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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



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Overview

Background to the term affordance

Multimodality and affordance

Critical constellations

Disciplinary affordance

Illustrations

Conclusion



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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



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Background to the term affordance

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.



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Background to the term affordance

Norman (1988)

Interested in design

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



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Background to the term affordance

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.



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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.



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Multimodality

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)



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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**



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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



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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)



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Critical constellations

Airey & Linder (2009)

Build on Kress to propose

A critical constellation of modes



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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



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Critical constellations



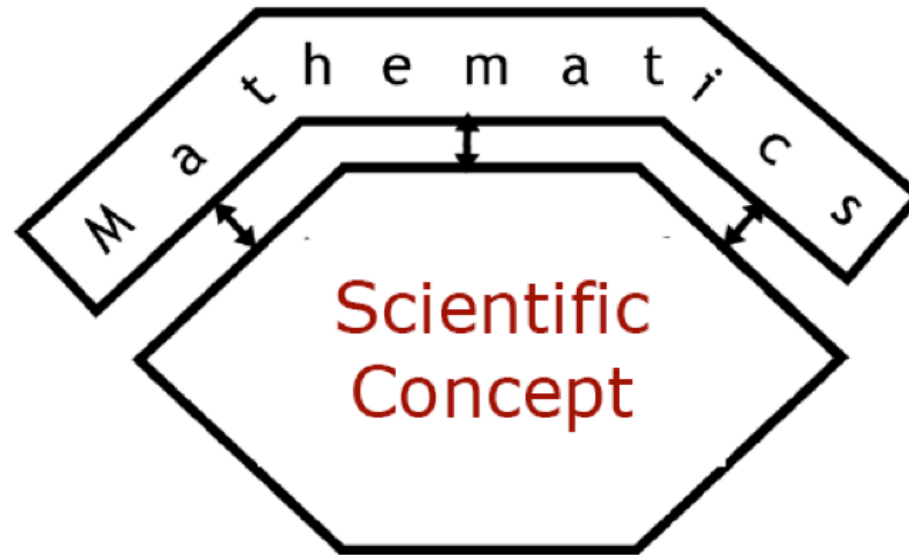
Airey & Linder (2009)

**This hypothetical scientific concept
has six separate attributes or **facets****



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Critical constellations



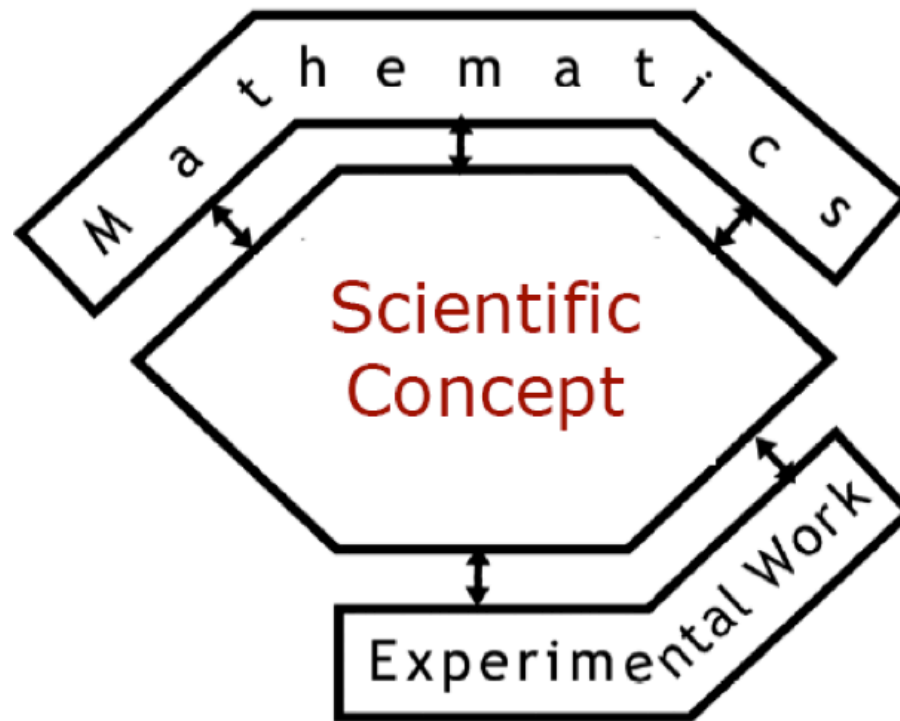
Airey & Linder (2009)

A mathematical resource **affords access to three of the six facets of the scientific concept**



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Critical constellations

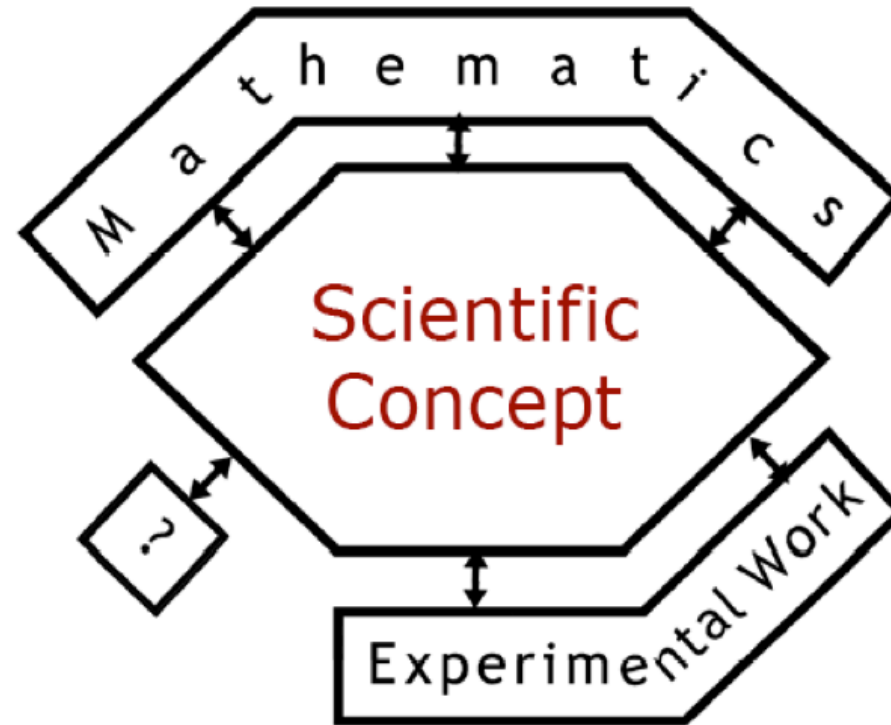


Airey & Linder (2009)



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Critical constellations

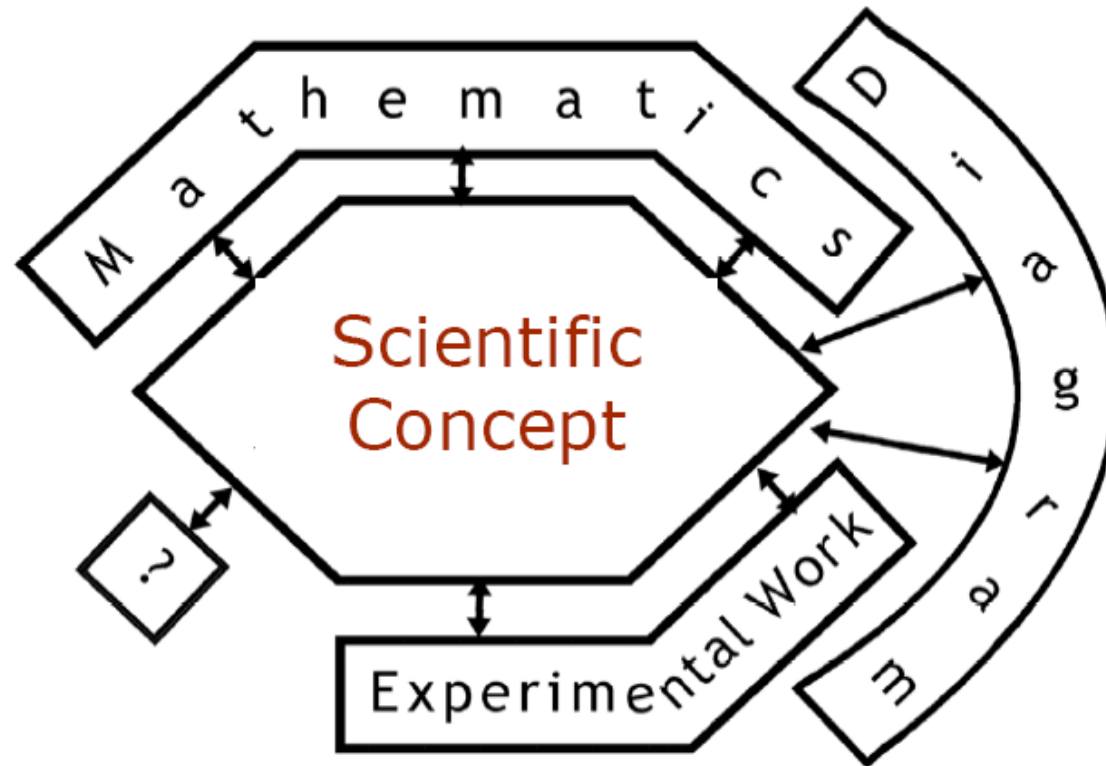


Airey & Linder (2009)



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Critical constellations



Airey & Linder (2009)



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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



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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.



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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)



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Disciplinary affordance

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



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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



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Disciplinary affordance

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



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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)

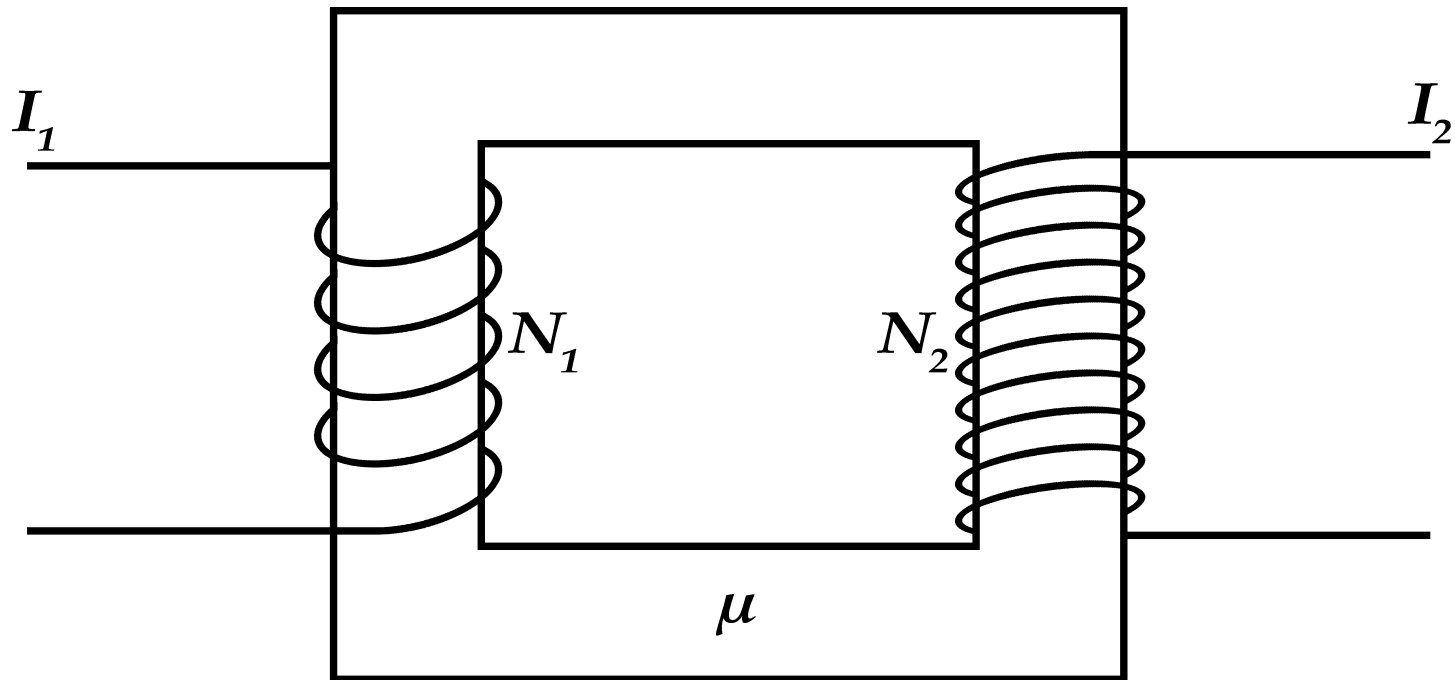
And

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



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Illustrating disciplinary affordance





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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.*



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Illustrating disciplinary affordance

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



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Illustrating disciplinary affordance

$$\nabla \times E = 0$$

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 $\nabla \times E = 0$]

Student: *Um, I think the E is er the intensity of er an electric field. And then the curl of E... [quietly to herself] mmh 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.*



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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)



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Summary

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)



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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.



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