities], but I think it's **important to ask why or how you can enhance it.”**

Framing the future of classroom pedagogy

Continue to do what you already do …
noticing the purpose

Practical example: Finger counting



Use your fingers to count to 10

Did you...

- Have palms or back of hands facing?
- Start with right or left hand?
- Start with closed fist or open hand?
- Hold your hands vertically, horizontally, other?
- Start to count with your thumb, pointer, little finger, other?
- Use the same order of fingers on your second hand?

Practical example: Finger counting

From the research…

- Neuropsychological evidence on the importance of ‘finger sense’ (finger gnosis) and fine-motor skills (finger movement) in early number development
  (Barrocas et al., 2020)
- Overlapping neural pathways in the brain that are activated when thinking about our own fingers and thinking about numbers
  (Chinello et al., 2013; Penner-Wilger & Anderson, 2013).
- Training 5/6-year-olds to use their fingers to represent numbers and for finger counting, improves their mathematical problem-solving abilities
  (Gracia-Bafalluy & Noël, 2008; Ollivier et al., 2020)

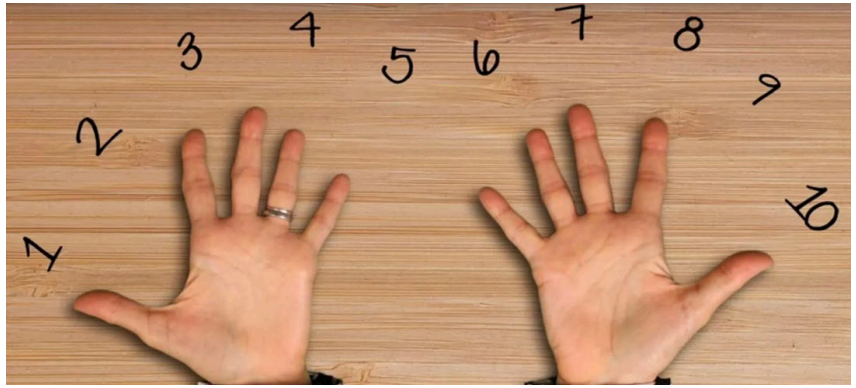
Practical example: Finger counting

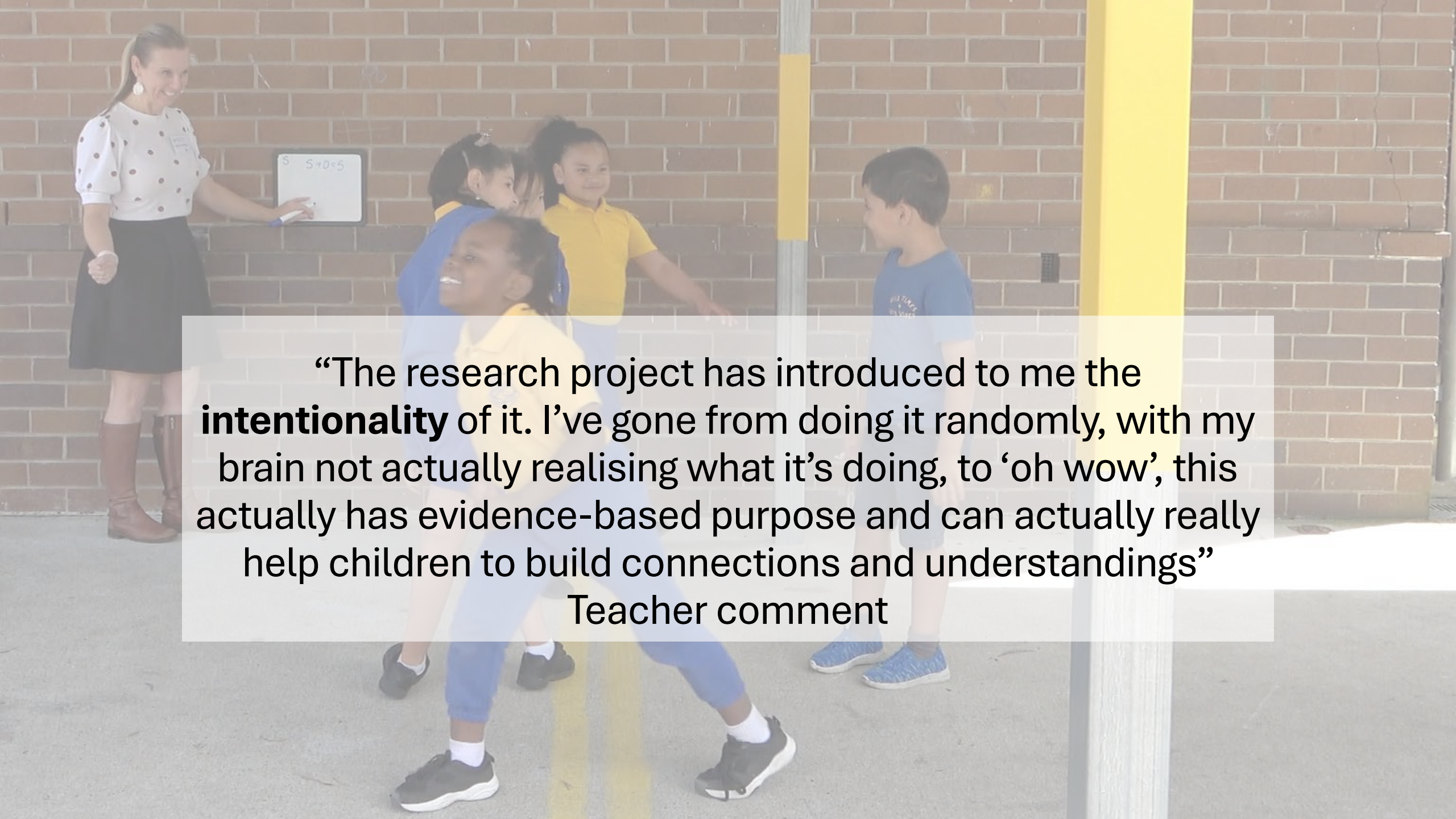
In the ELEMS project Phase 2: we assessed 320 P-2children from 8 preschools/schools and found:

- **Great variety** in methods for using fingers,
- Some children who **could not** represent numbers with their fingers,
- Many children who **hid their fingers** from view while using them to calculate,
- Some children who made **no attempt** at basic calculations that could have been easily achieved via fingers.

We recommend:

- All young children (4-6 years) should be supported to develop effective use of their fingers to represent numbers, count, and model basic addition and subtraction. (Jordan et al., 2008)
- It is advantageous to learn continuous left-to-right finger counting to strengthen the 'mental number line' (Moeller et al., 2011).

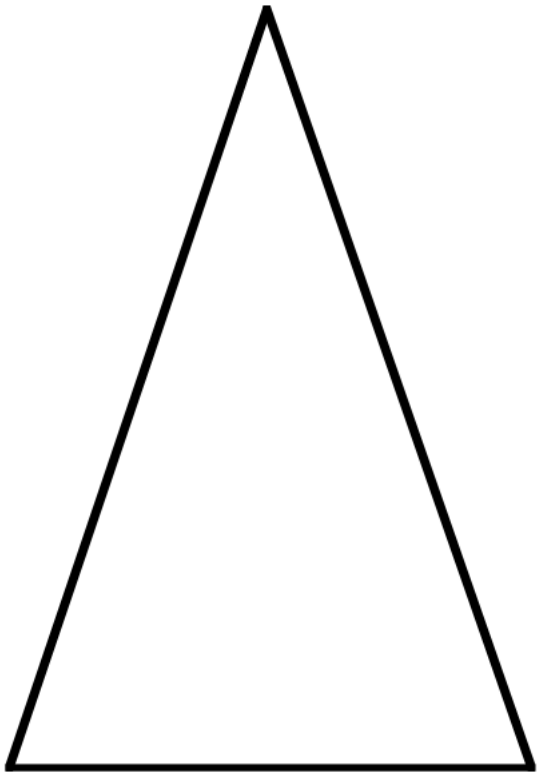




"The research project has introduced to me the **intentionality** of it. I've gone from doing it randomly, with my brain not actually realising what it's doing, to 'oh wow', this actually has evidence-based purpose and can actually really help children to build connections and understandings"
Teacher comment

This is a triangle

- What grade would you expect students to know what a triangle is?
- sort, name and create familiar shapes; recognise and describe familiar shapes within objects in the environment, giving reasons VC2MFSP01



Is this also a triangle?

What would you expect them to say as why?

- What about knowing this is a triangle? The same time?
- make, compare and classify familiar shapes; recognise familiar shapes and objects in the environment, identifying the similarities and differences between them VC2M1SP01

For the assessment, had to mention 3 sides to be fully correct

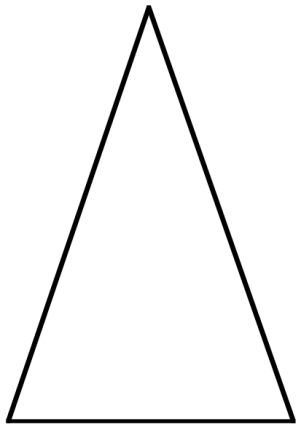
What year 1's said … apart from three-ness

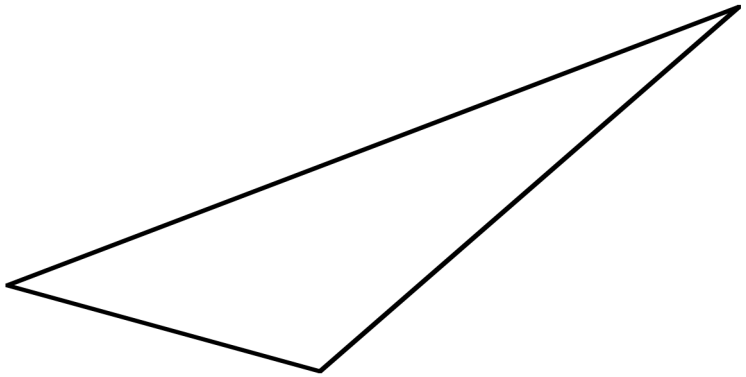
- No it looks like a house top
- No because its in diagonally
- No because its bigger and its rotated
- No I don't know
- No, just no
- "No because its sideways"
- No because if you put it straight it will still be pointing to the right so it won't make a triangle
- No because its bended
- No because that line's too long and that line's too long
- No because It's not the same as the first triangle

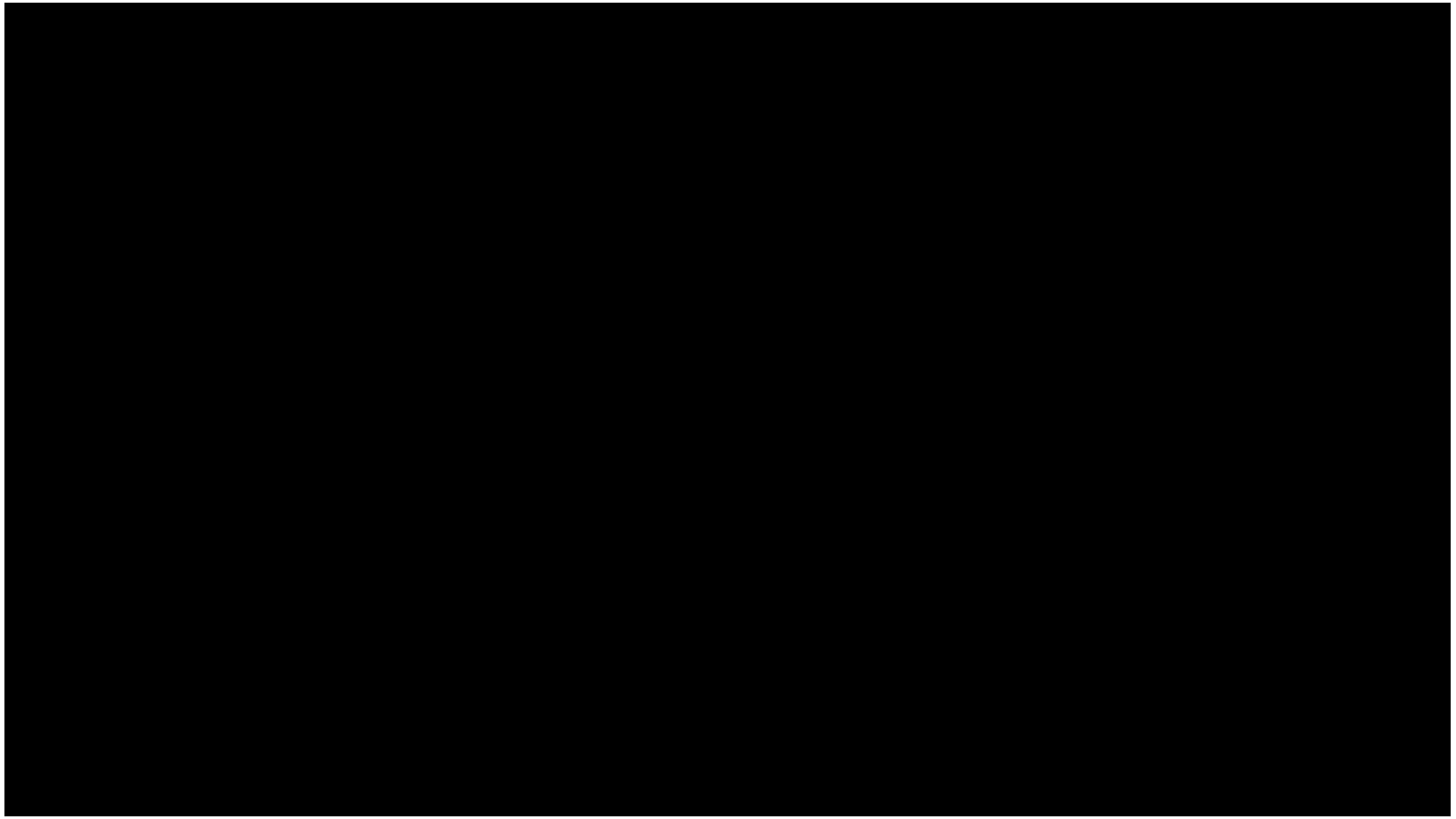
- Yes if you look upside down
- Said no because it has a line pointing right where this one is straight
- Traces around both - says no it doesn't look like it
- Yes but its up side down
- It's a diagonal triangle
- Yes facing the other way and it's longer and not straight.
- Yes because its a line like a triangle and has a point at the top
- Don't ask me! If you turn it this way maybe but right now it isn't
- Said yes you can look at it from a different angle
- Yes because if a triangle is shaped on another side its still a triangle like face down

What might this tell us about students' prior experiences with triangles?

How might using an embodied approach assist students in understanding that these are both triangles?

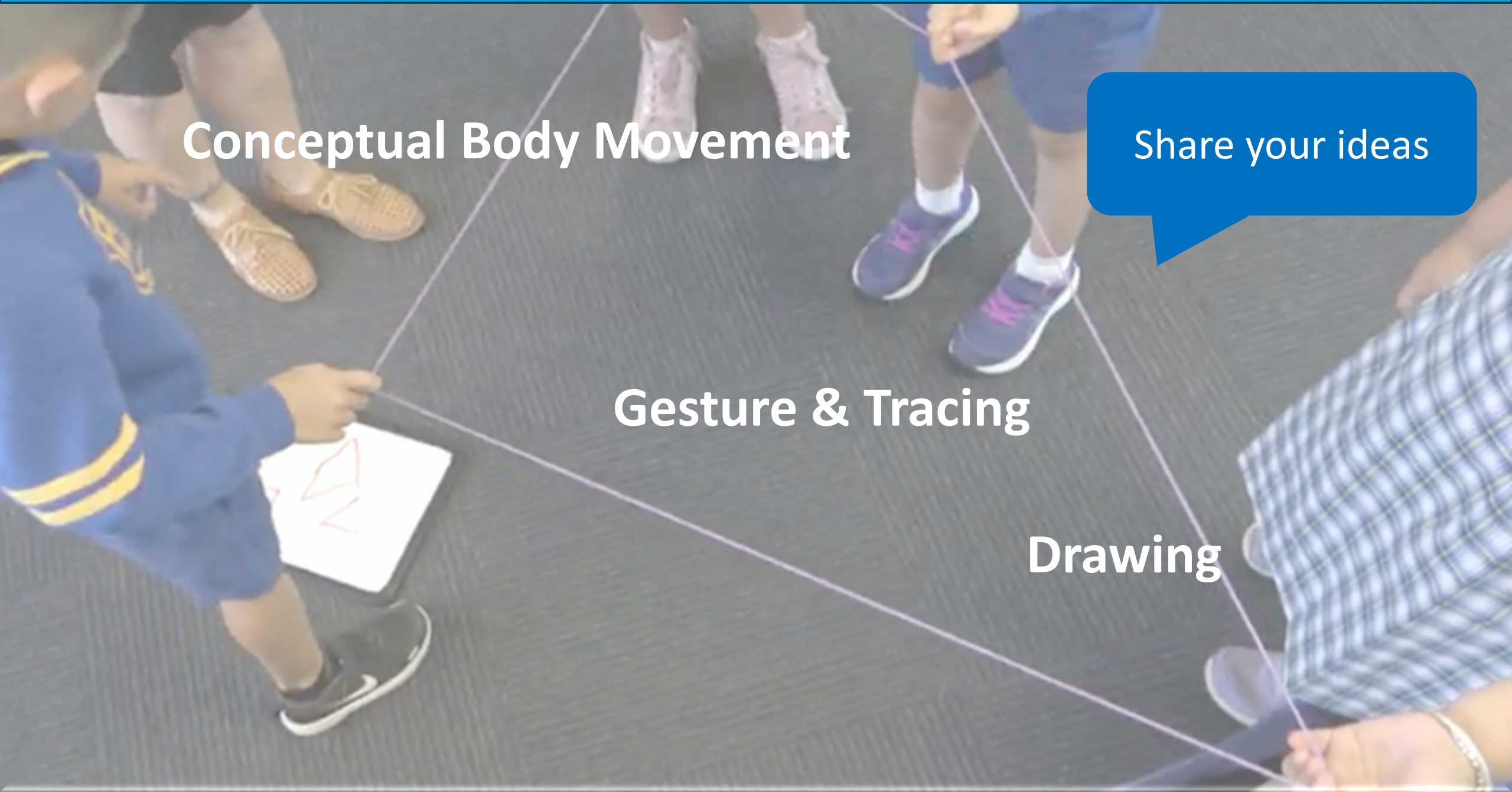






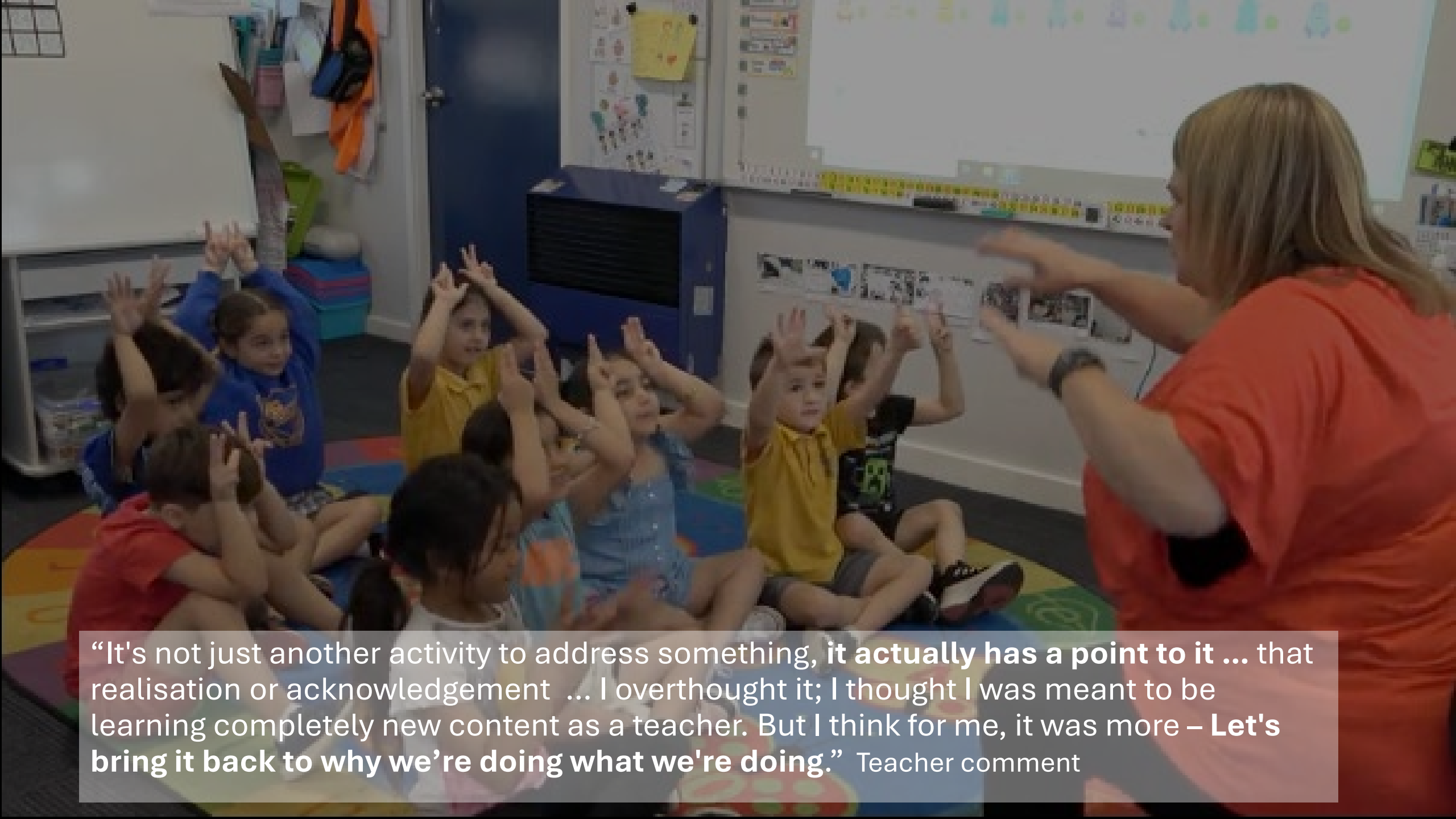
Polygon loops – year 2

Practical example: Representing the concept of ‘triangle’



Make a triangle

- Tracing around pattern or attribute blocks
- Making triangles with your fingers, arms or whole bodies
- Drawing triangles with chalk outside and walking around the shape
- Air draw a triangle and have a partner copy it
- Trace a given triangle then draw yourself (eye open then eyes closed)
- Make a triangle shape with glue and sand, then trace



“It's not just another activity to address something, **it actually has a point to it …** that realisation or acknowledgement … I overthought it; I thought I was meant to be learning completely new content as a teacher. But I think for me, it was more **– Let's bring it back to why we’re doing what we're doing.**” Teacher comment

Example tasks for representing numbers … from this to that

Preschool	Foundation	Year 1	Year 2
Play provocation: set up an area or table with large scale numbers on cards to trace	Children count aloud and show matching number of fingers	Teacher models number line and skip counting on board	Students locate missing numbers between decades on a number line on paper
Educator models making the number using air tracing, children copy (eyes open, eyes closed) trace numbers (sandpaper, in foam or sand) create large-scale numbers to walk along	Children hold a specified number of fingers out of sight. For example: eyes closed hands over head hands under table	Construct a floor number line for skip counting twos or tens, emphasising sequencing and equal spacing Children physically skip (jump) along the number line	Students construct a floor number line to display multiples of ten, with the addition of asking students to locate various 2-digit numbers relative to the nearest multiple of 10

Key takeaways:

- small pedagogical changes can make huge differences
- the development of quality pedagogical practices come from both research and the classroom
- using a variety of representations in the mathematics classroom supports students future learning

THE UNIVERSITY OF SYDNEY

Sydney School of Education & Social Work

Embodied Learning in Early Mathematics & Science

(ELEMS)

NSW GOVERNMENT Education

Strategic Research Fund

In collaboration with NSW Maths Strategy Professional Learning

Embodied Learning in Early Mathematics and Science

Acknowledgment of the research team

Research Team

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Associate Professor Christine Preston (Primary Science)

Dr Katherin Cartwright (Project Manager & Teacher mentor, Primary Mathematics)

Dr Amanda Niland (Early Childhood Education)

Dr Jonnell Upton (TESOL & Cultural Diversity)

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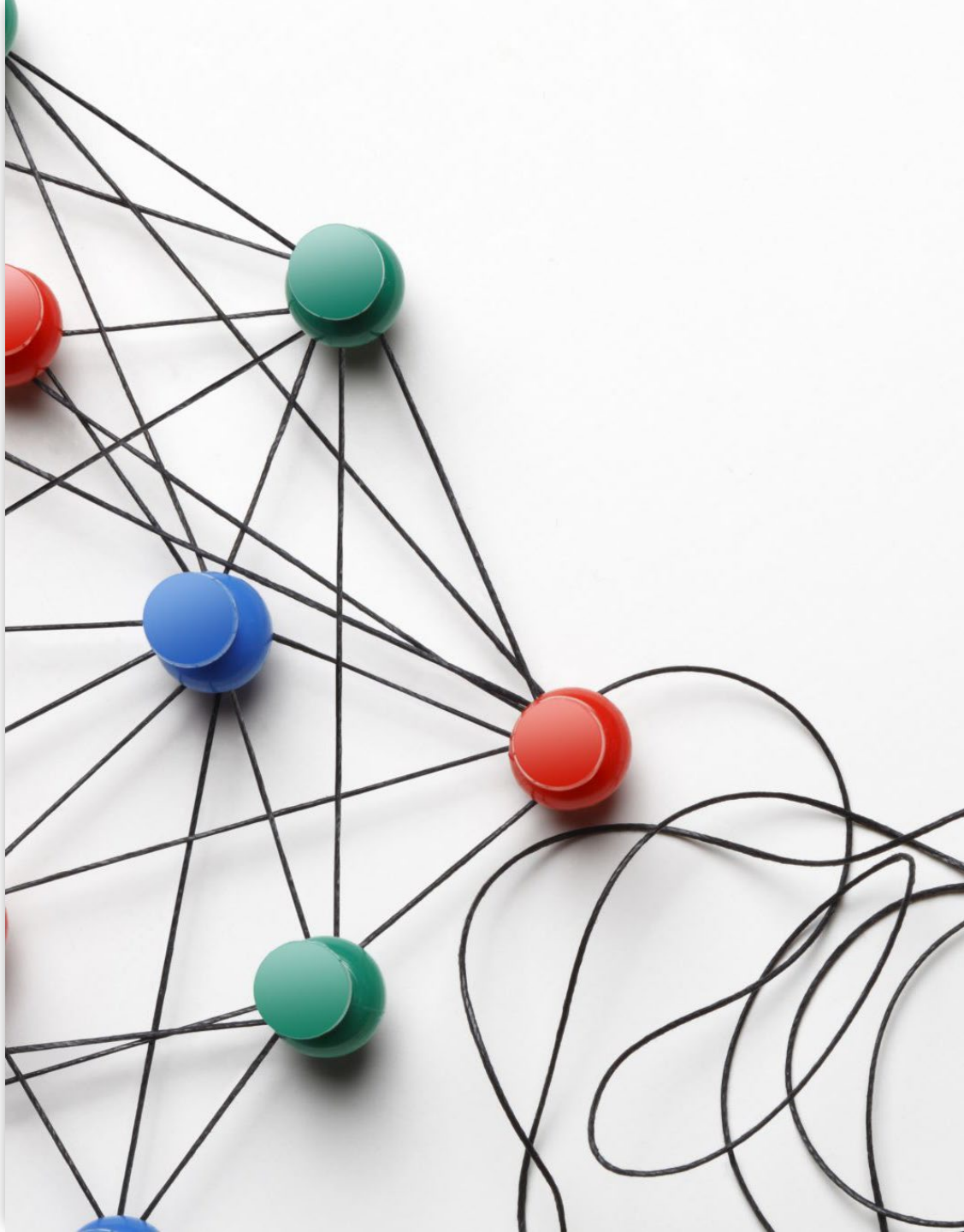


Questions

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Thank you, MAV25 Conference, Complete Survey & Morning Tea

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