On the disciplinary affordances of semiotic resources

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Why affordance?

Interested in learning

Specifically, relationship between physics knowledge and its representation

Physics lecturers need to understand what each semiotic resource they use affords (gives to) their students
Overview

Background to the term affordance
Multimodality and affordance
Critical constellations
Disciplinary affordance
Illustrations
Conclusion
Background to the term affordance

Gibson (1979)

Interested in organism and environment

Affordance treated as a property of an object in relation to an organism

Affordance is an invitation to action that is inherent in the environment
Critique:

Gibson treats affordance as an *inherent property* of an object.

An apple affords eating

The problem here is that affordance is *impossible to quantify*. A single object has multiple affordances depending on the setting and the organism.
Background to the term affordance

Norman (1988)

Interested in design

Suggested that affordance is only that which is perceived by the user.
Critique

Norman addresses the problem of multiple affordances by suggesting affordance is only what it affords to one individual *here and now*.

This means that *affordance changes* depending on the individual and setting.

Affordance is not a generalisable analytical unit.
Multimodality

Modality originally linked input through the senses:

Sight, hearing, smell, touch, taste.

Cognitive psychologists focus mainly on the first two senses i.e. visual and auditory modes.
Often interested in *matching input* from auditory and visual modes:

**Cognitive load** (Chandler & Sweller, 1991)

**Dual processing theory** (Clark & Paivio, 1991; Paivio, 1986)

**Multimedia effect** Mayer (1997; 2003)
Multimodality

Linguistic use of modes

Uses a looser definition of mode

*Written language seen as a separate mode*

Original interest in complementing/extending explanatory power of *systemic functional linguistics* using other *extra-linguistic materials* e.g. pictures
Multimodality and affordance

Building on Lemke and others, Kress et al. (2001) suggested the use of affordance (and constraints) with respect to *modes* i.e. a move from the affordance of an individual *object* to the affordance of a *mode*

*Is speech say, best for this, and image best for that?*  
Kress *et al*. (2001:1)

i.e. multimodality is interested in the *different* communication potential of modes
Multimodality and affordance

The affordance of a mode is shaped by its *materiality*, by what it has been repeatedly used to mean and do (its ‘*provenance*’), and by the *social norms and conventions* that inform its use in context – and this may shift, as well as through timescales and spatial trajectories.

Glossary of multimodal terms (Mavers)
Critical constellations

Airey & Linder (2009)

Build on Kress to propose

A critical constellation of modes
Critical constellations

Experiencing science concepts can be likened to viewing a multi-faceted object from different angles.

Each mode allows us to ‘view the object’ from a different angle.
This hypothetical scientific concept has six separate attributes or facets

Critical constellations

Airey & Linder (2009)
A mathematical resource **affords access to** three of the six facets of the scientific concept

Critical constellations

Airey & Linder (2009)
Critical constellations

Airey & Linder (2009)
Critical constellations

Scientific Concept

Airey & Linder (2009)
Critical constellations

Airey & Linder (2009)
Critical constellations

– So, for Airey & Linder (2009), learning a particular physics concept is seen as becoming *fluent in a critical constellation of modes*

– i.e learning to use the various modes in an appropriate, disciplinary manner
Disciplinary learning

Interested in disciplinary learning

Airey and Linder’s (2009) critical constellation is useful but focuses on the system of modes

Found we need a finer-grained unit of analysis

Need to differentiate affordance within modes

Want theory to allow two things in the same mode e.g. two diagrams to have different affordances within a discipline.
Critical constellations

Airey (2009)
Modified the earlier claim to suggest a *critical constellation of semiotic resources*

Clearly, semiotic resources *within the same mode* can have different affordances

Shifts focus from the affordances of modes to the affordances of individual semiotic resources and their collective affordance

Linder (2013)
Disciplinary affordance

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

Definition:

The potential of a given semiotic resource to provide access to disciplinary knowledge

Fredlund et al. (2012:658)

Deals with individual semiotic resources

Signals a break with earlier work on affordance

Focuses on the discipline’s interpretation of the resource rather than the learner’s experience
Disciplinary affordance

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

Appropriate disciplinary learning only possible when there is a *match* between:

- what a given semiotic resource *affords to the student*  
  (cf. Gibson & Norman)

And

- *its disciplinary affordance*  
  (i.e. what it affords for the discipline)
Illustrating disciplinary affordance
Illustrating disciplinary affordance

Interviewer: This is him starting this thing about transformers—what did you think about this particular part?
Student: Ummmh. Yeah, I don’t know what this is. I didn’t know what he was writing…
Interviewer: Okay, he’s drawing some kind of diagram, but you don’t really know what that is that he’s drawing?
Student: No.
Interviewer: Okay, so…
Student: And I think it’s quite often like that in the lectures he’s drawing something on the whiteboard and he assumes that we know this from before.
Interviewer: You’ve got no idea what this transformer thing is?
Student: [laughing] No.
Illustrating disciplinary affordance

Clearly this student has not experienced the disciplinary affordance of this semiotic resource
Illustrating disciplinary affordance

\[ \nabla \times \mathbf{E} = 0 \]

*Equation written by the lecturer on the whiteboard*

**Interviewer:** You’ve seen these equations before..?

**Student:** Yeah I’ve seen them before er… but I really don’t know exactly what they mean [laughs].

**Interviewer:** Can you tell me what this means to you?

[pointing to the equation \( \nabla \times \mathbf{E} = 0 \)]

**Student:** Um, I think the \( E \) is er the intensity of er an electric field. And then the curl of \( E \)… [quietly to herself] mmm equals zero…

Erm, I think this is erm a conservative vector field—and I know how to calculate it but I don’t know what it means.
Illustrating disciplinary affordance

Again the student has not experienced the disciplinary affordance of this semiotic resource

The student can ”read” the resource and use it to calculate but the meaning is still hidden.

Both the term ”conservative vector field” and the student’s calculations are correct, but the student is nevertheless only *imitating the discourse* (Airey, 2009)
For learning, focusing on multiple modes is often an inappropriate unit of analysis.

Rather, each individual semiotic resource has a particular *disciplinary affordance* Fredlund et al. (2012)
Conclusions

Lecturers need to unpack the *disciplinary affordances* of the semiotic resources they use in teaching.

Little is known about these individual disciplinary affordances in physics.

Even less is known about the *critical constellations of semiotic resources* that are needed for appropriate knowledge construction.
References


