On Biology and Education
My Curriculum as a Teacher and Researcher
Outline

Current Project: Dictionary of Everyday Conceptions in Biology Education

Linking Theory and Practice: Educational Reconstruction

Expectations of a Dissertation: Think first

Staying with a Problem: Love your Issue
Current Project

Ulrich Kattmann: On Biology and Education. My Curriculum as a Teacher and Researcher.
Keynote at the International Workshop of LÜP, Kunzehof, Seefeld, 2 June 2015
"I've encountered a lot of student conceptions and their importance for successful instruction. I personally doubted strongly that they can really play such a big role. I thought by myself: If the instruction goes on in a well structured manner and if I explain the topic in a simple way, then my students should grasp it. I was convinced it would work."

_Frau Schwarz, biology teacher_

_(Jelemenska 2010)_
Current Project

Everyday Conceptions

Structure of the Keywords

1 From Word to Concept
   Short draft of the use of the word in colloquial language and of the scientific concept

2 Everyday Conceptions
   Report of the main findings derived from empirical research and teaching experience

3 Assistance for Teaching
   Consequences and clues for fruitful learning with everyday conceptions

Current Project

Everyday Conceptions

Roles in Disciplinary Learning

1 Bridge
2 Link
3 Contrast
4 Change of Perspectives

Conceptual Reconstruction
Linking Theory and Practice

Empirical Research in Disciplinary Education (Fachdidaktik)

1 Analytical Task  2 Empirical Part  3 Constructive End

Linking Theory and Practice

Empirical Research in Disciplinary Education (Fachdidaktik)

1 Analytical Task

2 Empirical Part

3 Constructive End

Linking Theory and Practice

Model of Educational Reconstruction

- Design of learning environments
- Scientific clarification
- Investigation into students' conceptions

(Kattmann, Duit, Gropengießer & Komorek 1997)

Linking Theory and Practice

Animal Classification

Task 1
Criteria of grouping

In this task you will find a number of names of animals you know. You will note that some of the animals belong together.

Underline all names of animals which belong together with one colour.

Afterwards give an appropriate name to each group you formed. You can also invent appropriate names if you like.

[naming the groups:]
Finde Namen für die Gruppen:

Rot: Wassertiere [aquatic animals]

Grün: fliegende Tiere [flying animals]

Blau: kriechende Tiere [creeping animals]

Gelb: Haus-tiere [domestic animals]

Schwarz: Nagetiere [rodents]

Braun kluge Tiere [clever animals]

Wenn Du ein Tier nicht in eine Gruppe einordnen willst, schreibe diesen Namen in die Zeile "Einzelgänger"!

[singles:]
"Einzelgänger": Löwe, Spinne [lion, spider]
2. In the following tasks the names of five animals are given. Only four of them belong together.

f) Which of the animals does not belong to this group? Tick its name:
   - [ ] seal
   - [ ] cat
   - [ ] fox
   - [x] hen
   - [ ] hare

Please give the reason why this animal does not fit into the group:

3. In the following tasks you will find groups of animals which belong together.

d) blue whale
   - [ ] seal
   - [ ] dolphin
   - [ ] otter

Which of the following animals fits into this group? Mark its name:
   - [ ] frog
   - [x] horse

Please give the reason why, according to your opinion, the animal chosen fits into this group:
Linking Theory and Practice

Animal Classification
Tasks 1 – 3
Taxonomic and non taxonomic choices

Bar chart showing the distribution of taxonomic and non-taxonomic choices among Grade 4, Grade 5, and Grade 7/8 students.
From Water to Land – and back again

Evolution as Guiding Principle

1. Habitats help to classify

2. Traces of history

3. Traits are auxiliary criteria

4. Radiation into several biotopes

(Baumann, Schoppe, Harwardt & Kattmann 1996)
Linking Theory and Practice

- Key to re-learning: **Evolution of Vertebrates**  
  **From water to land and back**

Design of learning environments

- **Phylogeny**
- **Common descent**
- **Scientific clarification**
- **Investigation into students’ conceptions**
- **Habitat**
- **Locomotion**

Vom Wasser aufs Land – und zurück

Sachinformation

Didaktische Überlegungen

Der Unterrichtseinheit liegen – entsprechend der schrittweisen Ausbreitung der Wirbeltiere – folgende Gedanken zugrunde:
(1) Lebensräume helfen ordnen
RESEARCH REPORT

Traits, genes, particles and information: re-visiting students’ understandings of genetics

Jenny Lewis, Centre for Studies in Science and Mathematics Education, School of Education, University of Leeds, Leeds LS2 9JT, UK; e-mail: j.m.lewis@education.leeds.ac.uk; and Ulrich Kattmann, University of Oldenburg, Germany

Findings from a study of 10 German students aged 15–19, using problem-centred interviews, suggest that many students hold an ‘everyday’ conception of genes as small, trait-bearing, particles. Analysis of this notion identified a number of ways in which such a view might restrict the ability of students to develop an understanding of the scientific explanation. For example, if genes are equated with trait there is no clear distinction between genotype and phenotype, and hence little need to consider a mechanism by which a gene could be expressed in the phenotype. This everyday perspective provided a plausible explanation of the difficulties and misconceptions found, after formal teaching of genetics, in a survey of 462 English students aged 14–16 based on written questions and interviews. Drawing on this analysis, an approach to teaching genetics and inheritance that takes account of students’ everyday views is suggested.
Linking Theory and Practice

Genetics and Evolution

Traits, genes, particles and information: re-visiting students’ understandings of genetics

Jenny Lentini, Centre for Studies in Science and Mathematics Education, School of Education, University of Leeds, Leeds LS2 9JT, UK, e-mail: j.m.lentini@education.leeds.ac.uk; and Ulrich Kattmann, University of Oldenburg, Germany

Findings from a study of 10 German students aged 15–16, using students build an ‘everyday’ conception of genes as small, is identified a number of ways in which such a view might understanding of the scientific explanation. For example, if a distinction between genotype and phenotype, and hence little would be assessed in the phenotype. This everyday property of the students might be a concept that is not yet fully understood.

Birkenspanner:
Genetik im Kontext von Evolution

Sachinformation

Der Individuendynamismus des Birkenspanners (Distel betulina) ist ein Standardbeispiel für eine Populationsumwandlung durch Selektion (vgl. Kettlewell 1961, Kurtze 1995). In den Populationen des Spanners treten drei Phänotypen auf: die hellen Form der Erstbeschreibung (f. typica), eine dunkle Form (f. carbonaria) und eine Reihe farblich dazwischen liegender Fächer (f. insularia). Die Form carbonaria be ruht auf einem einzigen Allel und ist gegenüber den anderen Farbvarianten Folge der Luftverschmutzung starben Fliechen auf den Zweigen ab. Die dunkle Form – jetzt besser getarnt als die helle – nahm in den Populationen bis zu einem Anteil von über 90 % zu. Parallel zum Rückgang der Luftverschmutzung sank der Anteil der dunklen Form seit 1960 bis heute auf weniger als 10 %.

Die Erscheinung des Industrieraldynamismus des Birkenspanners ist also nahezu Vergangenheit. Aktuell ist jedoch die Diskussion über die Ursachen des Populationswandelns. Kettlewells Untersuchungen belegen die Tarnung vor Fressfeinden als

Bemerkungen zum Unterricht

Der Unterrichtsvorschlag greift ein bekanntes Beispiel auf. Abweichend vom üblichen Vorgehen, bei dem lediglich der Selektionsaspekt angesprochen wird,
Thanks to doctorate students

Regina Cypionka

Matthias Gluhodedow

Christian Hörsch

Children in science

Elke Sander

Anja Kizil

Regina Cypionka

Esther van Dijk

Julia Schwanewedel

Harald Gropengießer

Vera Frerichs

Anne Janßen-Bartels

Patricia Jelemenska

Anne Janßen-Bartels

Catja Hilge

Wilfried Baalmann

Grandchildren
Thanks to the participants of PRODID

Thanks to the participants of ProfaS

"What do you expect of a dissertation?"

Supervisor: "Nothing special!"

Human centred biology curriculum
Expectations

Step 1) Think
Step 2) Study
Step 3) Go back to step 1)
Expectations

"Science does not gain to reach eternal truth but is satisfied by removing some of the main errors which concern nature and society."

(Hall of Fame, University of Vienna)

Staying with a Problem

"My mother advised me: 'Never sing a song you don't like!'"
Staying with a Problem

Racial stereotypes
Race and culture

Table of Human Races from a local museum (19th/20th century)

“As far as differences between humans are concerned, I guess that education and culture are of greater importance than appearance. Whether it is possible to understand humans of other culture? – one can try it.”

“I do not believe that a Jamaican who lives in Germany will be able to internalise our mentality sometime. I do not believe that he will become a real European.”

“Whites are in no case more intelligent than Blacks.”

“When I hear the word ‘race‘ I directly think of the Third Reich and I’m associating racism. But, for me, there are certain features of persons, which is why I’m sorting them into a certain group.“

“If you compare the two influences, the one which is genetically transferred, and the other which is environmentally conditioned, then you are clearly more engrained by that which is passed on to you. Yes, quite clearly, you can push yourself as much as you like: There is always and everywhere a spark of origin.”

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(grade 11, Janßen 1998)
Staying with a Problem

The Idea of Isolation
so called “major races”

Staying with a Problem

The Idea of Isolation
so called “major civilizations”


Staying with a Problem

The Idea of Isolation

Evolutionary Biology: Origin of races and speciation by geographical separation

Biological Anthropology: Origin of human races by natural selection in geographical isolation, regional development

Psychology: Origin of different cultures by apportionment and alienation, "pseudospecies" (Erikson 1968)

Cultural Studies: Thinking of cultures in plural only: Stressing differences and animosities between cultures. Cultures are treated as self-contained entities.
Staying with a Problem

1973

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“Current scientific findings do not support the earlier view that human populations can be classified into discrete ‘races’ like ‘Africans’, ‘Eurasians’, or any greater number of subdivisions.

There is no scientifically reliable way to characterise human diversity using the rigid terms of ‘racial’ categories or the traditional ‘race’ concept. There is no scientific reason to continue using the term ‘race’.”
Staying with a Problem

Genetic Studies

Humans

Montain Gorilla

Eastern Gorilla

ancestral form

Chimpanzee

Bonobo

Borneo Orang-Utan

Sumatra Orang-Utan

Western Gorilla

(after Gagneux et al. 1999)

Staying with a Problem

Continuous variation

(after Lewontin 1986)
Types are ideal or statistically derived kinds (classes) which displace the diversity of individuals. Types exist in our brains only.

Median values are instruments to reduce the diversity in order to get homogeneous groups. The spread of features is ignored, e.g. by deducing the ability of groups from mean IQ-values.

Dichotomies divide the diversity of processes and modes of living into seemingly incompatible alternatives: “Blacks” and “Whites”; clashing (western and Islamic) cultures, antithetic types of man and woman.
Staying with a Problem

This is Gordon!
The nurse brought a new child into the kindergarten-group. A little girl pointed to the dark-skinned boy and shouted: "Oh, look, a negro".

Aware of the situation the nurse told the group: "This is not a negro, this is Gordon!"

Elly is Jewish.
"I was a good friend of Elly. Suddenly Elly did not appear at school. The teacher told the class that Elly had to leave the school.

When I told my mother, that I’m very sad that Elly is absent and that I don’t know, why Elly left the school, my mother told me: ‘Elly is Jewish, you know’. 
Staying with a Problem

- Key to re-learning: Diversity within unity
  - Focus on the individual
  - Design of learning environments

Heterogeneity within groups
Continuous variation
Scientific clarification
Investigation into students’ conceptions

Types
Essential differences

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Only one Humankind. Only one Culture.
Recommendations

- Link theory and practice.
- Love your topic.
- Be patient with problems.
- Have compassion for learners.
In the End

“It’s not that I’m so smart, it’s just that I stay with problems longer.”