Using variation and unpacking to help students decode disciplinary-specific semiotic resources

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Undergraduate teaching and learning in physics
Interested in how people become physicists
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*Interactive science education at the university level: Combining variation theory with social semiotics.*

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Overview

Social semiotics
Critical constellations
Disciplinary affordance
Learning as appreciating disciplinary affordance
Pedagogical affordance
Using variation and unpacking
Social semiotics

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

Airey & Linder (2017:95)
(See also Halliday, 1978; van Leeuwen 2005)
Social semiotics

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

Airey & Linder (2017:95)

(See also Halliday, 1978; van Leeuwen 2005)

Use social semiotics to analyse teaching and learning in university physics.
Critical constellations

A Physics Concept

Airey & Linder (2009)
Mathematics has no interpersonal metafunction "borrows" this from language
Disciplinary affordance

Physics forms a perfect playground for semioticians since disciplinary meaning is largely agreed and relatively fixed.

The semiotic resources used in physics often have specific disciplinary affordances.

Fredlund et al. (2012)
Disciplinary affordance

Definition:

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

Airey (2015)
Disciplinary affordance

The disciplinary affordance of a semiotic resource is shaped by its:

- Materiality
- Rationalization (carried out by the social group)
- Historical anomalies

Airey (2014); cf Mavers *Glossary of Multimodal Terms*
Learning and Disciplinary affordance

If each disciplinary-specific semiotic resource has a particular disciplinary affordance

Then

Disciplinary learning can be problematised in terms of coming to appreciate the disciplinary affordances of semiotic resources

Fredlund et al (2012:658)
Teaching with disciplinary affordance

Two problems:

1. Experts leave things out
   They know what to add

2. Experts include irrelevant information
   They know where to look
Leaving things out

Channel 2

Channel 1
Disciplinary affordance

Six different ways to connect the circuit

Only one is correct

Deal with this problem by **unpacking**
Unpacking disciplinary affordance

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Unpacking disciplinary affordance

The disciplinary affordance has been unpacked

The resource has been given more pedagogical affordance

But this means it has less disciplinary 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)

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Coordinate systems

In books coordinates appear fixed

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

[Diagram showing a car on a slope with an x-y coordinate system.]
Coordinate systems
Coordinate systems

Coordinate systems have high disciplinary affordance

But how can you teach this?
Teaching with pedagogical affordance

Main problem:

Can’t usually do physics as easily (or at all)

Low disciplinary affordance

Usually need to change to another semiotic resource
Pedagogical vs disciplinary affordance

Disciplinary affordance

Pedagogical affordance

Airey (2015)
Teaching with disciplinary resources

Two problems:

1. Experts leave things out
   They know what to add

2. Experts include irrelevant information
   They know where to look
This is the essence of variation theory

(Marton & Booth 1997)

We notice what changes against an unchanging background
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

Disciplinary Affordance
The agreed meaning making functions that a semiotic resource fulfils for a particular disciplinary community.

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

These two are often in functional opposition

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Summary

Disciplinary affordance

Pedagogical affordance

Airey (2015)
Summary

When teaching with disciplinary resources experts tend to leave things out.

It is possible to solve the first problem by unpacking

Unpacking increases the pedagogical affordance but decreases the disciplinary affordance
Summary

When teaching with disciplinary resources experts tend to include too much information.

It is possible to solve the second problem by using systematic variation to draw attention to the aspects you are interested in.
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

Questions and Comments
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)


