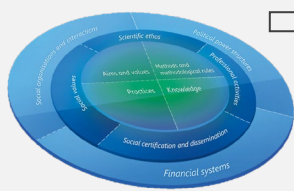


Differentiation of the Family Resemblance Approach to Nature of Science

Theoretical Background & Research Question



FRA to NOS
(Erduran & Dagher, 2014)

Differentiated FRA to NOS (Reinisch & Fricke, 2022)

Cognitive-epistemic system of science

Scientific Practices:

Observing, Experimenting, Comparing and Classifying, Modeling

Knowledge:

Hypotheses, Theories, Models, Rules

Social-institutional system of science

Scientific Ethos:

Respect of Research Objects, Respect for the Environment, Protection of Human Subjects, Confidentiality, Communalism, Legality

Discipline specificities for biology:

Errors in experiments can be traced back to the variability of living beings as research objects (Bässler, 1991)

“Not all sciences may have laws”
(Irzik & Nola, 2011, p. 600)

Which NOS aspects can be justified as **discipline-general** and which as **biology-specific**?

Methods: Expert Interview Study

Criteria based sample selection (e.g., professorship in the respective discipline, successful third-party funding application)

Guided interviews
(Gläser & Laudel, 2010)

“Please assess the characteristics of experimenting in biology, in comparison to chemistry or physics.”

Tab. 1. Sample (N=22)

Discipline		N
Biology	Cell Biology	2
	Genetics	2
	Evolution	2
Chemistry	Anorganic Chemistry	2
	Organic Chemistry	2
	Theoretical Chemistry	2
Physics	Experimental Physics	4
	Theoretical Physics	2
Philosophy	Philosophy of Science	3
Education	Science Education, research focus: FRA	1

Content structuring analysis including inductive coding
(Mayring, 2015)

Communicative validation process
(Bryman, 2016)

Results: Aspects of Experimenting

It is described that during experimenting, ...

... hypotheses are examined.

Other disciplines of the natural sciences will also formulate hypotheses and conduct experiments to **examine the hypotheses**.
(P2, Cell Biologist, 4-35)

The difference in the experimental design of **biological experiments compared to chemical or physical experiments** is that **organisms** always stand in the centre. Perhaps these are somewhat more **complicated systems** overall, and perhaps partly more expensive systems.
(P3, Geneticist, 185-200)

... the experimental design is oriented on specificities of the research object (e.g., organisms as complex systems).

In **biology**, we have the problem of the **variation** in the basic set and therefore we often work with **probabilities** in the explanations or with **statistical methods**. These also exist in **physics** but **play a lesser role** there because laws of nature are much better understood.
(P6, Evolutionary Biologist, 126-153)

... probabilities, statistical methods, and laws or rules are considered due to specificities of the research object (e.g., variability).

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 Gläser & Laudel (2010) *Expert interviews and qualitative content analysis*
 Kampourakis (2016) The “general aspects” conceptualization
 Lederman & Lederman (2014) Research on teaching and learning of NOS
 Mayring (2015) *Qualitative content analysis*
 Reinisch & Fricke (2022) Broadening a NOS conceptualization

Discussion & Conclusion

Biology-specific features of experimenting: alignment of design and interpretation towards **living beings** as research objects (see Bässler, 1991)

Discipline specificities of individual NOS aspects can be used to design **NOS learning pathways** along a continuum (Kampourakis, 2016)

How to analyze data from experts who refer to a scientific discipline outside of their own expertise?

To what extent can results be generalized?



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