Multimodal Transduction in Upper-secondary School Physics

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Demonstrate three kinds of transduction in the physics laboratory.

Suggesting that teachers should be looking for transduction as a sign that learning is taking place.
Transduction

The movement of semiotic material from one mode (or semiotic system) to another.

Bezemer & Kress 2008
Transduction: an example

The man moved out of the way

Written language

Ambiguity about how the man moved

Diagram or picture ➔ no longer possible

The transduction process complements or constrains meaning

Ainsworth 2006
Critical constellations

A Physics Concept

Airey & Linder (2009)
Transduction and physics

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

• Need devices to transduct the meaning potential in the environment to a resource system that is available to our senses.

• One example is magnetic field.
The Compass

• Built for navigation.

• Shows the component of the magnetic field along surface of the Earth.

  It points North.

• But this is not the actual direction of the magnetic field.
Earth’s magnetic field
The Compass

- The compass has high disciplinary affordance for geographers, but low disciplinary affordance for physicists.
Mediating tool: IOLab

- Device with a coordinate system printed on it.
- Gives visual display (graph) of magnetic field on a laptop.
- Has high pedagogical and disciplinary affordances.

Airey, 2015
Pedagogical vs disciplinary affordance

Airey (2015)
Airey & Linder (2017)

Volkwyn et. al, ISEC 2018, NIE, Singapore, 21st June
Wanted students to learn some basic facts about the Earth’s magnetic field.

Gave students an open-ended task.

Find the direction of the magnetic field.
A set of resources
A set of resources

Graph
Manipulation – proprioception
Gaze
Speech

Volkwyn et. al, ISEC 2018, NIE, Singapore, 21st June
Devising a strategy

Students quickly learned to leverage their proprioception whilst looking at the screen to affect the graph.

Made first one and then two components show zero.

They had found the direction of the magnetic field.

But not yet made sense of this.
We gave students a cut out cardboard arrow

Students fixed this to show their result.

Meaning was transduced to the arrow.

Became a placeholder for all the meaning making that had gone on up to this point. Volkwyn et al. (submitted)
Transduction to an arrow
A persistent resource as a coordinating hub

• *Fredlund et al.* (2012) showed that students can more easily create a critical constellation if they have a persistent resource that functions as a coordinating hub.
Our coordinating hub

Graph
Manipulation - proprioception
Speech
Arrow

With the arrow as a coordinating hub for meaning making the students quickly experienced a critical constellation of resources.
New gestures
Three types of transduction

1. The IOLab device transducts meaning potential in the room to a visual plot that we can see.

2. Students transduct meaning from the set of resources to a placeholder—the arrow. This then functions as a coordinating hub.

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

Volkwyn et. al, ISEC 2018, NIE, Singapore, 21st June
Conclusions for teachers

Given the right open-ended task students can make appropriate disciplinary meanings in a short timeframe.

Learning is dependent on the disciplinary and pedagogical affordances available.

Students need time to explore transductions.

Disciplinary meaning is complex—students need persistent placeholders to “offload” the meaning that they have made.

Volkwyn et. al, ISEC 2018, NIE, Singapore, 21st June
Conclusions for teachers

Teachers should think carefully about what such placeholders might be.
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Teachers should think carefully about what such placeholders might be.

Want the placeholder to function as a coordinating hub for further meaning making.

Finally,

We suggest that teachers should be looking for student transductions to new semiotic resources as a sign that learning is taking place.
Questions
References


Airey, J. & Linder, C. (2015) Social Semiotics in Physics Education: Leveraging critical constellations of disciplinary representations ESERA 2015 From [http://urn.kb.se/resolve?urn=urn%3Anbn%3Ase%3Au%3Adiva-260209](http://urn.kb.se/resolve?urn=urn%3Anbn%3Ase%3Au%3Adiva-260209)


