SCIENCE OF LEARNING RESEARCH CENTRE

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Challenges of video-based micro-ethnographic analyses of representational work

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Research Questions

- What processes of reasoning and learning can drawing enact and support in inquiry science?
- What are the conditions under which drawing enacts reasoning and learning processes?
- In what ways can drawing enact reasoned interactions in science classrooms?

Drawing as creative and critical reasoning

Drawing as creative reasoning

The act of drawing can be prior to conscious intention, mental representation or verbal framing. It can be a capturing device, a sampling mechanism where you are in the drawing before you know it. Drawing as enactive, spontaneous and emergent, unscripted, pre-linguistic apprehension, “sensuous cognition” (de Freitas & Sinclair, 2012, p. 133).

No sharp demarcation between reasoning and perceiving (Peirce, 1998)

Act of drawing can ”mirror” drawer’s existing ideas for new manipulations, and also “unveil” new ideas to be assessed (Magnani, 2013, p. 318).

Drawing as critical reasoning

Reviewing intended, realized and unintended meanings in drawings can be used to reason about and refine understandings (Bracey, 2017; Giljers, Weinberger, van Dijk, Bollen & van Joolingen 2013; Tytler, Prain, Hubber & Waldrip, 2013).

”All reasoning is an interpretation of signs of some kind.” (Peirce, 1998, p. 4).

Potentially drawing enables/prompts synaesthetic “transformation”, “transduction”, “conversion”, “resemiotization”, ”modal transfer” between visual and other modes (linguistic and haptic) (Kress, 2010; Tytler, Prain, Hubber & Waldrip, 2013; Volkwyn, Airey, Gregorcic & Heijkenskjold, 2016).

Micro-ethnographic approach to research (Erickson, 2006)

Research Methods

- Six single lessons videotaped.
- Case study focus on analyzing collaborative activity of student pairs in terms of multi-modal semiosis or meaning-making (including talk, gestures, practical experimentation, haptic activity, drawing, writing, revisions) with the aim of identifying student intentions, mode shifts, reasoning processes (as suggested from literature), and outcomes.
- Five researchers analyzed lesson videotapes and transcripts independently to identify key episodes in inquiry sequences, and then researchers conferred about data interpretation (still ongoing).
- From this analysis a narrative of each task was constructed on different reasoning processes achieved by the act of drawing and by student review of the adequacy of the drawing to their understanding of the topic, and communicative success (as perceived by students and researchers).

Methodological Challenges

- Semiotic excess. What are relevant and salient signs/enablers of reasoning?
- How do we determine (justify accounts of) learner intentions, meaning alignments between students?
- How do we represent adequately the evidence for our claims?
- Given theoretical complexities and selective framing, to what extent do our theoretical frameworks pre-determine what we find? Do we only find what we look for?

Astronomy Case

Students were reminded that understanding astronomical events required them to coordinate two perspectives – a space view, and an Earth-centred view.

They were given two challenges, the first asked for a drawing that describes to a 7-year-old boy how it can be evening in Melbourne and morning in London at the same time.

Pairs of students were then required to draw an explanatory diagram on their whiteboard of a new challenge. Each group was given a small Earth globe and torch to help them work out what was happening.

In the following case study students in pairs were asked to explain through a drawing why the Sun is higher in Australia in summer than winter.

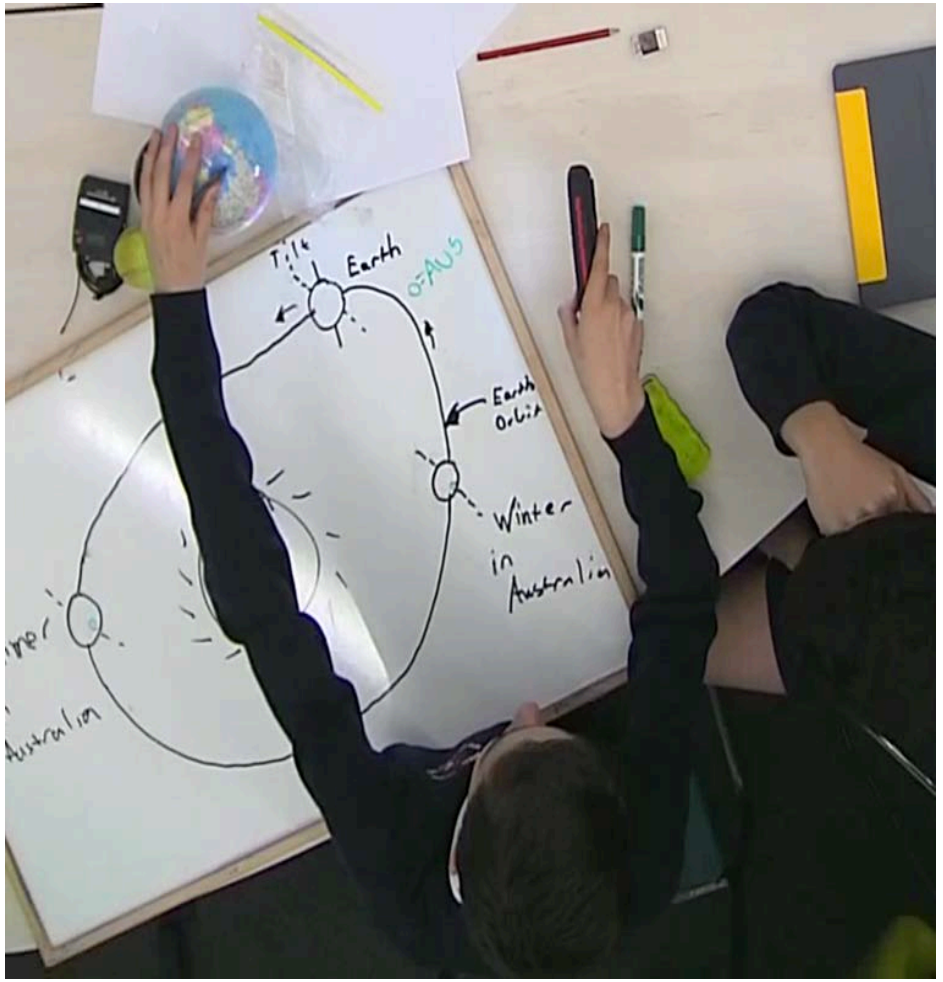
Video Analysis

In viewing the following video, what can be justifiably claimed about:

- The learning about astronomy that occurs?
- The role of drawing in reasoning and learning?
- The nature and extent of the collaboration?
- The resources students draw on?

Explain why the Sun is higher in Australia in summer than winter

BS1: This is the Earth… The Sun, in the middle of the solar system. BS2: Oh now I get it. BS1: I get it too. BS1: Okay? Earth's on a tilt-	*BS1 draws Earth and on the whiteboard, before quickly erasing initial drawings.* *Redraws for BS2.* *Continues with drawing Earth with a tilt, erases and draws again.*
BS1: Hang on. Did I put the tilt the wrong way? BS1: Did I put the tilt the wrong way? Is it that way? BS2: I'm pretty sure it's that way. Yeah. BS1: No but it goes anti-clockwise so it'll be like this. So yeah, it's this way, okay. I get it.	*BS1 draws on whiteboard, indicating direction of tilt.* *BS1 indicates to 3D model of Earth. He picks up model of Earth and rotates it to demonstrate spin.* *BS1 draws model of Sun with Earth orbiting around it.*
BS1: … OK. I know how to explain, I'm just trying to make it as accurate as I can.	*BS1 continues to update model of Sun-Earth with several re-drawings of the orbit of the Earth.*



Findings

- Drawing can be part of multi-modal model-based reasoning where it facilitates students generating and clarifying claims, depending on context, purpose and student relevant background knowledge.
- Drawing as student co-representation can enact and contribute to student creative reasoning as students generate, monitor and share visual claims (reasoning through drawing).
- Drawing can support critical reasoning when it functions as a product for review and refinement (reasoning from drawing).

Affordances of drawing that can support creative and critical reasoning

Material Properties

- Abstraction/reduction, specificity, revisability, spatial distribution of key parts, productive space constraints.

Cognitive Processes during and after drawing

- Integration of correspondence- and coherence-making requirements (and their checking) for claim-making in scientific drawing.

Implications for future research

- Need to identify generative challenges for student creative and critical multi-modal reasoning on particular topics.
- Need to develop teacher understanding of how to guide student use of drawing.
- Need for more extended micro-ethnographic research on mode-switching in reasoning about different topics.
- Need for further research on enabling conditions for ontogenesis of model-based reasoning.
- Need to research development of student visualization processes and outcomes across science curriculum.