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A Social Semiotic Approach to Teaching and Learning Science

John Airey

Department of Physics and Astronomy
Uppsala University

Department of Mathematics and Science Education
Stockholm University
What is Social Semiotics?

The study of the development and reproduction of specialized systems of meaning making in particular sections of society.

Airey & Linder (2017)
(See also Halliday, 1978; van Leeuwen 2005)

Use as a lens to understand teaching and learning in undergraduate physics.
We can partly talk our way through a scientific event or problem in purely verbal conceptual terms, and then we can partly make sense of what is happening by combining our discourse with the drawing and interpretation of visual diagrams and graphs and other representations, and we can integrate both of these with mathematical formulas and algebraic derivations as well as quantitative calculations, and finally we can integrate all of these with actual experimental procedures and operations. In terms of which, on site and in the doing of the experiment, we can make sense directly through action and observation, later interpreted and represented in words, images, and formulas.

Lemke (1998:7)
My interest

• Interested in the relationship between disciplinary knowledge in physics and these semiotic resources.

• Present some theoretical constructs I have been involved in creating and illustrate their usefulness.
Three constructs

• Critical constellations
• Disciplinary affordance
• Pedagogical affordance
Critical constellations

• Knowledge is constructed multimodally.

• We have argued that this is dependent on critical constellations of semiotic resources.
Critical constellations

A Physics Concept

Airey & Linder (2009)

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Critical constellations

There is a particular set of resources coordinated in a particular way that allows access to disciplinary knowledge.

(Airey & Linder 2009; Airey 2009)

Once you have accessed knowledge you no longer need this full set of resources.

Experts often share knowledge through a single semiotic resource.
A problem for learning

Unlikely that experts will use all the resources necessary to fully understand a physics concept.

Don’t even know what set of resources are necessary for understanding.

Need an analysis of *which combination of resources* provides access to *which knowledge*. 
Disciplinary affordance

Fredlund et al. (2012) suggest the term disciplinary affordance for semiotic resources.

Definition:
The agreed meaning making functions that a semiotic resource fulfils for a particular disciplinary community.

Airey (2015)
Disciplinary affordance

Channel 2

Channel 1
Unpacking disciplinary affordance

Channel 2

Channel 1
Unpacking disciplinary affordance

The disciplinary affordance has been unpacked

The resource has been given more pedagogical affordance
Pedagogical affordance

Definition:

*The aptness of a semiotic resource for teaching some particular educational content*

Airey (2015); Airey & Linder (2017)
Unpacking disciplinary affordance

Unpacking a semiotic resource *increases* its *pedagogical affordance* but *decreases* its *disciplinary affordance*

Airey (2015)
Pedagogical vs disciplinary affordance

Disciplinary affordance

Pedagogical affordance

Airey (2015)
2: Coordinate systems

In books coordinates appear fixed.

One major disciplinary affordance of coordinate systems is that they are **not fixed**.
Coordinate systems
Coordinate systems
Coordinate systems
Airey (2015)

Disciplinary affordance

Pedagogical affordance

Pedagogical vs disciplinary affordance
3: Disciplinary discernment

Helping students to notice disciplinary affordances through variation theory

One other mistake that experts make is that they expect students to know where to look…

Takes time to develop disciplinary discernment

(Eriksson et al 2014)
3: Disciplinary discernment

Too much information

Students don’t know where to look!
Imagine you are out with your two-year old son.

You see a worm on the ground.

He doesn’t know what a worm is.

How do you get him to notice?
This is the essence of variation theory
(Marton & Booth 1997)

We notice what changes.
See Fredlund, Airey & Linder (2015a)

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Variation for noticing disciplinary affordance

1. Choose an appropriate semiotic resource

2. Get rid of unnecessary information

3. Hold all aspects constant except for the aspect you want students to notice

Summary

Critical constellation
The agreed meaning making functions that a semiotic resource fulfils for a particular disciplinary community.

Critical constellation
Summary

The aptness of a semiotic resource for teaching some particular educational content

Critical constellation

Pedagogical affordance
Summary

1. Using non-disciplinary resources
2. Unpacking
3. Variation for disciplinary discernment

Critical constellation

Disciplinary affordance

Pedagogical affordance

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Questions and Comments


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