Establishing an interpretive focus in a video ethnography study

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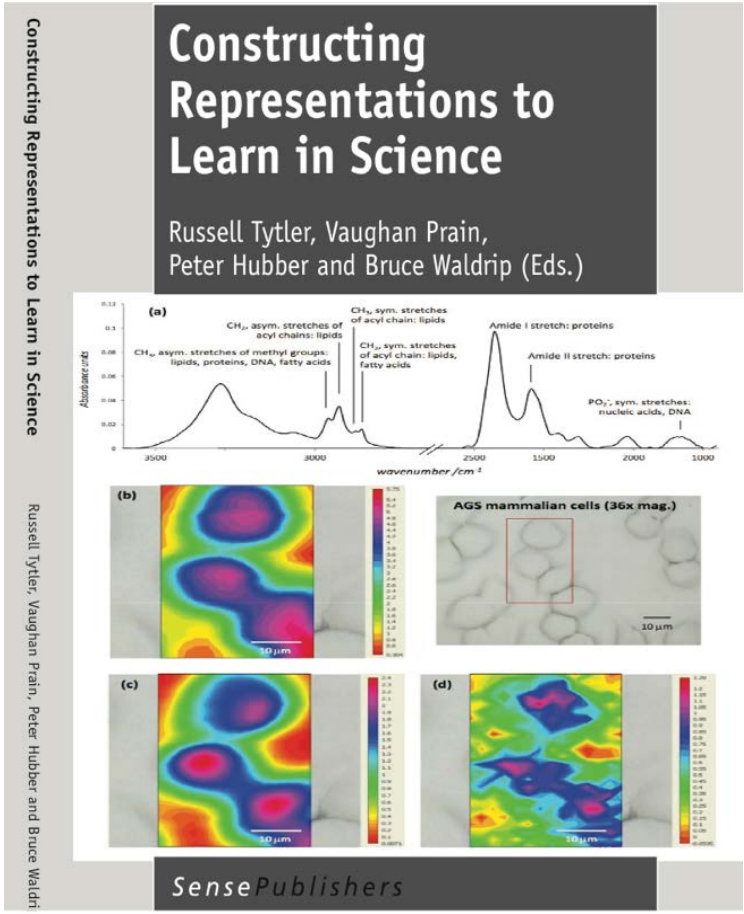
We acknowledge the Wurundjeri people of the Kulin nations as the traditional custodians of the land on which this Symposium takes place and acknowledge elders past, present and future.

REPRESENTATION CONSTRUCTION & DATA MODELING

- Model based reasoning is fundamental to discovery processes in science and mathematics, and to teaching and learning in STEM.
- Foundational learning in science and mathematics involves learning to work with key representational systems.
- Students learn about measurement and data through engaging in epistemic processes of the discipline.
- Students invent displays and compare them, under the guidance of the teacher, to learn about:
  - The nature and characterization of variation in measurement
  - The contingent nature of displays and their different affordances
  - Graphs as approximations



Theoretical bases:
Socio semiotic pragmatist perspectives of Peirce, Lemke, Vygotsky, Dewey
Model based reasoning, Lehrer & Schauble

Lehrer, R., & Schauble, L. (2012). Seeding evolutionary thinking by engaging children in modeling its foundations. Sci Ed, 96(4), 701-724.
Lehrer, R. (2009). Designing to develop disciplinary dispositions: Modeling natural systems. American Psychologist, 64(8), 759-771.

EXPLORING DATA MODELING

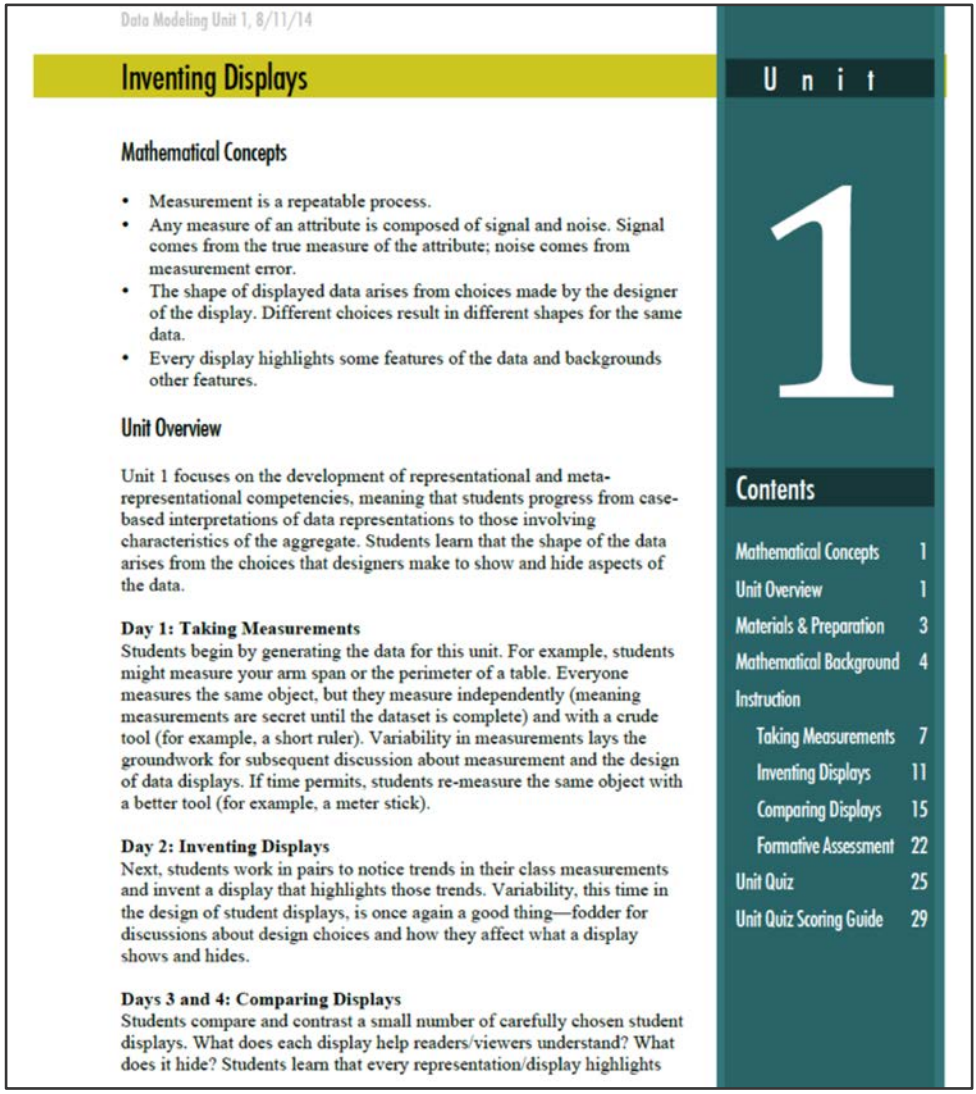
Tytler, White, Lehrer, Ferguson

DEAKIN UNIVERSITY

Worked with a year 4 class (government school, co-ed) and their teacher, developing 9 lessons, 7 at school and 2 at the SLRC

- What is the process by which the teacher and students come to an appreciation of data modeling? What are the key challenges?
- What growth in student understanding occurred?
- What are the key conceptual features of an advanced understanding/capability for representing data and its variation?

Our aim was to explore details of student reasoning about data displays and purposes, at key points in a structured sequence.



Inventing Displays

Unit 1

Mathematical Concepts

- Measurement is a repeatable process.
- Any measure of an attribute is composed of signal and noise. Signal comes from the true measure of the attribute; noise comes from measurement error.
- The shape of displayed data arises from choices made by the designer of the display. Different choices result in different shapes for the same data.
- Every display highlights some features of the data and backgrounds other features.

Unit Overview

Unit 1 focuses on the development of representational and meta-representational competencies, meaning that students progress from case-based interpretations of data representations to those involving characteristics of the aggregate. Students learn that the shape of the data arises from the choices that designers make to show and hide aspects of the data.

Day 1: Taking Measurements
Students begin by generating the data for this unit. For example, students might measure your arm span or the perimeter of a table. Everyone measures the same object, but they measure independently (meaning measurements are secret until the dataset is complete) and with a crude tool (for example, a short ruler). Variability in measurements lays the groundwork for subsequent discussion about measurement and the design of data displays. If time permits, students re-measure the same object with a better tool (for example, a meter stick).

Day 2: Inventing Displays
Next, students work in pairs to notice trends in their class measurements and invent a display that highlights those trends. Variability, this time in the design of student displays, is once again a good thing—fodder for discussions about design choices and how they affect what a display shows and hides.

Days 3 and 4: Comparing Displays
Students compare and contrast a small number of carefully chosen student displays. What does each display help readers/viewers understand? What does it hide? Students learn that every representation/display highlights

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Contents

FOCUS OF THIS PRESENTATION

1. The refinement of our focus around aesthetic considerations and their role in conceptual learning
2. The linking of aesthetic appreciation with shifts in the ontological status of phenomena
3. The role of examples in the video record and students' work in drawing attention to and enabling exploration of aesthetic dimensions of coming to know data modelling
4. The crucial role of being in the classroom and working with the teacher, for appreciating the key elements of the teaching and learning process
5. The infusion within the research process of the aesthetic experiences of the students, the teacher, and ourselves as researchers.
6. The complexity / layered nature of the research process

9 LESSON SEQUENCE

Lesson 1 (July 24, **school**) - *Measurement of teacher arm span with 30cm ruler*

Lesson 2 (July 31, **SLRC**) – *Inventing and comparing data displays for 30cm arm span measurements*

Lesson 3 (August 2, **school**) – *Formative assessment (jumping rope and statue quiz)*

Lesson 4 (August 4, **school**) – *Measuring centre and comparing methods*

Lesson 5 (August 7, **school**) – *Exploring traditional measures of centre (mean, median, mode) and repeating measurement of teacher arm span but with 1m ruler*

Lesson 6 (August 9, **school**) – *Comparing distributions and discussing precision*

Lesson 7 (August 10, **school**) – *Rate walk*

Lesson 8 (August 14, **SLRC**) – *Inventing and comparing data displays for rate walk measurements*

Lesson 9 (August 16, **school**) – *Formative assessment (water treatment quiz) and interviews with students*

(August 18, **school**) – *Interview with teacher*

Data sources: **Video at SRLC** and in classroom (teacher, and groups), interviews with children and teacher, **student work**.

SLRC VIDEO DATA

Overhead camera

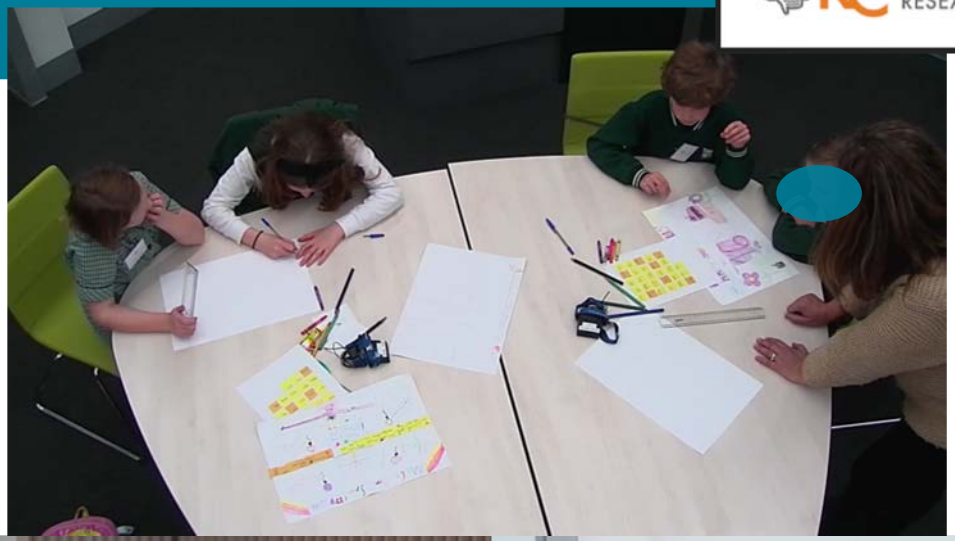
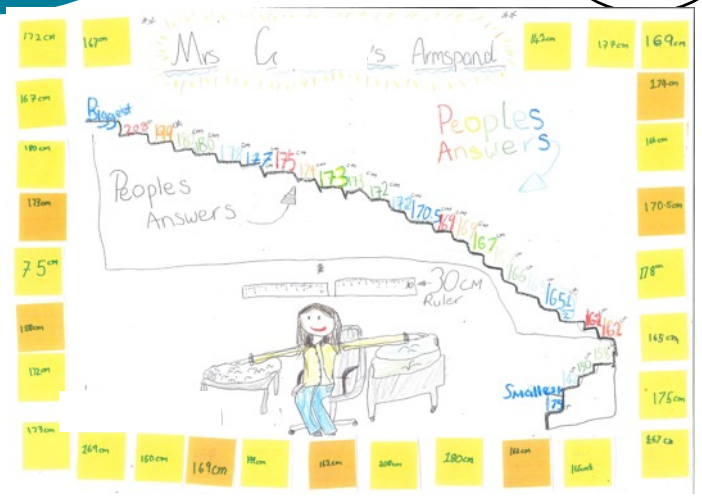
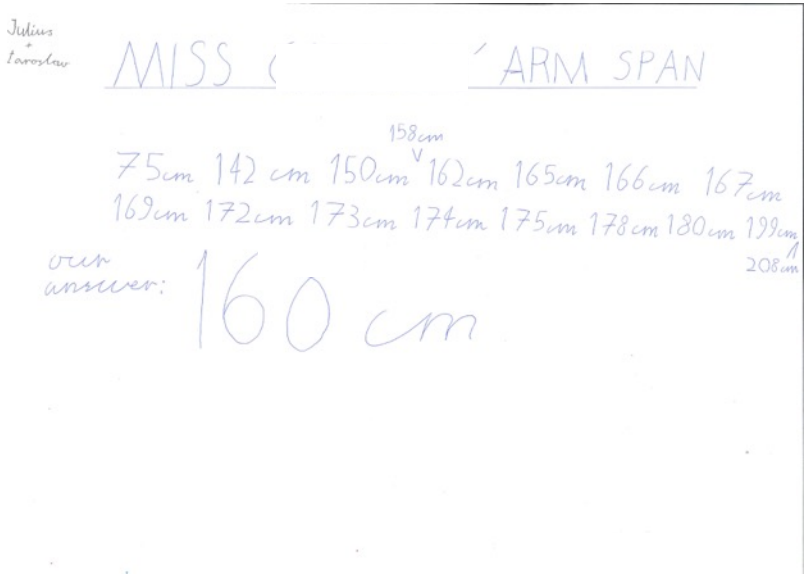


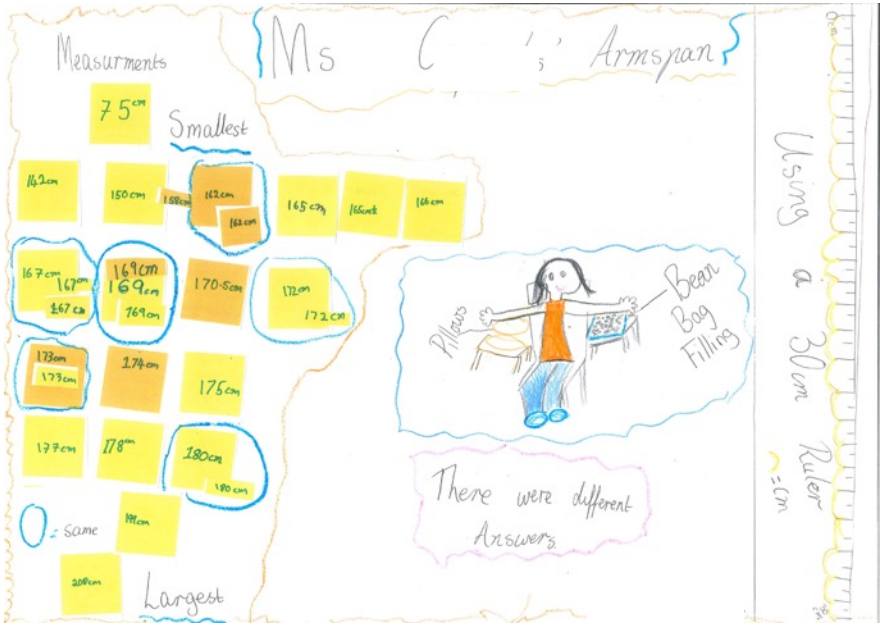
Table camera

Teacher camera

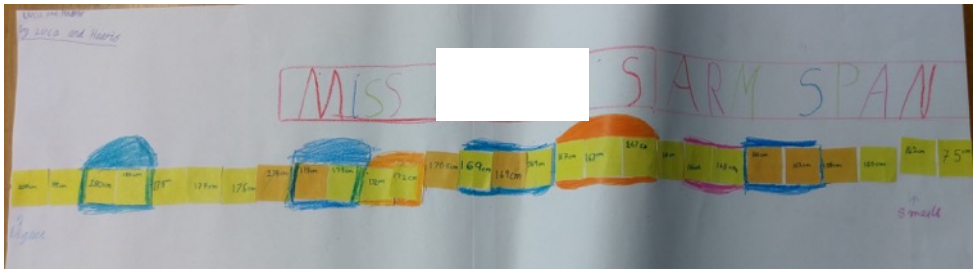
1ST SLRC SESSION: NOTICING ORDER

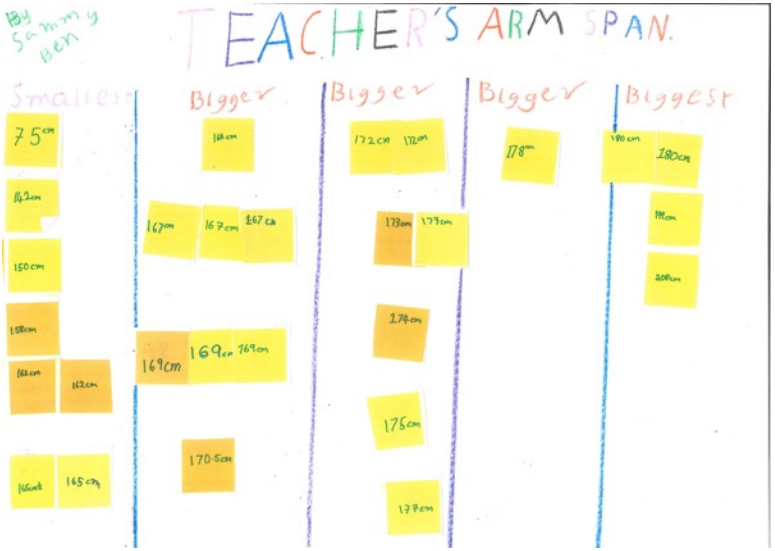




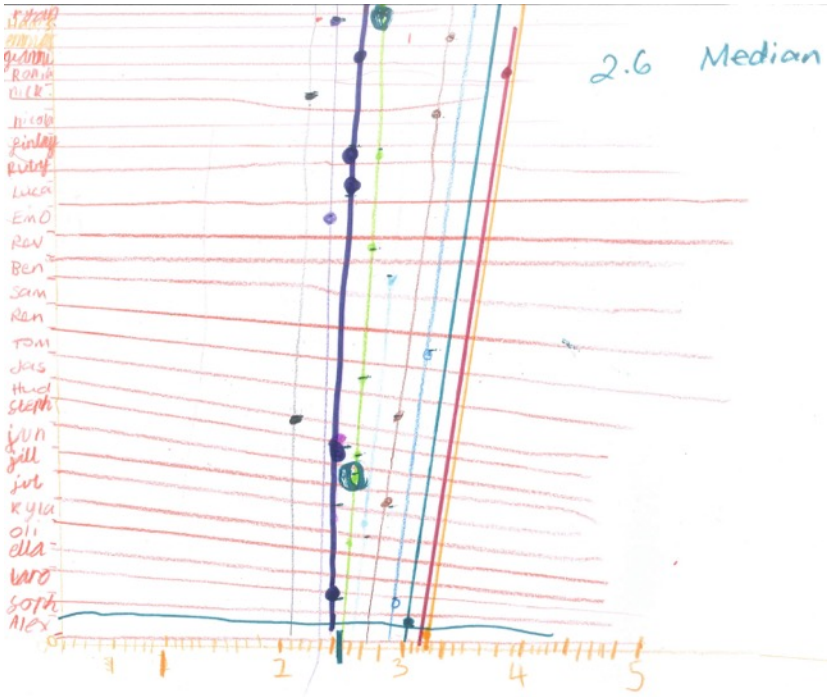


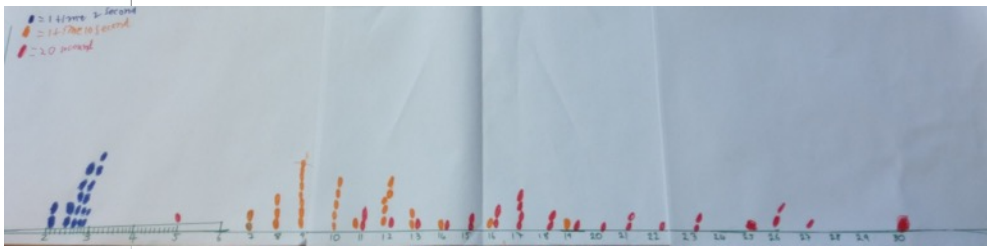
NOTICING SIMILAR VALUES - GROUPING





2nd SLRC SESSION: RATE WALK- REPRESENTATION OF SCALE





Noticing the aesthetic dimension

AESTHETICS

- Through our experience of being with the teacher in the classroom it became clear that a major task was to shift students' focus from artistic representations to exploring patterns in the numbers.
- Further exploration identified a range of aesthetic and personal considerations that interfered with the students' construction of clear data representations.
- These included:
  - Commitment to the personal process by which measurements were made – linking numbers with people, belief in their own measures.
  - A commitment to artistic displays- colour, shape- instead of to the logic of the data.
  - Lack of appreciation of the data as a patterned set, as a *thing in itself* to be considered.

- We were able to trace the changes to these aesthetic commitments in case studies of student pairs.

Wickman, Anderhag, Hamza: Aesthetics and 'taste' in science learning

Dewey: Aesthetic experience. Girod: Aesthetic Understanding

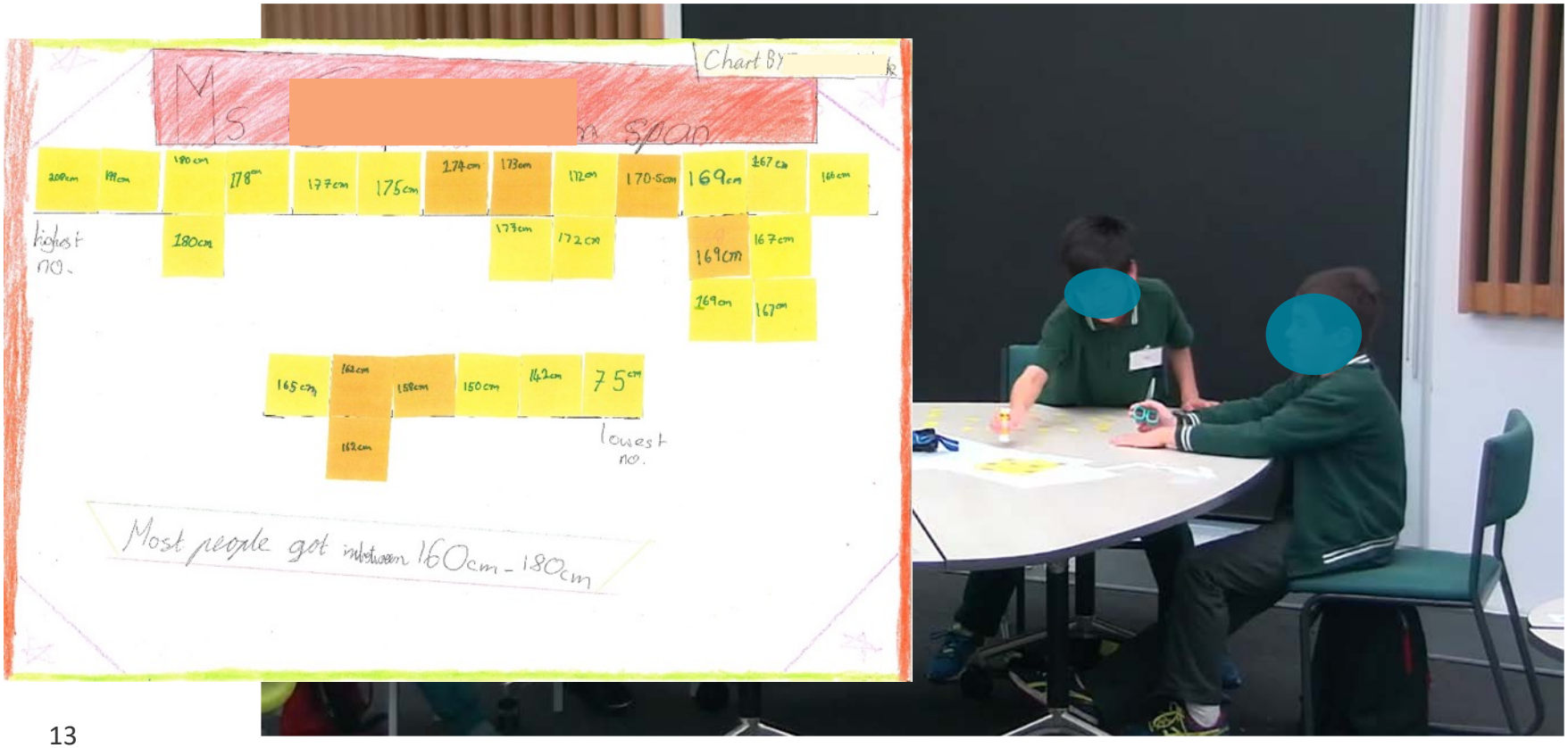
ERIN AND ELIZ – FIRST SLRC SESSION

1. Initial concern to represent the teachers' image with numbers floating around.
2. The teacher pushed the students to think about a meaningful display of the numbers.
3. They then put the numbers in order but in a triangle shape, inspired by another group.

NOEL & TIM – FIRST SLRC SESSION

1. From the start Noel particularly is concerned to explore patterns in the numbers, laying them out. A data focused aesthetic?

2. He gradually works through to a coherent number line.

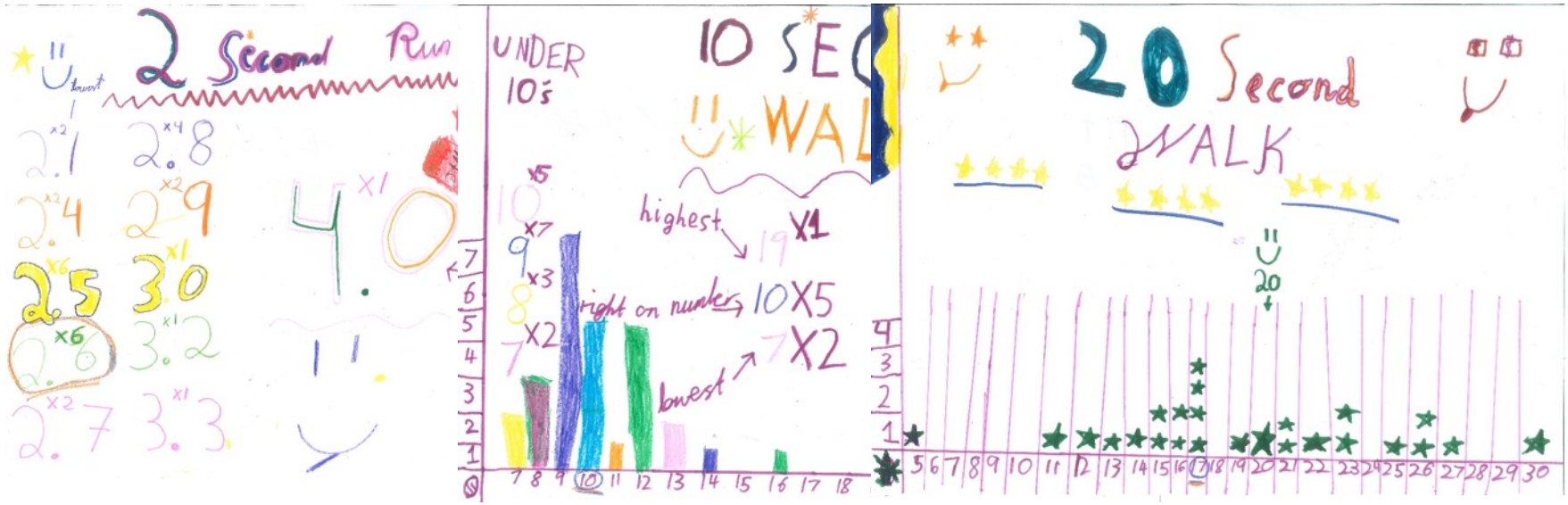


ERIN & ELIZ – SECOND SLRC SESSION

1. Both students instantly laid out the numbers in order and explored ‘highest’ and ‘lowest’.

2. Peta encouraged the students to construct a meaningful display - Erin spontaneously commits to a number line and bar graph. Eliz – ‘I don’t think you should have done that … it looks full’. Erin – ‘I like it’.

3. Erin leads to construct the 20s number line. Eliz - can we represent the numbers with crosses? They work out the median together very competently.



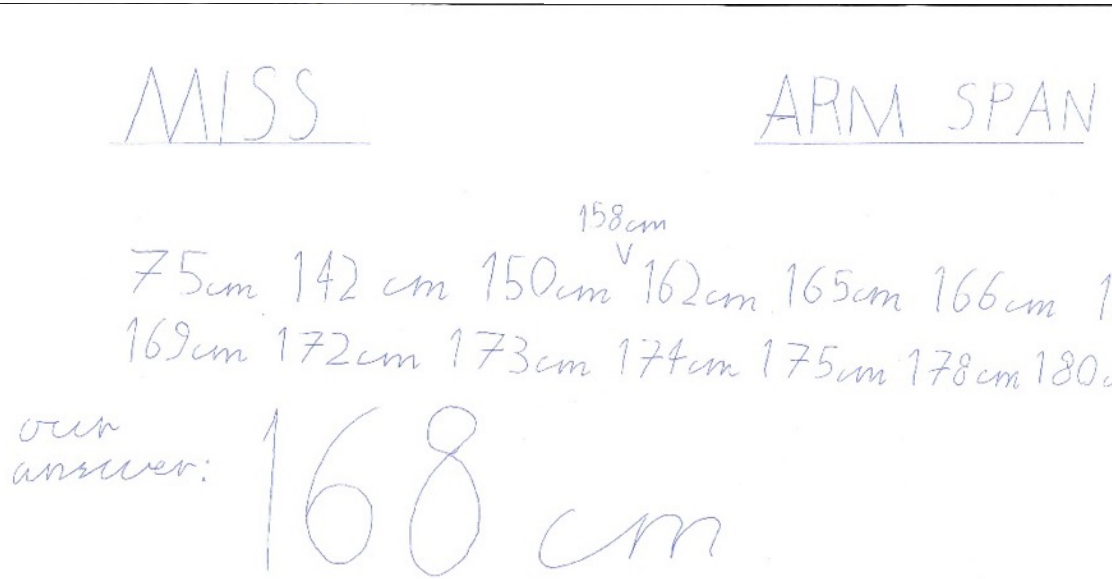
4. In the interview when asked about not including names, Erin: they’re not necessary (an aesthetic commitment) while Eliz: People might be embarrassed.

ERIN & ELIZ AESTHETIC DISCUSSION – SECOND SLRC SESSION

JOHN & IAN – FIRST SLRC SESSION

1. For these boys the only important numbers are those they themselves measured, which were 167 and 169. So they write ‘168’ as a matter of fairness.

2. They are very resistant to Peta’s suggestion that their display should make it clear how they come up with this number.



Summing up

THE AESTHETIC DIMENSION

1. Learning about measurement, data display and variation involves invention, evaluation and coordination of multimodal representational systems – the phenomena to be measured, the measures, their display in number lines and graphs, measures of spread. These constitute the multimodal discursive practices of the science/mathematics disciplines.

2. The 'objective' consideration of patterns/variation in measures involves a conceptual commitment to the ontological status of sets of measures as 'things of interest in themselves', that is fundamentally also an aesthetic commitment.

3. This accords with Dewey's account of the aesthetic experience as integrating the affective and cognitive.

4. The competing aesthetics for these children involved the beauty of displays and their shapes, association of measures with children involving competitive values and feelings, and commitment to their own measures.

5. A large part of the task of the teacher was to engage children in an interest in the number set patterns – to shift from their personal connection with the construction of the measurements to engaging with these as an abstract data set.

6. Children's difficulty in the final session with constructing number lines was not a problem of procedural knowledge but rather one of perception of the purpose of the display – there was a mismatch between the activity's immediate, and broader epistemic purposes (Between 'proximate' and 'ultimate' purposes – Dewey; Jakobson and Wickman 2011)

METHODOLOGICAL DIMENSIONS

1. The role of examples in the video record and students' work in drawing attention to and enabling exploration of aesthetic dimensions of coming to know data modelling
2. The importance of being in the classroom and working with the teacher, for noticing and appreciating the key role of aesthetics in the teaching and learning process
3. The infusion within the research process of the aesthetic experiences of the students, the teacher, and ourselves as researchers.
4. The complexity / layered nature of the research process

Relationships in the ethnographic methodological process