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What Knowledge Do Trainee Physics Teachers Need to Learn? Differences in the Views of Training Staff

John Airey¹,²  Johanna Larsson¹

¹University Physics Education Research Group
Uppsala University, Sweden

²Department of Languages
Linnaeus University, Sweden
Interested in teacher training.

In particular the process of becoming a physics teacher (cf Larsson & Airey 2014 a,b).

What do training staff think students need to learn?
Disciplinary differences

Very different environments.

Suggest that physics is similar across these environments (Airey, 2012, Linder et al 2014).

For our trainee physics teachers, movement between the environments of the physics department, the education department and teaching practice in schools poses much bigger problems.

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Overview

1. Theory
   • Hierarchical vs horizontal knowledge structures
   • Singulairs vs Regions

2. The Knowledge Structure Matrix

3. Illustrative examples

4. Disciplinary literacy

5. Conclusions

6. Future work
Theory

Draw on the work of Basil Bernstein (1999) in the Sociology of Education and my own work on Disciplinary Literacy (Airey 2013; Airey 2011a,b)

Based on this theoretical approach, becoming a physics teacher can be seen to present particular challenges for trainees.
Basil Bernstein

Bernstein is best known (and criticized) for his Elaborate and Restricted Codes

Later work deals with disciplinary differences.

Similar ideas to Becher and Trowler’s Academic Tribes and Territories (2001) but addresses more than the academy.
Disciplinary differences

Bernstein introduces some useful analytical categories:

Hierarchical and Horizontal knowledge structures

Singulars and Regions
Disciplinary knowledge structures

Bernstein (1999) claims that disciplines can be categorised as hierarchical or horizontal.

Hierarchical knowledge structures

Develop by integration of new knowledge with existing knowledge into one coherent system

Horizontal knowledge structures

Develop by introducing new perspectives that do not need to be coherent with existing perspectives

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Progression in knowledge structures

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Adapted from Martin (2011)
Bernstein identified physics as the discipline with the most hierarchical knowledge structure.

Lord Kelvin 1890s

"There is nothing new in physics to be discovered now. All that remains is more and more precise measurement" (Davies & Brown 1988)
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In horizontal knowledge structures, development involves introducing new perspectives that help us to see new things or to see old things in new ways.

This new perspective does not need to be integrated with earlier knowledge.
Disciplinary knowledge structures

Adapted from Martin (2011) and Wignell (2004)

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Bernstein also introduced the analytical categories *singulars* and *regions* (2000)
Singulars

A singular is a discipline with strong boundaries such as physics, history, economics etc.

Singulars generate strong inner commitments centred around their perceived intrinsic value.

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Regions are knowledge structures in which a number of singulars are brought together in an integrating framework (Young 2008).

While singulars face inwards, regions face outwards to the various fields of practice in everyday life.
I have brought together Bernstein’s ideas in a knowledge structure matrix.
Knowledge structure matrix

Hierarchical  Horizontal

Singular  Region

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Knowledge structure matrix

- Singular
- Region
- Engineering
- History

- Hierarchical
- Horizontal

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Knowledge structure matrix
Disciplinary differences

What might these disciplinary differences mean for the process of becoming a physics teacher?

Mismatch between:
  a horizontal region (Education) 
  and 
  a hierarchical singular (Physics)
Some quotes from interviews with different actors in physics education:

Singular ➔ Region
Education is a region, so we need lots of different types of input from different areas:

You can’t just send anyone to teach a course. They need to know what they are talking about so there are lots of short courses with different teachers

Examples

Lecturer Education Department

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Physics is a singular—it is an end in itself

Interviewer: *Do you have different goals for physics and engineering students?*

Lecturer: *Yes, I suppose, but only slightly different*

Interviewer: *And for the teachers, is it the same?*

Lecturer: *Yes I don’t really distinguish between them. You need to understand physics to be able to teach it.*

*University physics lecturer*

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Examples

Singulars create strong identities…
I’m a physicist not a teacher!

*To me it’s important that I’m not a physics teacher but I’m a teaching physicist. I want to stay curious and learn more about physics and continue to use all the tools of a physicist*

University physics lecturer

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Examples

Hierarchical ➔ Horizontal knowledge structure
Examples

Moving to a horizontal knowledge structure means that different forms of knowledge production are valued:

For me it was a shock to be thrown into an institution where you have to write essay-type exam questions. The students who had read History, Swedish, Social science, they passed these exams without any problems. For me the first time it was like ok, how do I do this?

School physics teacher

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Examples

Is it knowledge if you can’t measure it?

These new values that they’ve included in the curriculum now—they don’t seem so natural to me. There are competencies that I’m supposed to develop that can’t be measured—it’s silly! The whole thing falls like a house of cards because you just can’t measure these things.

School physics teacher

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Bringing it together…

Use the concept of **disciplinary literacy** (Airey 2011a,b)
We suggest the goal of any degree programme is the development of **disciplinary literacy**.  

Airey (2011a,b)

*Disciplinary literacy refers to the ability to appropriately participate in the communicative practices of a discipline.*

Developed for three sites **academy, workplace and society**
Disciplinary Literacy Triangle

Airey (2011b)

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Disciplinary Literacy Triangle

Society

Each of these sites places different demands on disciplinary literacy

Academy

Workplace

Airey (2013)

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Disciplines can be categorized according to their knowledge structure and whether they are singulars or regions.

Teacher training is a region with a horizontal knowledge structure.

Physics is a singular with a hierarchical knowledge structure.
Conclusions

We suggest that an understanding of these disciplinary differences is important for teacher trainers.
Trainees come from singulars with a strong identity that needs to be renegotiated into a teacher identity.

Trainees from disciplines with hierarchical knowledge structures may struggle to see the validity of other types of knowledge.

Trainers should expect these issues and discuss them with trainees.
Future work

How are singulars incorporated into teacher training courses?

Specifically, how do disciplinary literacy goals change when moving from physics to physics teacher training?

What are the consequences of educational researchers treating education as a singular?

How do the demands of society and the workplace affect disciplinary literacy goals?
Disciplinary Literacy

Society

Teacher training

Academy

Workplace (school)

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References


