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Teaching and Learning in University Physics: A Social Semiotic Approach

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Undergraduate teaching and learning in physics

Theoretical constructs from 15 years of research

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Overview

What is social semiotics for us?

Constructs we have introduced

- **Critical constellations**
- **Fluency**
- **Discourse imitation**

More recent constructs

- **Disciplinary affordance**
- **Unpacking**

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What is social semiotics for us?

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

Airey & Linder (in press)

(See also descriptions in Halliday 1978; Hodge & Kress 1988; Thibault 1991; van Leeuwen 2005)

Use as a lens to understand teaching and learning in undergraduate physics.

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Theoretical constructs

Created a number of theoretical constructs

Two observations:

Physics is multimodal—meaning is distributed across a range of semiotic resources.

Meaning is relatively fixed and agreed.

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Critical constellations

Airey & Linder (2009) suggested that there is a **critical constellation of semiotic resources** needed for appropriate disciplinary meaning making.

A particular **multimodal ensemble** that affords access to a particular piece of disciplinary knowledge.

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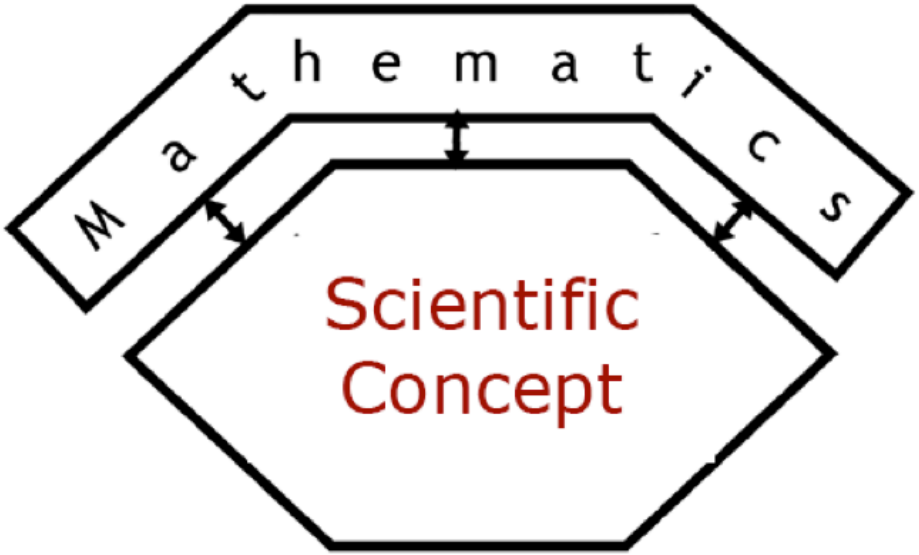

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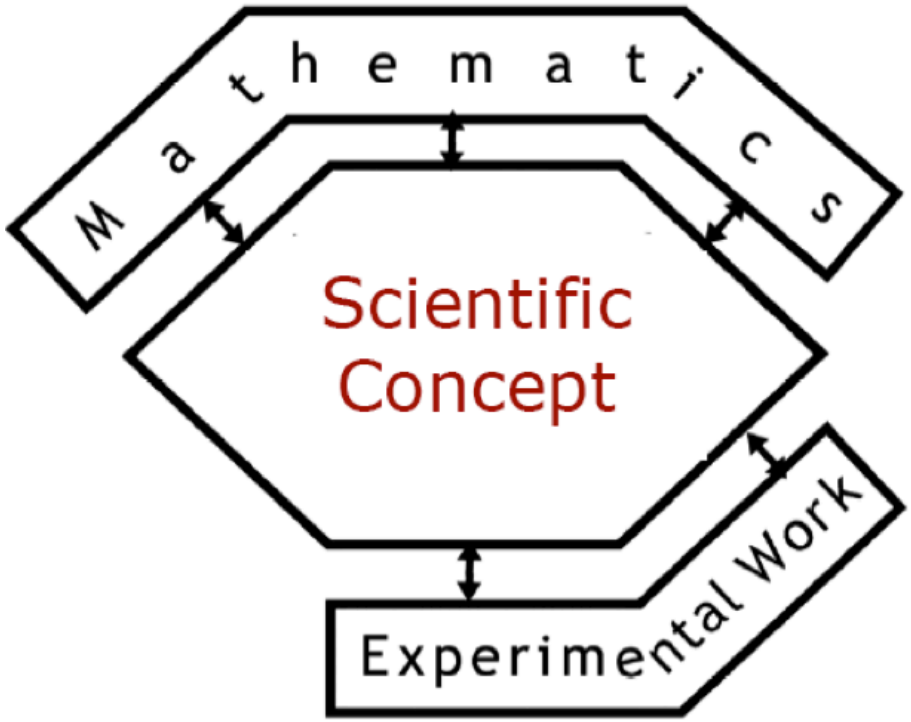

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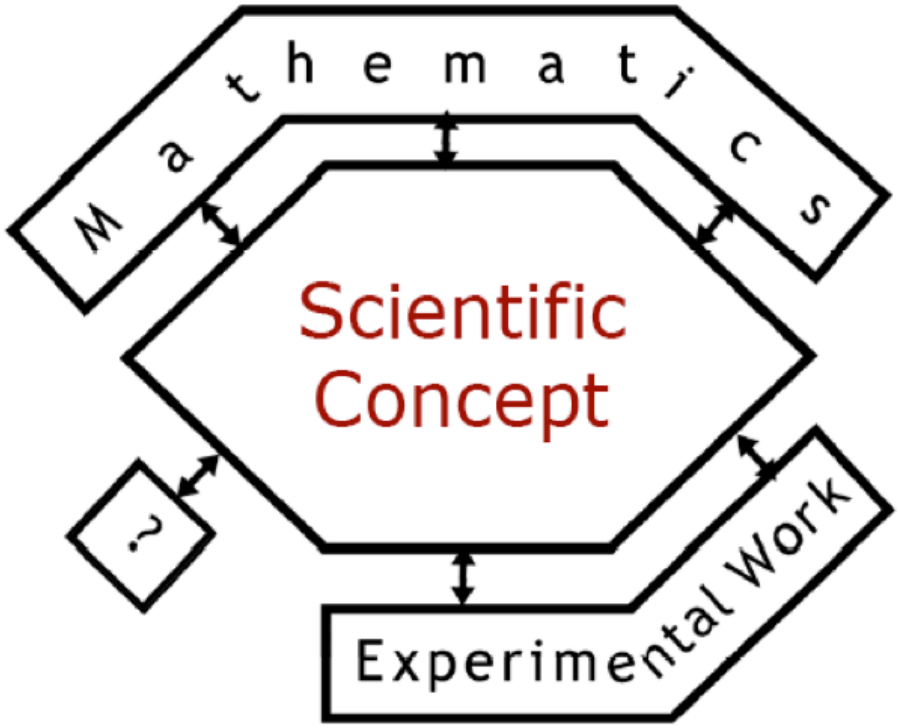

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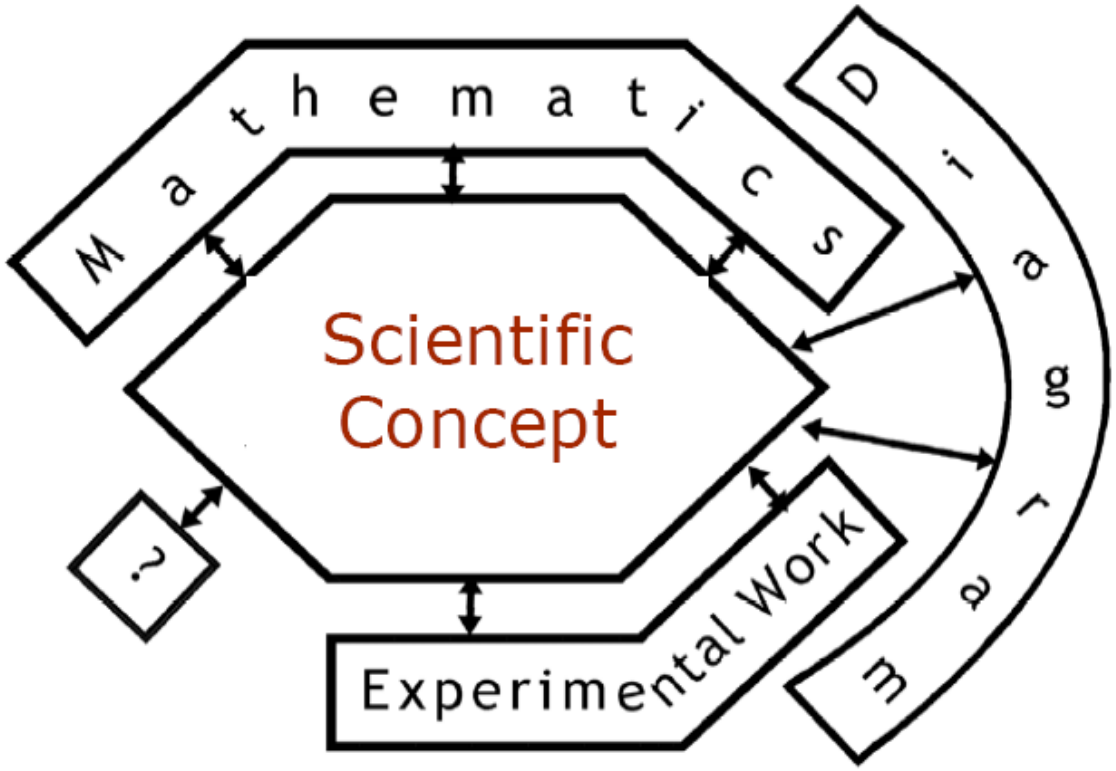

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Fluency

Students need to become fluent in each of the semiotic resources that together create the critical constellation before they can appropriately experience disciplinary meaning

(Airey & Linder 2009; Airey 2009)

Fluency is about learning to use the various semiotic resources in an appropriate, disciplinary way.

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Fluency

What happens when students are not fluent?

Claim: They imitate disciplinary discourse

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Discourse imitation

Discourse imitation is when students use semiotic resources appropriately **without** the **associated disciplinary understanding**

Discourse imitation occurs because students can't become fluent in everything at once.

Airey (2009); Airey & Linder (2009)

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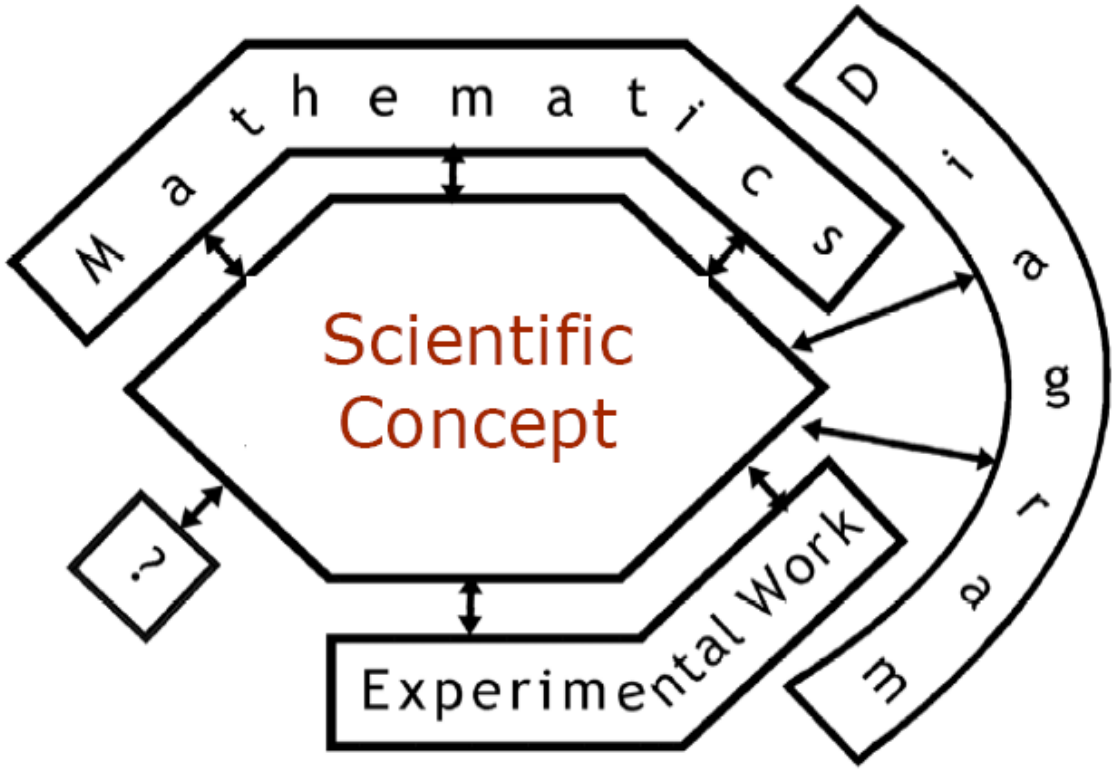

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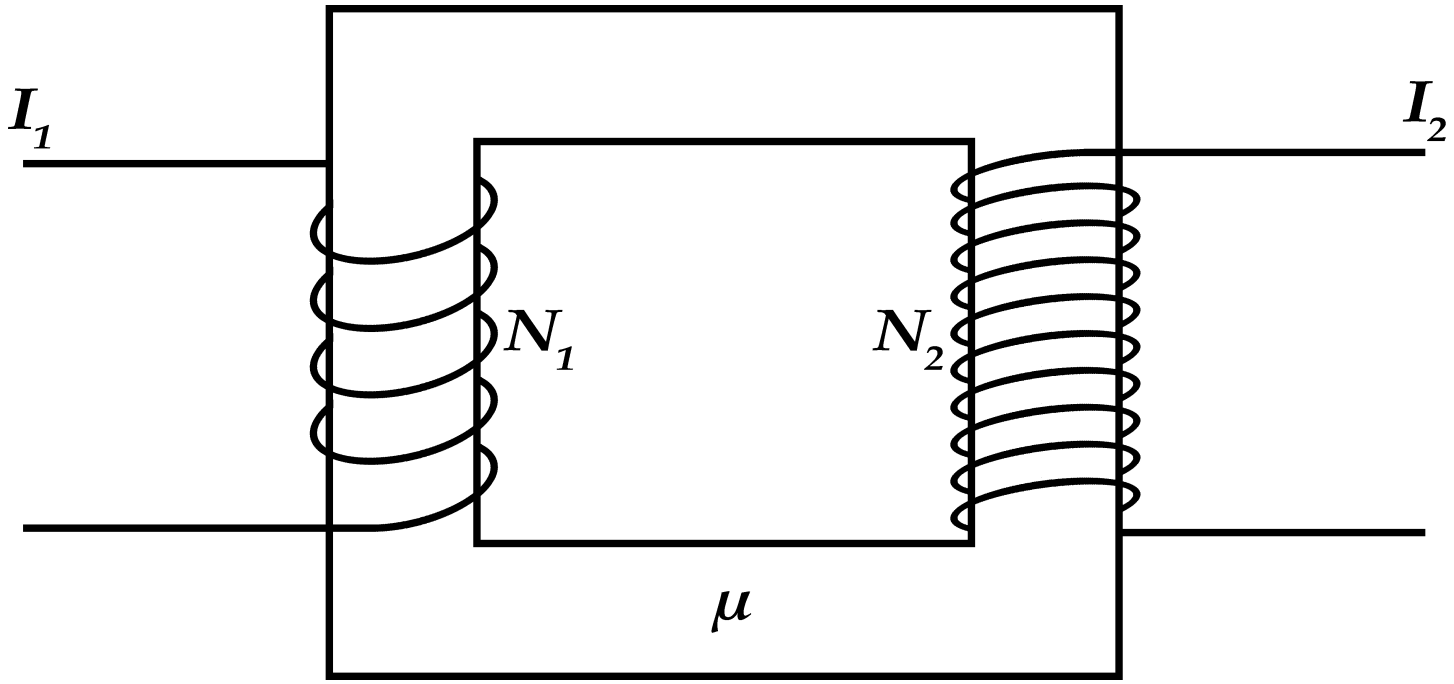
Illustrating discourse imitation



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Illustrating discourse imitation

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 discourse imitation

Clearly this student has not experienced the meaning of this semiotic resource—the student is imitating the discourse.

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Illustrating discourse imitation

$$\nabla \times E = 0$$

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 discourse imitation

Again the student has not experienced the meaning 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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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 (2014)**

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Unpacking disciplinary affordance

Learning can be problematized in terms of coming to understand and use disciplinary affordances.

Lecturers need to unpack these disciplinary affordances for their students.

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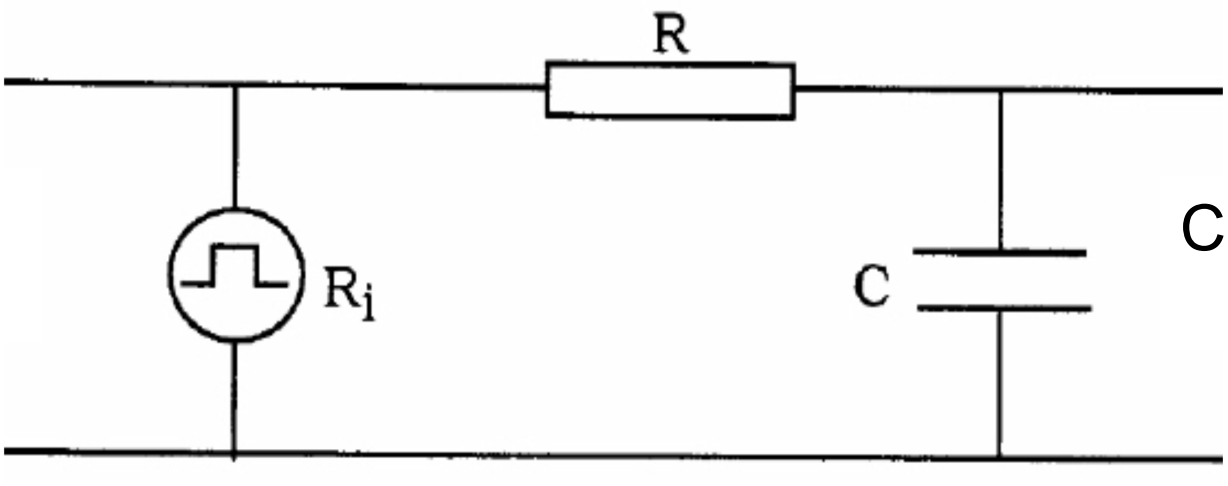
Unpacking disciplinary affordance

Channel 2



Channel 1

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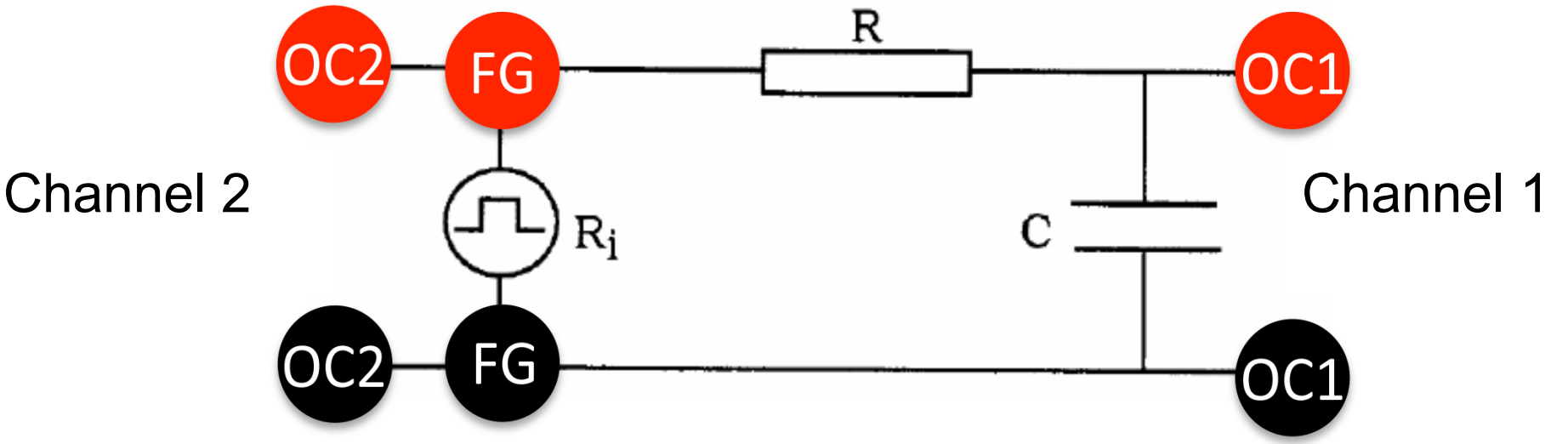
Unpacking disciplinary affordance



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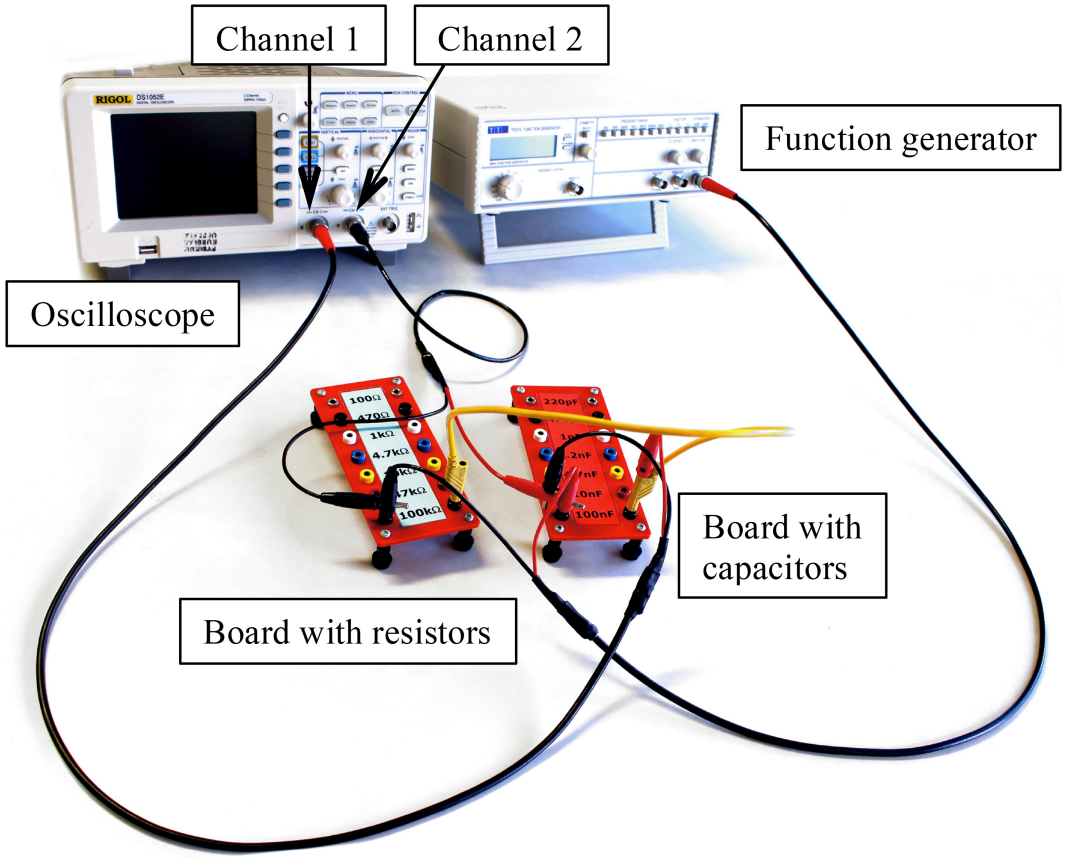

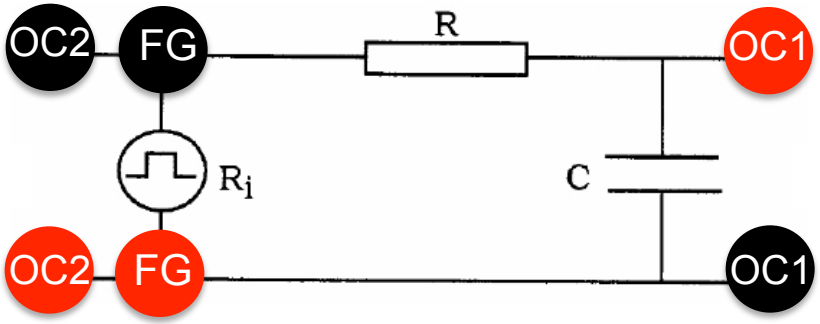

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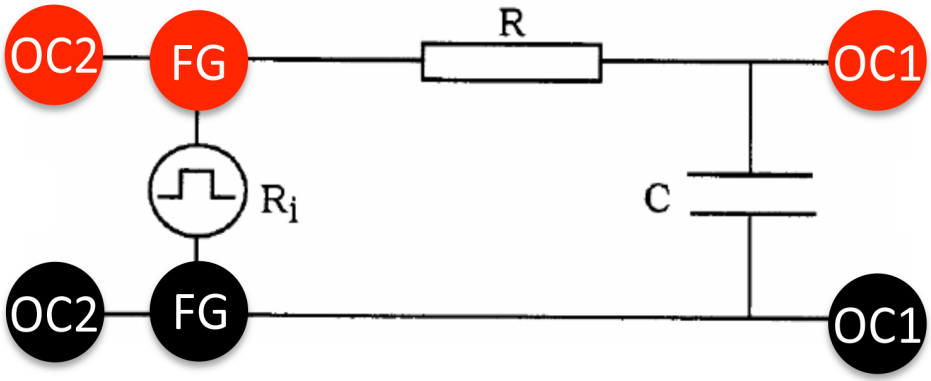
Unpacking

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

Airey (2015)



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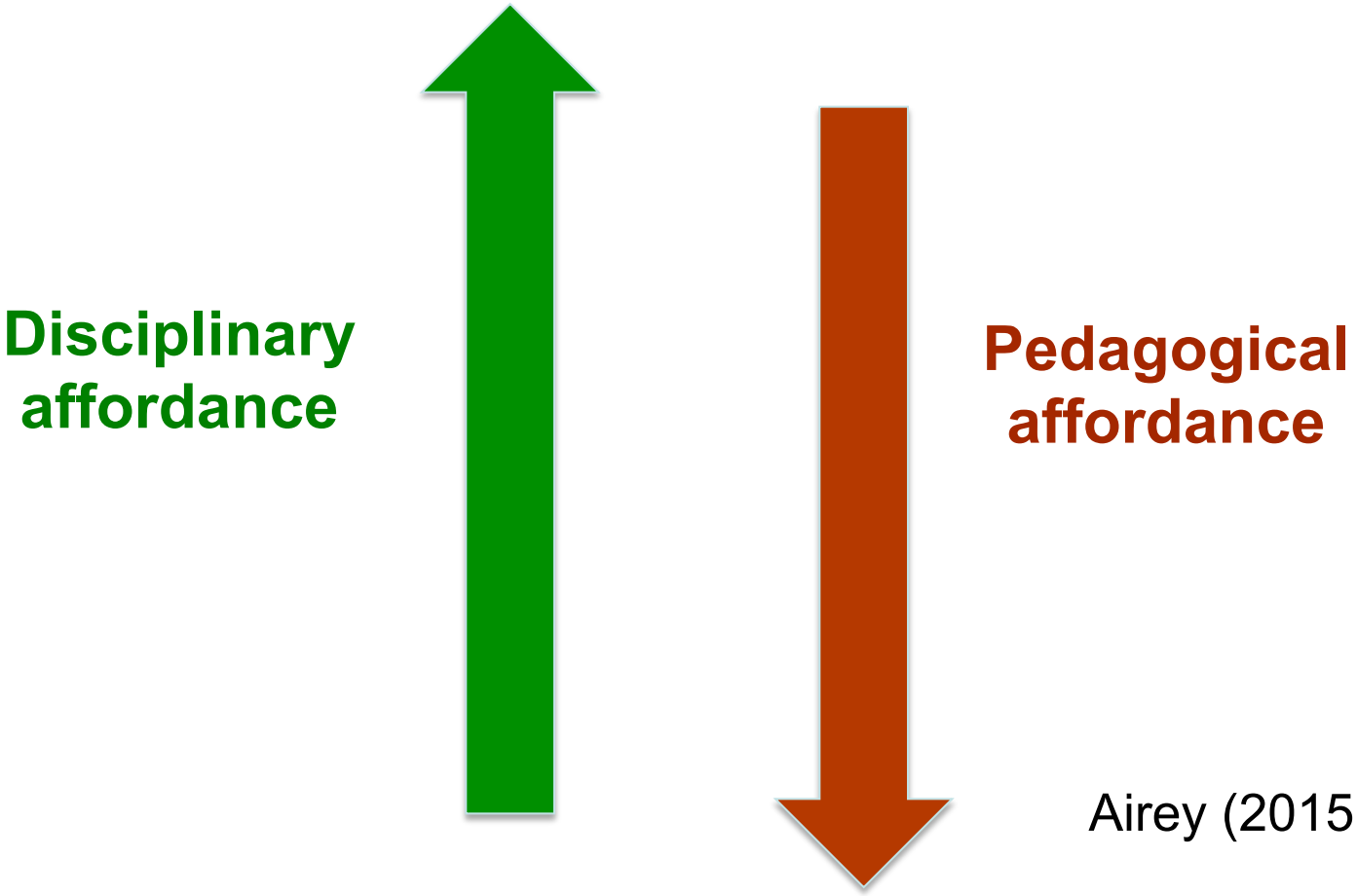
Pedagogical vs disciplinary affordance



Airey (2015)

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Summary

Social semiotics

Critical constellations

Fluency

Discourse imitation

Disciplinary Affordance

Unpacking

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Conclusions for teachers

Disciplinary learning is multimodal

Lecturers should think about the critical constellation of semiotic resources that makes disciplinary knowledge available.

Lecturers should expect discourse imitation.

Students need time to become fluent.

Lecturers need to unpack the disciplinary affordances of semiotic resources.

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Thanks for listening!

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