

Harald Gropengießer & Ute Harms (2023): *Fachdidaktik Biologie*, Hannover: Aulis Verlag in Friedrich Verlag.

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There are many things a didactician (or teacher) of a specific subject can learn from a closer look at an introduction to the didactics of another subject. In this case, taking a look at *Fachdidaktik Biologie*, an introduction into the didactics of biology edited by Gropengießer and Harms, from the perspective of didactics of philosophy, there are two aspects of particular interest. First, the introduction to a didactic model, which has found application in philosophy education – the Model of Educational Reconstruction (*Didaktische Rekonstruktion*). Second, the dealing with philosophical questions, specifically from the disciplines of philosophy of science (e.g. the nature of science) and applied ethics (e.g. bioethics), which have become topics in the curricula of natural sciences in Germany and other countries. The book is written in German, but given its reputation, it should be of interest beyond German-speaking countries.

Fachdidaktik Biologie has been the main German language reference work in didactics of biology for more than 35 years. The new edition has been revised by 29 renowned experts. It is structured into 44 single chapters, which are divided by subchapters referencing key statements as advanced organizers. According to the editors, the first 12 chapters should be read ahead of the rest (p. 13), but there does not seem to be a definitive structure to the first part nor to the rest of the book. This may be due to the number of different authors of the chapters. While general structure may not be necessary for those who are only reading a specific chapter (for class preparation) or searching for an answer to a particular question, it can be a limitation when the book is intended to be worked on front to back.

The first chapter, authored by Gropengießer and clearly addressed to student teachers of biology, provides a nice introduction into the profession, highlighting the shift in perspective from learner to teacher. Chapters 2, 3, and 4, authored by Gropengießer and Kattmann, introduce the Model of Educational Reconstruction. This model, based on the conceptual change theory of learning (Posner et al. 1982¹), has been developed by Ulrich Kattman, Reinders Duit, Harald Gropengießer, and Michael Komorek in the mid-1990s (for presentations in English, see Kattman et al. 1996, Komorek & Kattmann 2009; Duit et al. 2012). Since learning in philosophy can be largely conceived of as conceptual change, the Model of Educational Reconstruction is highly relevant to philosophy education (Zimmermann 2016). While originally developed for educational research, this model has proven useful for lesson planning as well. Of the three parts (clarification of scientific concepts, investigation of students' (pre-)conceptions,² and design of learning environments), the first two are presented here in individual chapters, followed by the introduction to the model itself, and then in chapter 6, authored by Birgit Neuhaus, selection of teaching content is explained, presenting different historical approaches and the approach based on “basic

¹ Unfortunately, this background is only referenced to later in the book (p. 130 and p. 447).

² Originally, Posner et al. (1982) speak of “misconceptions”, but the now widely used term “preconceptions” seems more appropriate at least for the following two reasons: it does not have a negative connotation and indicates that concepts referred to are ones that one has *before* encountering scientific conceptions.



concepts” or “Disciplinary Core Ideas”, which is stated as being the standard in Germany since 2005, as well as internationally (p. 64-65).

While it makes didactically sense to start with the first part of the Model, it would also be helpful to have the bigger picture at hand (the model and its grounding in a didactical theory) from the start. Personally, I would have preferred a presentation that unifies the contents of chapters 2, 3, 4, and 6, starting with the Model of Educational Reconstruction and then going in depth on the three parts, that ground the model in didactic theories, leaving the historical contents to a separate box as content for further discussion.

Chapter 5, authored by Harms and Kattmann, offers justificatory arguments for including biology as a school subject. The first argument is based on biology’s contribution to a scientific understanding of the world, also known as “scientific literacy”. The second argument is that biology offers a specific value for the personal development of students, specifically concerning their health and sexuality. The “four modes of world encounter” (*vier Modi der Weltbegegnung*) by German educational scientist Jürgen Baumert are presented in a box (p. 49-50), which are said to correspond to four specific “ways of thinking” (cognitive-instrumental, aesthetic-expressive, normative-evaluative, constitutive rationality). Philosophy, together with religion, is classified under the fourth way. Reference is made to an article by Ulrich Kropač (2013) in which it is argued that Baumert’s distinction shows that religion is a school subject on a par with all other school subjects.

While it is to be welcomed that questions concerning the place of biology, and of natural sciences in general, in our understanding of the world are addressed in the didactics of biology, it is deplorable that this specific model is used: it is philosophically unfounded, it misrepresents the place and role of philosophy, and it overestimates the role of religion.

In chapter 7, Gropengießer and Kattmann take on a meta-perspective and explore didactics of biology as a scientific discipline. Chapters 8 and 9, authored by Harms, introduce educational standards and competences, and combine them with the basic disciplinary concepts of biology.

In Chapter 10, Jürgen Mayer claims that the only method of empirical sciences is the hypothetical-deductive method. But Mayer barely introduces the method (and refers to chapter 36 instead), he leaves the seemingly false claim (which is contradicted in the later chapter) unfounded, and overwhelms the reader with references to empirical studies in educational research.

Chapter 11, authored by Harms and Kattmann, is devoted to the communication of biological phenomena and findings. First, communication is one of the areas of competences in the German curriculum for biology, and second, scientists are supposed to be able to explain new scientific findings to a wider audience. (One might wonder whether it is didactically useful to bring both topics into one chapter, but the authors’ take on the issue is that the challenges of both are essentially the same.) In the first subchapter, a theory of communication is explained. (Its use for the purposes of communication in biology remains unclear.) In subchapter 11.3, argumentation as “complex ability for professional communication” is thematized. Several characterizations are given: when arguing, “the reasons for an assertion are examined” (p. 109), an argumentation is “in its original signification a speech act whose aim is to create knowledge or to bring about changes in

attitudes through reasoned argumentation” (p. 109, citing Bußmann, a linguistic dictionary), and in research on science education it is said to mean “a communicative process in which assertions or conclusions are supported by evidence” (p. 110). Given the different characterizations, the concept of argumentation remains unclear. Toulmin’s argumentation schema is presented as the “fundamental formal structure” of an argument, using the “facts” that the impact crater in Yucatan (the Chicxulub crater) “could have” caused the extinction of dinosaurs as an example of factual evidence (p. 110). The criteria of evaluation by Blair & Johnson (and Trudy Govier) are related to “arguments” (instead of premises, p. 111). The lack of conceptual clarity and fundamental conceptual mistakes make this subchapter a particularly weak passage of the book.

Chapter 12, authored by Susanne Bögeholz, is devoted to evaluation at the intersection of biology and society. The science of biology, although “at the core not a normative” science, is influenced by societal interests leading to so called “socioscientific issues” (p. 116-117). These issues are expressed in questions such as, e.g., what we should do in the face of the consequences of climate change. Different concepts and models of competencies of evaluation and (ethical) judgment are introduced. No reference is made to philosophy.

Of the many subsequent chapters, one chapter focuses on students and one on teachers, some chapters look at general didactical skills such as formulating learning objectives, others look at skills that are specific to or of special importance in biology such as observation, microscopy, doing experiments, modeling, and diagramming, some investigate historical aspects of biology and biology education, and still others thematize specific topics such as health education and sexual education, and more. As mentioned before, there is no clear structure to the chapters, but a vast array of topics is addressed that will be of great interest to any biology teacher.

For the rest of the review, I will concentrate on two chapters in which concepts from philosophy of science and epistemology are applied, and on one chapter in which concepts from ethics are applied. Chapter 36, authored by Arne Dittmer and Jürgen Langlet, is devoted to what has internationally been called the “nature of science”, that is educational questions about how to foster understanding of what science is. It is laudable that at least here some philosophers are quoted. For example, Paul Hoyningen-Huene, a German philosopher of science, who lists five activities that are characteristic of science (p. 426). Another example is Thomas Nagel, a US-American philosopher, and his argument from the article “What is it like to be a bat?” against a reductionist view of the mind. Unfortunately, it is used misleadingly to show the subjectivity of perception and the possibility of knowledge in general (p. 428). Further philosophical contents are methods of reasoning (inductive reasoning, Popper’s hypothetical-deductive method, and abductive reasoning, p. 429-431), Kuhn’s theory of scientific revolutions and Feyerabend’s methodological slogan “anything goes” (p. 433-434). In further subchapters, general questions of biological research are presented.

Chapter 37, authored by Jörg Zabel and Alexander Bergmann-Gering, deals with epistemology and learning. Cognition is seen, in reference to Immanuel Kant, as a creative act. Radical constructivism as held by Ernst von Glasersfeld, an author widely received in German pedagogic literature, is uncritically presented as a valuable epistemic position (p. 442-444).

Chapter 39, authored by Harms and Kattmann, is about ethics in science and bioethics. Fundamental ethical concepts such as values, norms, and responsible action are introduced (p. 463), several areas of applied ethics are mentioned (medical ethics, animal ethics, ecological ethics, etc.), and three “ideal-typical” forms of ethical decision are described: order ethics (*Ordnungsethik*), ethics of conviction (*Gesinnungsethik*), and ethics of responsibility (*Verantwortungsethik*, p. 469-471). The only reference is to Dulitz & Kattmann (1990), a collection of examples for use in class; reference to a philosophical foundation of these theories is missing; the first term could be referring to an approach in business ethics, the latter two terms possibly to Max Weber’s famous distinction. But these are mere conjectures, none of this is made explicit, and it is not clear what the sources for these theories could be. At one point, Ethics (and Religion) is explicitly mentioned as the subject which deals with ethical questions at its core (p. 468). The call for interdisciplinary cooperation stands in stark contrast to the chapter’s noticeable omission of references to philosophical literature.

At the end of chapter 40, Kattmann relates epistemology and ethics in the following way: the task of rational inquiry cannot be completed without a clear relation to general ethical norms. He cites human rights and ecology as examples (p. 493). However, it remains completely unclear how the relationship to ethical norms contribute to rational inquiry in biology.

In conclusion, *Fachdidaktik Biologie* stands out as a remarkable collaborative effort, synthesizing a wide array of research within the field of biology didactics. This book could well serve as a model for other subject didactics, including philosophy. Of special interest to philosophy teachers and didacticians are the explanations around the Model of Educational Reconstruction. However, from a philosophical standpoint, the imprecise use of philosophical concepts and misleading presentations of (the value of) certain philosophical views may leave readers dissatisfied.³

References

- Dulitz, B., & Kattmann, U. (1990), *Bioethik. Fallstudien für den Unterricht*, Heidelberg: Metzler.
- Duit, R., Gropengießer, H., Kattmann, U., Komorek, M., & Parchmann, I. (2012), *The Model of Educational Reconstruction. A Framework for Improving Teaching and Learning Science*, In Jorde D. and Dillon J. (Eds.), *Science Education Research and Practice in Europe: Retrospective and Prospective*, Rotterdam: Sense Publishers, 13–37.
- Kattman, U., Duit, R., Gropengießer, H., & Komorek, M. (1996). *Educational Reconstruction. Bringing Together Issues of Scientific Clarification and Students’ Conceptions*. Paper presented at the Annual Meeting of the National Association of Research in Science Teaching (NARST), St. Louis, April 1996. URL: https://www.researchgate.net/profile/Ulrich-Kattmann/publication/271958515_Educational_Reconstruction_-_Bringing_together_Issues_of_scientific_clarification_and_students_conceptions_NA

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[RST_1996/links/54d731660cf25013d036c802/Educational-Reconstruction-Bringing-together-Issues-of-scientific-clarification-and-students-conceptions-NARST-1996.pdf](https://www.narst.edu.au/links/54d731660cf25013d036c802/Educational-Reconstruction-Bringing-together-Issues-of-scientific-clarification-and-students-conceptions-NARST-1996.pdf)

- Komorek, M., & Kattmann, U. (2009). The Model of Educational Reconstruction. In Mikelskis-Seifert, S., Ringelband, U., & Brückmann, M., Eds., *Four Decades of Research in Science Education – From Curriculum Development to Quality Improvement*, Münster, Germany: Waxman, 171–188.
- Kropač, U. (2013). Unterschiedliche Modi der Weltbegegnung – Eine bildungstheoretische Einordnung. *Kontakt: Informationen zum Religionsunterricht im Bistum Augsburg*, 6, 11-13.
- Posner, G. J., Strike, K. A., Hewson, P.W. & Gertzog, W. A. (1982), Accommodation of a scientific conception: Towards a theory of conceptual change, *Science Education* 66, 211-227.
- Zimmermann, P. (2016), Fachliche Klärung und didaktische Rekonstruktion, In J. Pfister & P. Zimmermann (Eds), *Neues Handbuch des Philosophieunterrichts*, Bern: Haupt, 61–78.