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Statistics beliefs of advanced social science students - a qualitative evaluation of focus groups

Florian Berens, Center of Methods in the Social Sciences, University of Goettingen, Germany

Problem

- My students in an introductory statistics course for social scientists show and report negative attitudes toward statistics.
- Also many other lecturers and some empirical studies report negative attitudes toward statistics among students of many different fields of study.
- According to Gal, Ginsburg and Schau (1997) negative attitudes have three major effects:
 1. They have effects on learning behavior within the course.
 2. They influence decisions on further non-obligatory follow-up courses.
 3. They influence on how (strongly) learned contents find their way into professional and everyday life.
- Empirical studies found that statistics attitudes have an influence on achievement in statistics courses. (Emmioglu & Capa-Aydin, 2012; Vanhoof et al., 2006).

Problem

- But what are these attitudes about? There is (almost) no statistics education in German schools.
- It can be assumed that personal experiences with statistics (where from and how ever they are) shape students attitudes towards statistics.
- Because there is no clear origin of their attitudes it is also not clear what they believe about statistics.
- From mathematics education we know that beliefs about mathematics have an influence on attitudes and on performance as well (Eichler, and Erens, 2015).
- So to go deeper into students attitudes I wanted to survey their beliefs about statistics. But there is no domain specific survey form beliefs about statistics.
- So I had a look at survey about beliefs regarding mathematics.

World views about mathematics according to Grigutsch and Törner

- There is no theory on domain specific beliefs about statistics.
- As a first shot an established instrument on world views about mathematics is used.
- Grigutsch and Törner propose 4 dimensions of world views about mathematics:
 - Schema:
“Mathematics is a collection of procedures and rules that determine exactly how to solve a task.”
 - Formalism:
“Mathematics is logical, without inconsistencies and everything is build upon proof.”
 - Process:
“In mathematics you can invent and try things for yourself.”
 - Application:
“Many parts of mathematics have a practical use or a direct application.”

Tests on the measurement of world views

- *First step:* Cronbachs alpha range between 0.712 (formalism) and 0.789 (process) and can therefore be rated as acceptable to good (schema: 0.713).
- *Second step:* Confirmatory factor analysis results in a CFI of 0.775, RMSEA of 0.068 and SRMR of 0.073. Summarizing these three indices there seems to be some problem in the fit of the model.
- *Third step:* A series of explorative factor analyses were performed to determine an own factor structure, which was calculated using maximum likelihood estimation and promax rotation. Scree plots as well as the eigen value criterion support a 3-dimensional as well as a 2-dimensional structure.
- *Result:* The factors schema and formalism can go together to one factor but do not have to. The dichotomy between static and dynamic beliefs seems to be most important.

Research Questions and Hypotheses

- Research Questions:
 1. Can we replicate that there are static and dynamic beliefs about statistics?
 2. Can we subdivide these two (main) types of beliefs?
 3. Can we find other beliefs that do not fit into the static – dynamic – dichotomy?

- Long-term goals:
 1. Comprehensive conceptualization of beliefs about statistics
 2. Create a measurement instrument for beliefs about statistics

Investigated sample

- To exploit the open field a qualitative approach was chosen.
- In order to capture as many perspectives as possible and let students reflect upon them, focus groups were initiated for data generation.
- For the focus groups *social scientists* (political science and/or sociology) have been gathered at the *University of Goettingen*.
- All participants had already completed two out of four compulsory statistics courses so that they had already some experience with statistics but could also remember their first experiences in the field.

Design of the focus groups

- Since the convictions could be strongly influenced by the lecturer, two focus group discussions were held.
- Within each group the lecturer was kept constant, but between the groups he differed (almost at most) in teaching experience and professional background.
- Participants were asked to prepare three questions in advance:
 - What is statistics for you? How would you describe or define it?
 - What does a person have to bring to be good at statistics?
 - What does a person have to do to be successful in statistics?
- The discussion was moderated as far as possible without intervention and followed the three questions.

Excerpts from the discussions

For me statistics is the handling of data and in particular the filtering out of relations. ...

Statistics links the theories of our studies with reality in order to better understand them. ...

Statistics makes the complexity of the world communicateable through numbers or graphs.

Statistics is dealing with numbers as hard facts.

Statistics is learning to deal with (such) data.

Statistics supports or falsifies statements or theories.

In statistics empirical reality shall be described.

In statistics I use formulas, do it right or wrong, but I can't develop new formulas.

Statistics is a language for interpreting reality.

Static beliefs

Descriptive beliefs

Testing beliefs

Exploring beliefs

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Discussion

■ Key results

- There are students who view statistics as a system of terms and rules, and there are also students who understand statistics dynamically.
- Dynamical beliefs can be subdivided into those that extract information out of data and those that want to check theory using data.
- A fourth group sees statistics as a form of systematic description of reality.

■ Limitations

- The results may be specific for social sciences, Germany or the University of Goettingen.
- Two focus groups are not yet sufficient for theoretical saturation.



THANK YOU FOR YOUR ATTENTION!

Contact:
Florian Berens
Center of Methods in the Social Sciences
Working group on quantitative Methods and Statistics
Gosslerstraße 19, 37073 Gettingen, Germany
Phone: +49 551/39-21522
Mail: florian.berens@uni-goettingen.de