Multimodal Transduction in Secondary School Physics

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Learning goal

Want students to work with magnetic field to experience movability of a coordinate system
Illustrate three types of transduction
A critical constellation

• Disciplinary meaning is distributed across modes.

• Airey & Linder (2009) suggested students need fluency in a critical constellation of modes.
A persistent resource

• Students need a persistent semiotic resource that functions as a coordinating hub (Fredlund et al. 2012).
Theory

Multimodal learning sequence:

1. Set of non-persistent semiotic resources
2. Coordinated around a persistent semiotic resource
3. Creates a critical constellation
4. “Aha!” moment of understanding
5. Confirmatory transduction (this work adds an extra phase to the above established sequence)
The need for mediating tools

• Many physics phenomena are not directly accessible to our senses.

• Need mediating tools to transduct the meaning potential to a modality that is available to the senses Bezemer & Kress (2008), Newfield (2017).

• Example: The Earth’s magnetic field.
The Earth’s magnetic field
Mediating tool: Compass

• Interests of signmaker: Navigational.

• Shows direction of magnetic field along surface of the Earth. It points North

• But this is not the direction of the magnetic field (compass needles are weighted).
Mediating tool: IOLab

- Device with a coordinate system printed on it (NB!).
- Gives visual display (graph) on a laptop.
- Interests of signmaker: pedagogical, but generic.
Learning goal

- Want students to work with magnetic field to experience movability of a coordinate system
Coordinate Systems

In books coordinates appear fixed:

One major disciplinary affordance of coordinate systems is that they are not fixed.

Pedagogical affordance? How can students experience this movability of a coordinate system?

Example: use a physical coordinate system with three wooden rods in mutually orthogonal arrangement); but no physicist does disciplinary work with this!
The task and setup

- Students worked in pairs
- No detailed instructions or what they had in front of them
- Task statement: "Find the magnetic field of the earth in room and paste red arrow to show it."
A multimodal ensemble

- Gaze
- Graph
- Manipulation – proprioceptory
- Speech
Students explore

What happens if we move it? … Look at that, holy crap!
Getting a feel for the system

Gaze

Graph

Manipulation – proprioceptory

Speech
Help from the teacher
Transduction to an arrow...
A critical constellation

Gaze
Graph
Manipulation – proprioceptory
Speech

Fredlund et al. (2012) persistent representation as a coordinating hub for meaning making

Volkwyn et al., 8icom, Cape Town, 7-9 December 2016
Theory (so far …)

Multimodal learning sequence:

1. Set of non-persistent semiotic resources
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4. “Aha!” moment of understanding
The Aha! Moment…

It’s a 90 degree angle there. Aha! That is so cool … Yes!!

Yeah, that makes sense.
But what happens next?
Confirmatory transduction

New meaning quickly transducted to iconic gesture – a new semiotic resource
Confirmatory transduction

More iconic gesture – using arrow as coordinating hub (Fredlund et al. 2012)
Multimodal learning sequence:

1. Set of non-persistent semiotic resources
2. Coordinated around a persistent semiotic resource
3. Creates a critical constellation
4. “Aha!” moment of understanding
5. Confirmatory transduction
Three types of transduction

1. IOLab transducts meaning potential in the room to something available to our senses (graph)

2. Students can then transduct meaning from the set of resources to a persistent representation (the arrow)

3. Once students experience the critical constellation, they quickly transduct meaning to a new semiotic resource (gesture) to confirm their new understanding.

Volkwyn et. al, 8icom, Cape Town, 7-9 December 2016
Conclusions for teachers

- Disciplinary meaning is distributed across semiotic resources (modes).
- So there is a critical constellation of semiotic resources that is needed.
Conclusions for teachers

• Task must **facilitate appropriate coordination**.

• Need to carefully decide what the **persistent coordinating semiotic resource** will be.

• Should look for **confirmatory transduction to new semiotic resources** as signal that learning is taking place.
References


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Questions