How Can the History and Philosophy of Science Contribute to Contemporary U.S. Science Teaching

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Organized by the School of Education and the Center for Philosophy and History of Science at Boston University.

History of Science in the Classroom

A Story of Obstacles to Overcome

Lack of an effective implementation strategy for HPS

Culture of teaching physics

Physics' teacher's attitudes and beliefs

Institutional boundaries

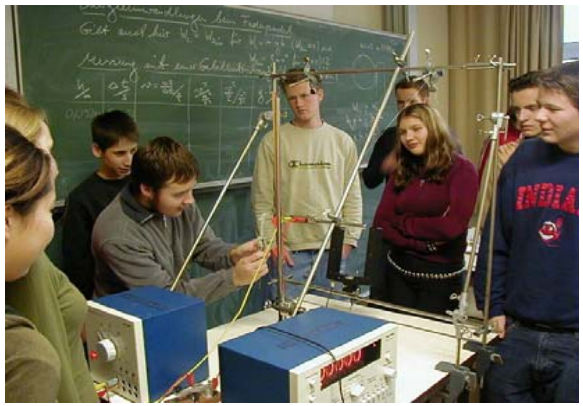
Höttecke, D. & Silva, C.C. (2011). Why Implementing History and Philosophy in School Science Education is a Challenge - *An Analysis of Obstacles. Science & Education, 20(3-4), 293-316.*

Teachers' Perspectives and the Problem of Implementation Curricular Innovations

Differences between norms, rewards and working arrangements between researchers and practitioners at school = two cultures (Huberman, 1993)

A boundary has to be crossed between these two cultures!

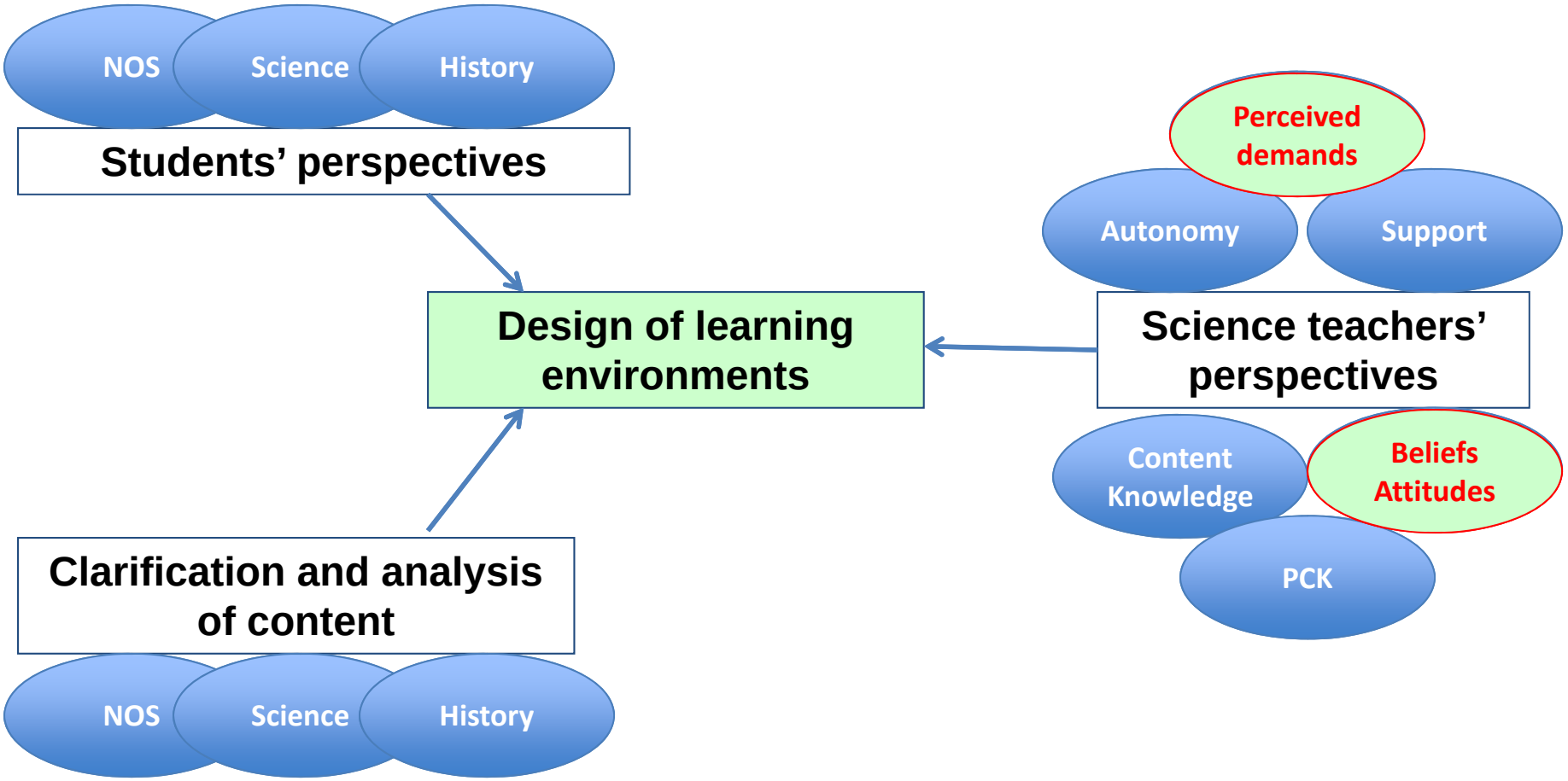
Design of HPS-Centered Learning Environments: the Teacher as a Factor to Be Considered



- **Content knowledge** regarded as predominant objective of teachers
- Communication and interaction are **teacher centred**
- **Beliefs** about teaching and learning are **traditional**

Höttecke & Silva (2011)

Towards a Model for Designing Learning Environments with HPS in Science Education



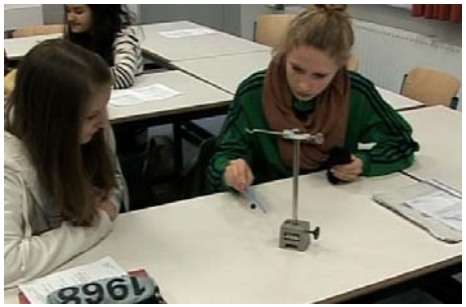
Science Teachers' Perspectives on Uncertain Evidence in the Classroom

Jan Ruhrig

Janne Krüger

Malte Ohlsen

Science Teachers' Perspectives on Uncertain Evidence in the Classroom



practical vignettes (physics, chemistry, biology)

non-practical vignette (climate change)

Ruhrig, Ohlsen & Höttecke (in print)

Science Teachers' Perspectives on Uncertain Evidence in the Classroom

- Results of a study with 2 groups of teachers
- Method: documentary analysis (Bohnsack)
- Reconstruction of general orientations and belief systems of teachers

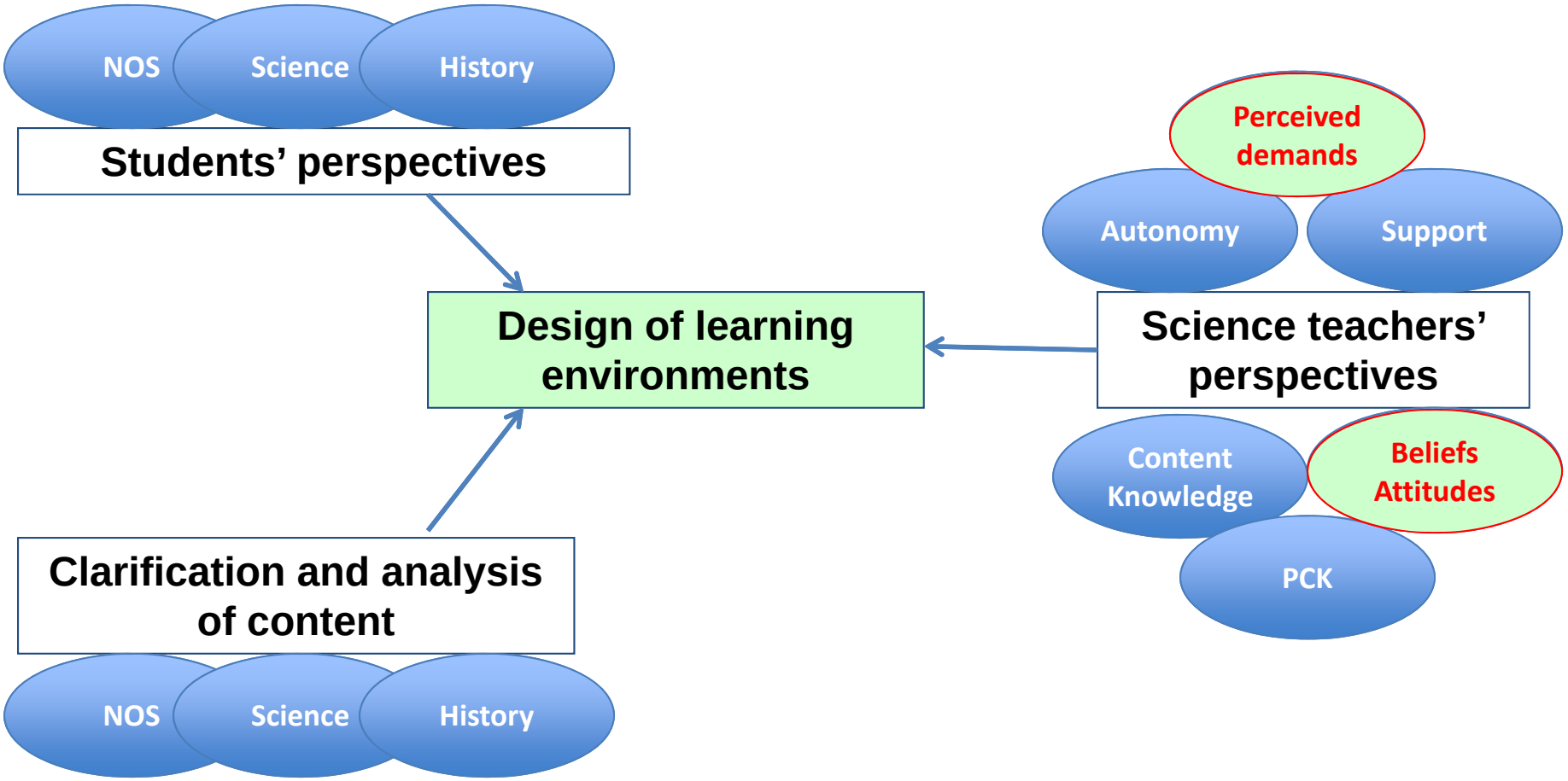
Krüger, Ruhrig & Höttecke (in print)

Science Teachers' Perspectives on Uncertain Evidence in the Classroom

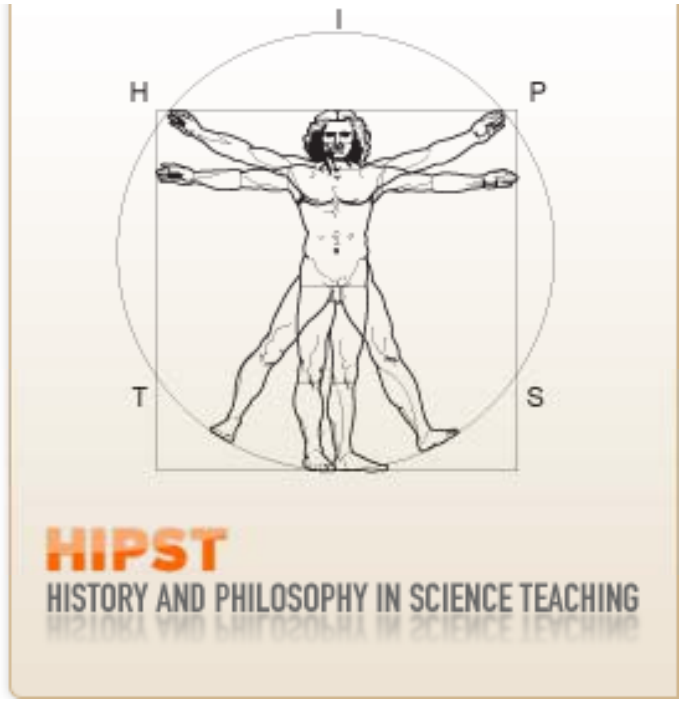
Ambiguity	Ambiguity is generally felt to be avoided by planning a lesson strictly or if necessary by talking about uncertainty during the lesson.
Teacher	Is making plans for teaching and thereby avoids uncertainty. He/she feels responsible for students getting the *right* result.
Science & Science Teaching	Science is tentative, but knowledge in science teaching is not. If evidence has ever been uncertain in science teaching, there were organisational or natural reasons. There is no educational role for uncertainty in science teaching.
Limiting Factors	Teachers' plans and decisions are based on factors like limited time, students' age and motivation of students or teachers' effort.

Krüger, Ruhrig & Höttecke (in print)

Towards a Model for Designing Learning Environments with HPS in Science Education



HIPST 2008 - 2010

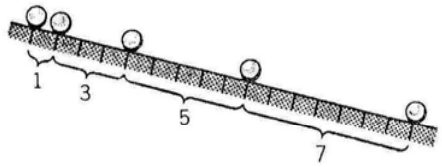


- 10 partners, 8 countries
- 32 case studies
- HIPST-Wiki (www.hipst.eu)
- symbiotic developmental strategy

Case studies of German groups

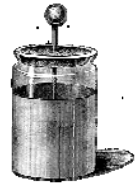
- **History of refrigeration technologies**
  Exploring the interrelation of technology, culture & science (grades 5-6)


- **“Moving bodies”**
  A case study for enhancing conceptual understanding of early mechanics with HPS (grades 7-8)









- **Steam engines**
  History and the degree of efficiency (grades 8-10)


Methods of Learning and Students‘ Activities

- **Staged reading**
  e.g. of scenic dialogues
- **Role play activities / freeze sculptures**
  Reenactment of controversies
- **Inquiry activities**
  With and without historical replicas
- **Creative writing activities**
  Interviews, Letters to the Editor etc. involving reflection on NoS/PoS
- **„Reflection Corner“**
  Reflecting explicitly on NoS

Höttecke, Henke & Rieß (2012)

Physics Teachers‘ Perceived Demands

- Interview-study with 7 HPS-experienced physics teachers about their perceived demands with teaching physics based on HPS particularly with the HIPST materials
- framework Henke & Höttecke (2010)
- findings preliminary

Andreas Henke

Lack of Routine to Teach HPS Causes Pressure of Time and Reduction of Curriculum

If I have made one thing already five times than I will know: Ah, at this certain point I have to do this and that and than it does only take 10 minutes, but for the first time I need 20 minutes for the same. But the time adds up and up and that means, I have to reduce the curriculum to three central aspects und than I can make it in a time. (P1)

Putting Oneself into the Position of a Scientist of the Past

According to my view the teaching I did more or less succeeds with my abilities to pull the students into that time. A part of this is that you have to act a bit like an actor … (P3)

Let us imagine we live in this or that century … and then we switch off the light as long as is light enough, such things, I mean one really has to force oneself to keep on going in this artificial way, to maintain such a setting … as naturally as possible […]*. I mean this is really hard for me to engage myself with such a situation.* (P2)

Problems with New Methods like Role-play

I mean this really depends on the method of role-play, so not basically, but they [the students, DH] *absolutely can extract an opinion and can sum it all up, but keeping their opinion and to answer questions of others with other opinions, well this is really not easy and I think this is rather a problem of the method.* (P2)

Curricular Demands

... and instruction in upper secondary is different and at least for me it is a kind of presenting and passing information, just because the temporal framework is limited, and then you really have to find a way how to cope with that and how you manage to go through and finish all the content ... (P2)

Teaching the NOS explicitly and reflectively is demanding

I mean I have not learned it. […] *Are these, are these the best questions to ask? Yes, I think they are. But, what about these spontaneous comments* [of students, DH], *there is one comment, where shall I put it into? Which category does it fit to? Learning about physics, or learning about science or learning about methods in science at all?* (P1)

Demand of Changing Students' Ideas of Past Science and Scientists

[...] *but anyway this stereotype of a rather feeble-minded scientist, they* [the students, DH] *do not give it up.* (P2)

Established and Well-proven Educational Strategies Conflict with HPS

Here, I don't have the distinction between a current of energy, I can not have it here, or? If I will follow this approach now [HIPST, DH]. *This is a grappling for an understanding of electricity which took decades or centuries at all. And later I have the same grappling with the notion of energy. And then we are here and now and try to explain, and then I can say: Ok, we separate an electric current from a current of energy. Here, we basically try to clarify concepts from a backwards perspective. Well, I don' t know.* (P1)

Summary

- Science teachers avoid **uncertainty and ambiguity** regarding evidence
- **Lack of routine** to teach science with HPS
- Balancing HPS with **curricular demands**
- **Taking roles** of scientists of the past causes feelings of uncertainty
- Explicit reflections demand **teaching skills which are alien for science teachers**
- **Students' ideas** on science & scientists of the past are hard to change
- Established and well-proven **educational strategies** conflict with HPS

Thank you for your attention!

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