Scientific Epistemological Beliefs Between the Poles of Professional and Classroom Science

Frauke Voitle, Nele Kampa, Irene Neumann, Julia Schwanewedel & Kerstin Kremer

In experiments at school [...] you want to prove a law and you measure the results that fit the strongest.

[...] In scientific experiments [...] the physician wants to discover a new law and has to be objective.

Students' quote by Meyling (1990, p. 92)

Theoretical Background

Defining Epistemological Beliefs (EBs)

EBs are the set of individual subjective theories one holds about the nature of knowledge and (the process of) knowing.
(Anschütz, 2012; Hofer & Pintrich, 1997)

Structure of EBs according to Conley et al. (2004)

Nature of knowing

Source
Knowledge is not a privilege of few authorities

Justification
Experiments as (one) possible means to create knowledge

Nature of knowledge

Certainty
There's not always an absolute answer;
Knowledge can be revised

Development
Science is constantly evolving

EBs in Science Class

- EBs as precondition for learning science: EBs have multiple influences on students' learning (e.g., use of learning strategies, perceiving and processing information, …)
  (Bromme et al., 2010; Hofer, 2001)
- EBs as achievement goal (Kampa et al., 2016): EBs are part of scientific literacy
- Development of EBs is affected by instruction:
  - EBs are context dependent and develop with experience
    (Bromme et al., 2010; Muis et al., 2006)
  - Perceived distance, missing relevance of classroom science for professional science or missing experience may lead to separate sets of views or beliefs concerning classroom and professional science.
    (Clough, 2006; Hogan, 2000; Sandoval, 2005)

Research Design and Procedure

Research Questions

- Do students' EBs related to classroom science differ from their EBs related to professional science?
- Is the adapted questionnaire for assessing students' EBs related to classroom science verbally appropriate for 8th grade students?

Sample

N=102 (♀= 60, ♂= 42) 8th graders' from 3 academic-track schools

Instrument

Adapted questionnaire with 26 items (5-point likert-scale); 10 likert-scale, 3 open-ended items targeting students' understanding and general feedback.

Adapting the Questionnaire

The developed questionnaire is based on the one by Conley et al. (2004). Analogous phrases referring to the school context were iteratively developed and then systematically applied.

Exemplary Items

Certainty (related to classroom science)
You always agree about what is true *in science class*.(-)

Certainty (related to professional science, Conley et al., 2004)
Scientists always agree about what is true *in science*.(-)

Research Findings and Implications

Students' EBs concerning Classroom Science

Table 1: Research findings for 8th graders' school-specific EBs.

Dimension	Mean	SD
Source (5 items, α=0.84)	**3.05**	(1.22)
Justification (9 items, α=0.42)	**4.11**	(.91)
Certainty (6 items, α=0.72)	**3.38**	(1.13)
Development (6 items, α=0.54)	**3.74**	(.98)

Reliability for justification, if f25 is omitted: α=0.59

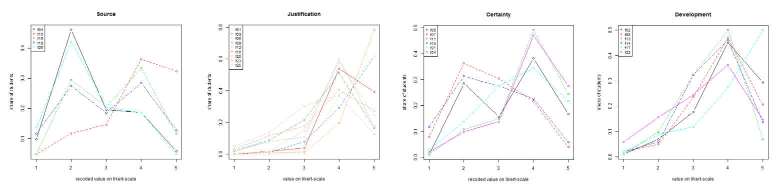

Fig. 2: Ranges of students' responses (recoded for source and certainty) for the four dimensions source, justification, certainty and development of students' school-specific EBs.

Two peaks in Fig 1 for items f15 and f19 and a relatively high inter-item-correlation (.65) indicate two differing opinions concerning trust in authorities. This should be assessed in further studies.

Note: In the school-specific context interpreting EBs as naive or sophisticated may differ from the interpretations in the context of professional science.

Comparing Students' EBs concerning Classroom and Professional Science

Students' EBs differ significantly regarding the context of classroom and professional science, respectively.

Table 2: Research findings for 9th graders' EBs related to professional science by Urhahne & Hopf (2004), N=167.

Dimension	Mean	SD
Source (5 items, α=0.67)	**3.94**	(.58)
Justification (9 items, α=0.68)	**3.96**	(.50)
Certainty (6 items, α=0.41)	**3.69**	(.50)
Development (6 items, α=0.66)	**3.22**	(.67)

Students' Understanding of the Questionnaire

- 6 items in the dimensions justification (4) and development (2) were perceived difficult by at least 5 % of the students.
- Understanding the items was perceived to be rather easy (f28: 81.4%, f35: 84.3%)
- Stating an opinion was perceived rather difficult by a significant share of students (f27: 18.6%, f29: 13.7%, f32: 28.4%). This seems to be connected with referring to science in an integrated sense.
- Low reliabilities, inter-item-correlations and students' feedback demand for revision of the items referring to development and justification.

Prospect to further Research

Summer/Autumn 2018:
Quantitative comparison of students' EBs concerning classroom and professional science

Autumn/Winter 2018:
Qualitative assessment of causes for students' differing EBs

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Contact information

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