Misconceptions or Missing Conceptions?

Presentation (from tomorrow):
www.cvauf.de/material/ESERA09_vAufschnaiter.pdf

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A woman exerts a constant horizontal force on a large box. As a result, the box moves across a horizontal floor at a constant speed "v_0".

The constant horizontal force applied by the woman:

(A) has the same magnitude as the weight of the box.
(B) is greater than the weight of the box.
(C) has the same magnitude as the total force which resists the motion of the box.
(D) is greater than the total force which resists the motion of the box.
(E) is greater than either the weight of the box or the total force which resists its motion.

Revised version of the **Force Concept Inventory** by I. Halloun, R. Hake, & E. Mosca (August, 1995). [see also: http://modeling.asu.edu/R&E/Research.html]

How a group of students discusses this task

S2: […] Well, I would say greater, isn't it?

S1: Greater? […]

S2: But, no, wait. Hold it. Same magnitude, because the box is moving already. We don't have to accelerate it. It says "the box moves at a constant speed", that is, it moves. (indicates movement on the table) And we are right in the middle of the movement. Therefore, they have to have the same magnitude.

S1: Well, you mean, it's the same as the example with the lorry, only different?

S2: I don't know, I don't think so. But, if they had the same magnitude, then they would stand still, wouldn't they? (indicates stopping with his hands)

S1: Oh gosh, what a mess!

[duration: 35 seconds]

Have you identified some (mis-)conceptions?

A woman exerts a constant horizontal force on a large box. As a result, the box moves across a horizontal floor at a **constant speed** "v_0".

The constant horizontal force applied by the woman:

(A) has the same magnitude as the weight of the box.
(B) is greater than the weight of the box.
(C ✓) has the same magnitude as the total force which resists the motion of the box.
(D) is greater than the total force which resists the motion of the box.
misconception: *constant speed requires (constant) force; no force leads to objects coming to rest*
(E) is greater than either the weight of the box or the total force which resists its motion.

How a group of students discusses this task

S2: […] **Well, I would say greater**, isn't it? **D**

S1: Greater? […]

S2: But, no, wait. Hold it. **Same magnitude, because the box is moving already. We don't have to accelerate it.** It says "the box moves at a constant speed", that is, it moves. (indicates movement on the table) **And we are right in the middle of the movement. Therefore, they have to have the same magnitude.** **C**

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S1: Oh gosh, what a mess!

[duration: 35 seconds]

Blue: Indicates (mis-)conceptions

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S1: Greater? […]

S2: But, no, wait. Hold it. **Same magnitude, because the box is moving already. We don't have to accelerate it.** It says "the box moves at a constant speed", that is, it moves. (indicates movement on the table) **And we are right in the middle of the movement. Therefore, they have to have the same magnitude.**

S1: Well, you mean, it's the same as the example with the lorry, only different?

Students' ideas can change quite quickly – even within the same context!

S2: I don't know, I don't think so. **But, if they had the same magnitude, then they would stand still, wouldn't they?** (indicates stopping with his hands)

S1: Oh gosh, what a mess!

[duration: **35 seconds**]

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S1: Well, you mean, **it's the same as the example with the lorry, only different**?

How do students conceptualize a problem?

S2: **I don't know, I don't think so**. But, if they had the same magnitude, then they would stand still, wouldn't they? (indicates stopping with his hands)

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[duration: 35 seconds]

How a group of students discusses this task

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[duration: 35 seconds]

Does ticking an answer demonstrate a student's conceptual understanding?

How a group of students discusses this task

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S1: Greater? […]

S2: But, no, wait. Hold it. **Same magnitude, because the box is moving already. We don't have to accelerate it.** It says "the box moves at a constant speed", that is, it moves. (indicates movement on the table) **And we are right in the middle of the movement. Therefore, they have to have the same magnitude.**

S[1: …]

How have students grasped the idea of Newton's first law? How/why have they developed a common misconception?

S2: I don't know, I don't think so. **But, if they had the same magnitude, then they would stand still, wouldn't they?** (indicates stopping with his hands)

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[duration: 35 seconds]

Research aims

Describe how students develop **conceptual understanding** (correct or incorrect) and how they use their understanding while working on (similar) physics problems
→ Focus on learning processes, not just learning outcomes

Design **instruction** that takes empirical research results on students' concept formation processes into account
→ Focus on how instruction is used by students

Revise content und structure of **teacher education** accordingly and describe teachers' learning
→ Focus on (prospective) teachers as learners

Outline

(**1**) Investigating processes of concept formation and concept use

(**2**) Missing conceptions and (mis-)conceptions – empirical results and theoretical considerations

(**3**) Addressing missing and (mis-)conceptions

(**4**) Teacher education

Outline

Preface: From products to processes

***Possessing* conceptual knowledge**
- Students' (mis-)conceptions prior and post to instruction or at different ages
- → Informs about typical (mis-)conceptions and global effects of instruction

***Generating* conceptual knowledge**
- Students' development and usage of (mis-)conceptions during instruction
- → Can inform why (and how) specific instruction is more effective than other approaches

Outline

Preface: From products to processes

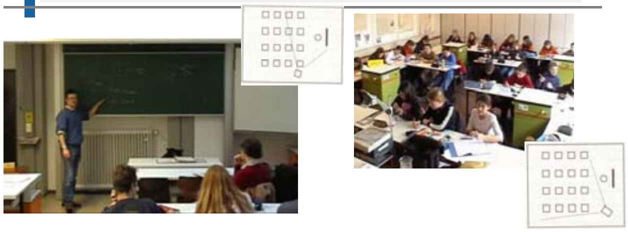
(1) **Investigating processes of concept formation and concept use**

(2) Missing conceptions and (mis-)conceptions – empirical results and theoretical considerations

(3) Addressing missing and (mis-)conceptions

(4) Teacher education

Video as a means to focus on teacher activities



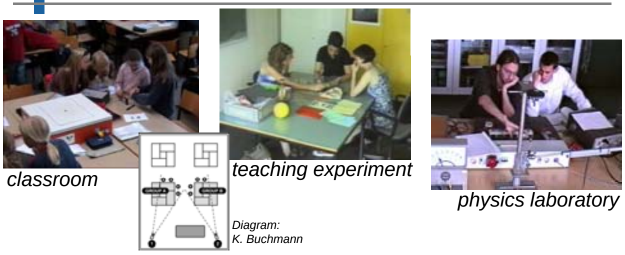
Describing *teaching processes* is the main purpose:
What constitutes instruction of high quality?

? Do *the students* understand the instruction and act accordingly?

? How do the students develop and use their knowledge?

Diagrams: Seidel, Prenzel & Kobarg (2005, pp. 32f.)

Video as a means to focus on learner activities



Describing how *students understand and work on instruction* is the main purpose

→ Focus on small groups but during classroom activities all student and teacher statements can be identified clearly

Side note I: The challenge of a learner focus

The quality of instruction can be described and judged from an observer's point of view:

correct/incorrect, coherent/incoherent, authoritative/dialogic, demanding/simple, …

→ **1st order perspective**

How a learner interprets and understands a particular instruction requires to see "the world through the learner's eyes":

Does a learner realize incorrect ideas? Is a learner happy with an authoritative teacher? Is XYZ simple for a learner? Is a repetition repetitive for a learner?

→ **2nd order perspective**

(see also Marton & Booth, 1997; Marton & Pang, 2008)

Participants and topics

- **Lower and upper secondary students** (age ≈ 11-18)
  (e.g., v. Aufschnaiter, 2006a/b; v. Aufschnaiter & v. Aufschnaiter, 2003)
- University students (physics bachelor) (year 2, age ≈ 21)
  (e.g., v. Aufschnaiter, 2003; v. Aufschnaiter & v. Aufschnaiter, 2007)
- topics: mainly electrodynamics, thermodynamics, optics
- **teaching experiments** and classroom settings
- partly: additional student questionnaires and concept mapping

→ almost always small groups of 2-4 students, usually several successive lessons/sessions

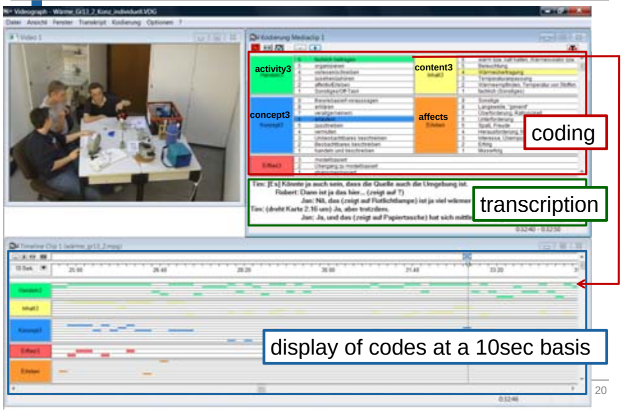
→ in total more than 150 participants investigated

A multilevel approach for investigating video data

1. **Coding of video data** (10sec intervals) to assess general dynamics (e.g., organizational vs. content-specific activities, type of discourse, affective statements)

→ Generates results which can be quantified

Videograph (Rimmele, 2008) (analysis & screenshot by C. Rogge)



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   Identification of sequences relevant for transcription

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Analyses based on criteria or generate criteria
→ Comparison between different cases possible

Codes used in 1. and 2. depend on the research questions addressed.

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2. **In-depth analyses of transcripts** to assess details of individual sense making *processes* (e.g., how a student understands tasks or contributions from other students)

3. Connection between process data and questionnaires/ concept maps

→ Approach is explorative but also tests hypotheses (iterative process)

Outline

Preface: From products to processes

(1) Investigating processes of concept formation and concept use

Aim: Investigate individual learning and how it is promoted (or hindered) by the social and material learning environment
→ Use learner-centered videos and a 2nd order perspective
→ Use criteria in order to compare different cases
(➦ generate hypotheses about mechanisms of learning and teaching)

Outline

Preface: From products to processes

(1) Investigating processes of concept formation and concept use

(2) Missing conceptions and (mis-)conceptions – empirical results and theoretical considerations

(3) Addressing missing and (mis-)conceptions

(4) Teacher education

Missing conceptions? An example (shortened) (C. Rogge)

"Imagine a cold object is brought into a warm environment. What happens to the temperature of the object?"

S3: *For instance, during summer a friend had a snowball which he took out of the freezer.*

S1: *If you take it from the cold to the warm environment it either melts or…*

S2: *Did it melt? How quickly?*

S3: *That was during summer. It melted within 20 seconds, maybe even quicker.*

S2: *Ok, if I take this metal cube in a real warm environment. Right now, this cube has about 22.5 degrees Celsius. It would then have about 25, I reckon.*

S3: *Not more than two degrees warmer, the most.*

[≈1:30 minutes]

Descriptions and concepts

Does this lamp still shine so brightly if you add a second one?

Look, it feels cold but it has 22°C.

Last time in the cinema, I could see how the light traveled to the screen.

Descriptions of cases, observed events, or remembered phenomena: **Concrete events**

If you add a lamp in a series circuit, all lamps will shine less brightly.

Even if two objects feel differently warm, they can have the same temperature.

Light always travels in strait lines.

Generalizations over classes of phenomena and events; generalizing explanations: **Rules**

Missing conceptions? An example (shortened) (C. Rogge)

"Imagine a cold object is brought into a warm environment. What happens to the temperature of the object?"

asks for rule

S3: *For instance, during summer a friend had a snowball which he took out of the freezer.*

S1: *If you take it from the cold to the warm environment it either melts or…*

S2: *Did it melt? How quickly?*

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S2: *Ok, if I take this metal cube in a real warm environment. Right now, this cube has about 22.5 degrees Celsius. It would then have about 25, I reckon.*

S3: *Not more than two degrees warmer, the most.*

descriptions of concrete events

[≈1:30 minutes]

Conceptual knowledge

Conceptual knowledge is often referred to as:

"implicit or **explicit understanding of the principles that govern a domain**" (Rittle-Johnson et al., 2001, p. 341)

(for a critical discussion of what counts as a concept: diSessa & Sherin, 1998, pp. 1155-1170)

Result

No matter of age, our students explicitly express conceptual knowledge in less than 20% of time spend with instruction.

→ Dealing with concrete events makes up the majority of students' (verbal) activities.

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Intuition between single instances and conceptions

S2: […] Same magnitude, because the box is moving already. We don't have to accelerate it. It says "the box moves at a constant speed", that is, it moves. (indicates movement on the table) And we are right in the middle of the movement. Therefore, they have to have the same magnitude.

S2 refers to a particular example ("it" = the box) but **S2 seems to "have" conceptual understanding even though not explicitly saying it**, for instance:

If an object is moved (moves) at constant speed (and velocity) all forces acting on the object compensate to zero.

→ **"Intuitive rules"** (about concrete events)

More examples

I reckon, you'll measure again something like 22°C.
This is the same electric circuit than we had yesterday.
The shadow is there, because the light cannot pass this box.
Last week, our teacher told us to say "energy" when talking about this situation.

Intuitive rules:
Students predict [not guess!] specific events/phenomena, relate specific events to each other, describe and explain specific events with physics words in a purposeful manner

Result (C. Rogge's thesis → session today, 1:30 pm)
Noticeable more intuitive rule-based (verbal) activities with older students but only slightly more explicit conceptions.

From conceptual qualities to learning processes

concrete events

Descriptions: Look, it feels cold but it has 22°C.
Just do (say) it.
→ **Explorative** trial-and-error, descriptive, manipulative (events and language)

Intuitions: I recon, you'll measure again something like 22°C.
Know how it works/what has to be said (but don't know why)
→ **Intuitive rule-based** predictive, purposeful, explanatory without conceptual ground

rules

Rules: Even if two objects feel differently warm, they can have the same temperature.
"For all…", "Always if… then…"
→ **Explicit rule-based** generalizing, explanatory with conceptual ground, hypothetical

From conceptual qualities to learning processes

New aspects of a topic and ways to verbalize things are intensively explored by students (even if instruction offers or asks for a rule…)
→ **Explorative** trial-and-error, descriptive, manipulative (events and language)

Increasingly, students develop an intuitive rule-based understanding which is reassured during further explorations;
more content elements, time increases
→ **Intuitive rule-based** predictive, purposeful, explanatory without conceptual ground

Generalizations are expressed which also have to be (re-)discovered via explorations for several times.
more events accumulated within one concept, from static to dynamic concepts
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* see also Marton & Booth, 1997; Marton & Pang, 2006

From conceptual qualities to learning processes

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Instruction that seems to promote such development:
⇦structures explorations
⇦offers variance-invariance relations*
⇦prompts explicit concepts and offers these when students have established them at least intuitively

* see also Marton & Booth, 1997; Marton & Pang, 2006

From conceptual qualities to learning processes

Results
- All of our students follow this conceptual development but
- in a particular aspect more experienced learners may start at an intuitive rule-based level immediately.
- Experienced learners are quicker in re-constructing conceptual knowledge (need less hints).
- Conceptual knowledge is almost always generated after dealing with the phenomenon.

Explorative
trial-and-error, descriptive

Offering concepts at an early stage is not very fruitful
- information is ignored
- students are confused
- a concrete interpretation is established

Explicit rule-based generalizing, explanatory with conceptual ground, hypothetical

From conceptual qualities to learning processes

"missing conceptions" — concrete events

Descriptions: Look, it feels cold but it has 22°C.
Just do (say) it.
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"(mis-)conceptions" — rules

Rules: Even if two objects feel differently warm, they can have the same temperature.
"For all…", "Always if… then…"
→ **Explicit rule-based** generalizing, explanatory with conceptual ground, hypothetical

Side note II: Are missing conceptions really missing?

A) Concepts are not present to the learner right from the beginning but develop from systematic, repeated and variant explorations
→ "missing" = a learner cannot create/understand *a particular concept* (yet)

B) The particular concepts has been established previously but is not explicitly expressed
→ "missing" = a learner might be able to construct specific conceptual knowledge but does not do so

→ Assuming that all student activity is based on concepts (mental entities) is not very helpful as it weakens the differences in the quality of these activities

From conceptual qualities to learning processes

"missing conceptions"

New aspects of a topic and ways to verbalize things are intensively explored by students (even if instruction offers or asks for a rule…)

Explorative
trial-and-error, descriptive, manipulative (events and language)

Increasingly, students develop an intuitive rule-based understanding which is reassured during further explorations; more content elements, time increases

Intuitive rule-based
predictive, purposeful, explanatory without conceptual ground

"(mis-)conceptions"

Generalizations are developed from variance-invariance relations* and have to be (re-)discovered via explorations for several times.
Conceptual explanations with similar content are understood conceptually.

Explicit rule-based
predictive, purposeful, explanatory without conceptual ground
conceptual understanding

Two types of conceptual knowledge

Whenever my teacher says "Ohm's Law" he wants to hear V=R×I.

If you add a lamp in a series circuit, all lamps will shine less brightly.

Even if two objects feel differently warm, they can have the same temperature.

Internal energy is the total amount of energy in an object.

In order to see an object light has to be scattered from the object into our eyes.

Sound is transferred by pressure variation.

What is the difference between these two groups?

Two types of conceptual knowledge

Whenever my teacher says "Ohm's Law" he wants to hear V=R×I.

If you add a lamp in a series circuit, all lamps will shine less brightly.

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Concepts can be inferred from experiences: "*phenomenon-based concepts*"

Internal energy is the total amount of energy in an object.

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Sound is transferred by pressure variation.

Concepts cannot be inferred from experiences directly: "*model-based concepts*"

Two types of conceptual knowledge

"Results"
- Phenomenon-based concepts seem to occur (slightly) more often and seem to be less demanding, but (!)
- because explicit concepts are rare we have not yet well established coding schema to distinguish these to types

→ 2nd order perspective important to reveal how a student conceptualizes an aspect (some "models" are constructed on a phenomenon-basis)

Concepts can be inferred from experiences: "*phenomenon-based concepts*"

Concepts cannot be inferred from experiences directly: "*model-based concepts*"

And how about misconceptions?

Physics concepts conflict with conceptions developed from everyday experiences:
- Seeing as an active process of looking at objects
- Metals feel colder than other materials
- Moving objects at constant speed requires force

„Misconceptions": misleading and missing experiences

→ Which experiences can help to establish appropriate concepts?

And how about misconceptions?

Physics concepts conflict with conceptions developed from everyday experiences:

- Seeing as an active process of looking at objects
- Metals feel colder than other materials
- Moving objects at constant speed requires force

„Misconceptions“: misleading and missing experiences

→ Which experiences can help to establish appropriate concepts?

Model-based concepts are generally difficult

- Scattering of light on rough surfaces
- Energy, force, voltage, …
- Properties of atoms

„Misconceptions“: non existing conceptions and/or misleading transfer of daily experiences

→ Which phenomenon-based concepts [analogies?!] help to establish model-based concepts (in the long run)?

Outline

Main idea: Describe conceptual qualities (not just "correct"/ "incorrect") and how these develop during learning.

→ Distinctions made can be applied to different topics and (maybe) to different subjects

(2) Missing conceptions and (mis-)conceptions – empirical results and theoretical considerations

- Regard concepts as a result and not as an initiator of (learning) activities.
- Experiences promote (and hinder) intended learning processes.
- → Establishing "robust" intuitive rule-based knowledge and phenomenon-based concepts is a great success.

Outline

Preface: From products to processes

(1) Investigating processes of concept formation and concept use

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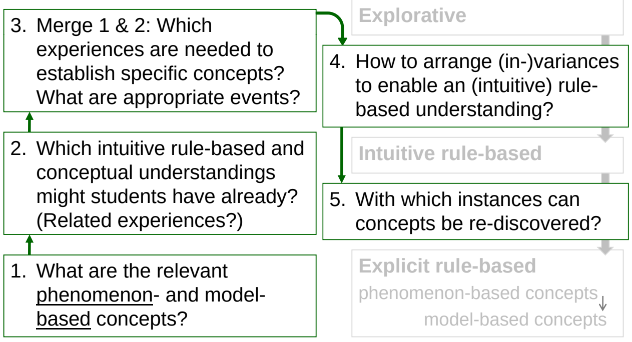
(4) Teacher education

Developing instruction



"Example" for step 4 (arranging (in-)variances)

Whenever my teacher says "Ohm's Law" he wants to hear V=R×I.

Internal energy is the total amount of energy in an object.

If you add a lamp in a series circuit, all lamps will shine less brightly.

In order to see an object light has to be scattered from the object into our eyes.

Even if two objects feel differently warm, they can have the same temperature.

Sound is transferred by pressure variation.

→ Arranged in a way that the audience (hopefully) discovers a rule for the distinction

→ Better: Same topic left and right in each row and additional exercise (e.g., sorting concepts, analysis of textbooks, …)

The electric bell (from Mortimer & Scott, 2003, p. 35)

T: Do you remember the electric bell?
C: Yes! [in chorus]
T: OK! Did any of you notice, did any of you actually hold on to the bell after it had…been working? What did you notice?
S: Vibration.
T: Well, the arm vibrated, yes. Sound. What else did you notice?
S: It was loud.
T: That's not quite what I'm getting at. Remember the bell. There's the bell [holding up a bell in front of the class]. You did the experiment. If you held on to this bit here where the wires were [indicating], did you notice anything there?
S: There were sparks there.
T: Did you notice some heat?
S: There were sparks from there.
T: There were?
S: Sparks.
T: There were some sparks, yes. Let's just ignore the sparks a minute…some heat. There was a little bit of heat there with that one.

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C: Yes! [in chorus]

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S: Vibration.

T: Well, the arm vibrated, yes. Sound. What else did you notice?

S: It was loud.

T: That's not quite what I'm getting at. Remember the bell. There's the bell [holding up a bell in front of the class]. You did the experiment. If you held on to this bit here where the wires were [indicating], did you notice anything

S:
T:
S:
T:
S:

> *One* example "demonstrating" that electricity causes heat.
> No systematic exploration for students to discover the effect: "*Leave the circuit open. Touch the wires, are they hot or cold? Close the circuit and touch the wires again. What do you notice? Can you find similar effects for the lamp, the …?*"

T: There were some sparks, yes. Let's just ignore the sparks a minute…some heat. There was a little bit of heat there with that one.

Different approaches to instruction…

…all with the same problem?!

a) typically a **small number of "good" (convincing) examples** is used to establish ("inductive approach") or demonstrate ("deductive approach") a scientific concept

b) usually, **model-based concepts** are in the focus

→ Not enough related examples, not enough opportunities to (re-)discover conceptual knowledge
➦ learning to talk about specific events ("intuitive rule-based") rather than establishing conceptual knowledge?!

→ Model-based concepts before/without phenomenon-based concepts: "*Why is the sea salty?*" before "*Which sea is salty? What makes these seas different from others?...*" (SAC, 2008)

Outline

- Analyze content in terms of phenomenon-based concepts (not just "the" main model-based concepts)
- Focus on students' experiences which might have caused misconceptions (or are lacking for appropriate conceptualizations) rather than solely justifying that these conceptions are "wrong".

(3) Addressing missing and (mis-)conceptions

- Create (sets of) systematically arranged experiences from which students can develop (phenomenon-based) concepts (rather than "demonstrating" correct concepts).

→ Learning concepts "quickly" requires well structured material!

Outline

Preface: From products to processes

(1) Investigating processes of concept formation and concept use

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(4) Teacher education – just two slides…

Assumption

For (prospective) teachers science education issues are as new as, for instance, physics for pupils

and

Like pupils, (prospective) teachers hold misconceptions about teaching and learning which they have developed from their school experiences (as pupils)

→ Prospective teachers' learning processes about educational issues should be similar to pupils' learning processes in physics:

Conclusion

(Prospective) teachers

- have to explore educational examples systematically in order to establish concepts about learning and teaching at least intuitively
- need to explicitly express these concepts and have to have the opportunity to re-discover them with similar cases before
  they are able to use these concepts to plan instruction and
- (much later) be able to "activate" these concepts while teaching

➔ Develop theory from practice rather than expecting educated theory to be transferred into practice (directly)

Outline

Preface: From products to processes

(1) Investigating processes of concept formation and

➢ The fact that most teachers do not connect theory with practice might be a result of them being taught theories that were not established from structured examples. Thus, theory was learned as a phenomenon-based concept only: "*Whenever I am asked about constructivism I have to answer…*"

(4) Teacher education

More research on that issue? Some suggestions…

- Is there any instruction resulting in (much) more explicit conceptualizations than reported in this keynote?
- Can distinctions be applied successfully to other science subjects? Similarity/differences in the results?
- Conceptual quality of students' argumentations? (→ Symposium on Thursday)
- Development of conceptual understanding about NOS, scientific inquiry, …?
- Different approaches towards teaching (dialogic/ authoritative, constructivistic, inquiry-based, …) and their impact on students' situated conceptual understanding?
- Teacher learning – similar processes?
- …

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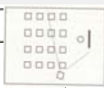
Appendix

Video as a means to focus on teacher activities



"…it captures the teacher-student-interactions completely and further interactions that characterize the teaching process as comprehensively as possible."

"…to film as much as possible of what is happening in the classroom. Further, it should compensate any possible loss of information from the […teacher] camera."

Describing *teaching processes* is the main purpose:
What constitutes instruction of high quality?

? Do *the students* understand the instruction and act accordingly?

? How do the students develop and use their knowledge?

Quotes: Seidel, Prenzel & Kobarg (2005, pp. 31f.)

Side note A: What does "process" mean?

On which time scale does something change?

→ clothes are changed at a daily basis, moods can change within minutes – and cognitions?

- Example at the beginning: within 35 seconds
- A neuro-cognitive perspective:

  "Immediate behavior: […] […] always new; always a sensorimotor circuit" (Clancey, 1993, p. 111)

  3 seconds for a mental image, a maximum of 30 seconds for a line of thought (e.g., S. v. Aufschnaiter & C. v. Aufschnaiter, 2003)

→ "In-depth" analyses not only refer to close investigations but also to rather short time scales (statement by statement, activity by activity)

Side note B: Case stories or case studies?

Case stories: (Few) individuals are described in great detail (what they do, how they do etc.)

? How can individual processes be compared?

2. In depth analyses of transcripts to assess details of individual sense making *processes* (e.g., how a student understands tasks or contributions from other students)

Case studies: Apply categories to cases so that a comparison between different cases becomes possible

→ Coding manuals and calculation of intercoderreliability

→ Results can be generalized to describe commonalities and differences between learners (→ hypotheses)

Descriptions and Concepts – another example

T: *Ok. Say bromothymol blue. Now you've got to give me some reasons why you choose that. Bromothymol blue. Why did you like that?*

P: *Because it's like, I like when you put two drops of it, it like changes to a different colour.*

T: *Different colour change. And what I heard you say? I heard you say different colours. You mean different whether it was an acid or whether it was a base.*

A student reporting a particular observation which is then interpreted by the **teacher as "referring to a generality or rule** about colour change and acidity-alkalinity"

(Erduran, 2003, p. 82).

Intuitive rule-based activity - another example

J: *I have an idea, why don't we try it with this one [whirlybird]?*

Int: *What small and big?*

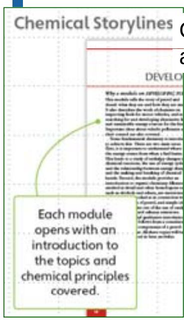
J: *Yeah, small and big (he predicts the big one will be slower, and tries)*

Int: *Oh yes, you were right. Can you come and tell me how this works? How does one of these work?*

J: *Um, because it's got longer fins and then it's got longer air and it can catch lots of air, and this one's only got little fins and it can't catch much air, and this can catch lots and lots and lots and lots of air.*

Level 3: "Children carry out focused observations or interventions which involve trying out an idea, or following up a prediction with some conceptual basis. Explorations have a recognisable hypothesis driving them." (Tytler & Petersson, 2003, p. 16/p. 28)

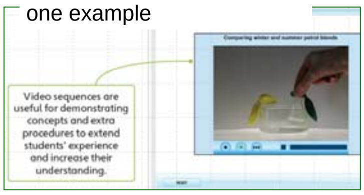
Instruction



Concepts presented in advance of examples?!

(SAC, 2008, slide 23)

Concepts demonstrated with one example



(SAC, 2008, slide 27)

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