

ProCivicStat © - Overview, 5.212

## Statistical Literacy in Mathematics Education - Seminar 2.0

Daniel Frischemeier | Susanne Podworny | Rolf Biehler  
[dafr@math.upb.de](mailto:dafr@math.upb.de) | [podworny@math.upb.de](mailto:podworny@math.upb.de) | [biehler@math.upb.de](mailto:biehler@math.upb.de)  
 Paderborn University, Germany

### Description

Statistical Literacy is part of the basic education of responsible citizens in a democracy and should already be promoted in school lessons. As a result, general statistical education has become increasingly important in secondary mathematics education in recent years, partly due to educational standards. In this seminar, the promotion of "Statistical Literacy" on socially relevant topics (such as gender pay gap, poverty, discrimination,...) is discussed using real examples and data sets. The critical handling of statistics and their descriptions in the media should also be learned. Suggestions for the implementation of these topics for mathematics teaching in secondary schools are presented, discussed and further developed using digital tools.

In this (project-)seminar the participants should develop critical thinking in dealing with statistics from everyday life (civic statistics) and reflect on the potential of addressing these statistics in school mathematics lessons. According to Ridgway (2015) and Engel, Gal and Ridgway (2016), typical civil statistics are located in the following areas: Demography, unemployment, salary, migration, health, crime, poverty, access to services, energy, education, human rights, etc. and contain the following five essential components

- - multivariate phenomena,
- - aggregated data,
- - dynamic data (time series),
- - contain data in the text and
- - various visualizations.

This seminar has two primary objectives. On the one hand, students should develop a critical approach to civic statistics by critically evaluating given media reports (texts and diagrams), if necessary developing suggestions for improvement, independently researching for further information, data, etc. and using given data sets for their own explorations (and for answering their own questions). On the other hand, the students should get to know the potential of civic statistical contents for interdisciplinary mathematics teaching and develop their own



teaching ideas for implementation. At a meta-level, this course is also intended to help students develop a positive attitude towards the theming of civic statistics in mathematics teaching and to recognize their significance for democracy and everyday life.

## Objectives of the course

**Overarching objective:** Develop critical thinking in dealing with real civic data (open data) and reflect the potential of using this content in schools.

### Objectives to develop content knowledge

- The subject competences of the students from the course "Elements of Stochastics" will be refreshed and deepened taking into account relevant civic-statistical backgrounds.
- Students deepen their knowledge of reading and interpreting key figures in civic statistical contexts.
- Students learn important statistical concepts such as "correlation and causality", "percentages of what", etc. using examples from civic statistics and apply them in critical thinking in civic statistics.
- The students are introduced to "multidimensional thinking" (i.e. to take various variables and their influences into consideration in a study).
- Students learn important terms that are relevant in the context of civic statistics (e.g. how is unemployment defined? How is poverty defined? What does "income" mean? etc.).
- Students explore multivariate data sets under given questions and document their findings adequately for their target groups.
- Students learn to ask adequate statistical evaluation questions.
- Students consolidate their tool competencies in data analysis.

### Objectives to develop pedagogical content knowledge

- Students look at civic statistical content across disciplines.
- Students learn about possible articles, data sets, tools and homepages relating to civic statistics content and evaluate these with a view to possible implementations in mathematics teaching.
- Students learn to elementarize relationships in civic statistics.
- Students develop ideas for teaching and implementing civic statistics in mathematics lessons.

### Attitudes

- Students should develop a positive attitude towards stochastics, in particular towards the implementation of civic statistical questions in mathematics teaching.
- Students learn to critically question media reports.
- Students recognize the importance and importance of civic statistic contents for democracy/the own life.
- Students recognise the importance and importance of civic statistics content for the-matisation in secondary mathematics education.

## Form of seminar sessions and forms of learning

In order to achieve the objectives, there should be different forms of learning in the seminar sessions: As suggested by Garfield and Ben-Zvi (2008) as well as Pfannkuch and Ben-Zvi (2011), cooperative forms of learning and feedback are to be implemented in the course. In particular, the "think-pair share" method is to be applied in the working phases of the project meetings.

- **Repetition sessions (lecturer-centred lectures with classroom activities):** In the repetition sessions, basic contents of elementary stochastics (such as cell, column and row percentages, group comparisons, correlation & causality, etc.) are repeated in connection with civic statistical contexts. The repetition is carried out lecturer-centered. Presence work phases between the lectures should further refresh and consolidate the corresponding competences of the participants. This also includes refreshing tool skills in the use of the Fathom software.
- **Mini project sessions:** In the mini project sessions, students work in teams of two on selected mini-projects, such as electronic worksheets. There will be a total of five of these mini-project meetings, one team of two is responsible for the moderation of such a project meeting as part of the study performance. During the work phases, the participants first deal with the task in individual work ("think") and then exchange ideas with a partner ("pair"). After this phase, the editing is revised and the presentation and discussion in the large group ("share") follows - followed by a second revision. Short presentations and "cyclical" feedback activate all participants in these sessions.
- **Project sessions:** Project meetings span several seminar sessions and include more complex open work assignments. Such a block of meetings consists of at least three phases (four sessions): "Introduction/Organisational/Background" (by lecturers), "Working phase" and "Presentation". First, the lecturers will introduce the students to the project and give them organisational advice on how the project is to be carried out in one block. In addition, students are given a research assignment so that they have to deal with the situation themselves and read up on relevant background information. Then a work order is processed in group work. In this seminar we see the exploration and presentation of multivariate data sets from the field of civic statistics according to given and self-chosen questions as a technical-oriented task (see sessions on the Gender Pay Gap Project). Two sessions are available for the working phase (data exploration). In the concluding session, the results will be presented in the form of a Power-Point presentation. In such a "presentation session" each team should present (~10 minutes) and receive feedback from students (~5 minutes).

An overview of the individual sessions and contents can be found on the following page.



## Promoting Civic Engagement via Exploration of Evidence: Challenges for Statistics Education

Co-funded by the  
Erasmus+ Programme  
of the European Union



Overview of the individual sessions and contents of a seminar on civic statistics education in mathematics teaching

No	Theme	Component	Job	Responsible
1	Organizational matters Introduction to the topic of the seminar: What is statistical literacy? What is civic statistics? Discussion of facets of statistical literacy Initial task for civic statistics	Introduction	Initial presence task	Lecturer
2	Initial task for civic statistics (continued) Refreshing and deepening technical knowledge in the field of descriptive statistics with Fathom	Repetition: Refreshing and expanding content knowledge and technological knowledge		Lecturer
3	Refreshing and deepening technical knowledge in the field of descriptive statistics with Fathom		Presence task	Lecturer
4	Explorative data analysis of the Jim data set / primary school data set with Fathom		Report of findings	Lecturer
5	Input for critical thinking Presentation of findings of the Jim data set / primary school data set with Fathom		Report of findings	Lecturer
6	Mini project 1: Accidents in Germany (e. g. 5.203)	Mini projects	2 students prepare presentation and moderation of an eWorksheet-based attendance phase (with tasks and subsequent discussion)	2 students
7	Mini project 2: Daily habits of US citizens (e. g. 5.202)		2 students prepare presentation and moderation of an eWorksheet-	2 students



**Promoting Civic Engagement via Exploration of Evidence:  
Challenges for Statistics Education**



			based attendance phase (with tasks and subsequent discussion)	
8	Mini project 3: Human Development Index (e. g. 5.105)		2 students prepare presentation and moderation of an eWorksheet-based attendance phase (with tasks and subsequent discussion)	2 students
9	Mini project 4: Statistics about the world (e. g. 5.101.)		2 students prepare presentation and moderation of an eWorksheet-based attendance phase (with tasks and subsequent discussion)	2 students
10	Mini project 5: Gapminder (e. g. 5.201)		2 students prepare presentation and moderation of an eWorksheet-based attendance phase (with tasks and subsequent discussion)	2 students
11	Investigation session for Gender Pay Gap (5.205 to 5.209)	Gender Pay Gap project	Reading task	Lecturer
12	„Gender Pay Gap in Germany“: working session Identify causes of wage gaps in the data set		Explore VSE data & prepare PowerPoint	Lecturer
13	„Gender Pay Gap in Germany“: working session Identify causes of wage gaps in the data set (continued)		Explore VSE data & prepare PowerPoint	Lecturer
14	„Gender Pay Gap“ in Germany“: Presentations		Presentations (PowerPoint)	Lecturer
15	Final reflection	Closure		Lecturer



## Promoting Civic Engagement via Exploration of Evidence: Challenges for Statistics Education

Co-funded by the  
Erasmus+ Programme  
of the European Union



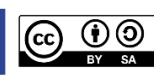
### Literature

Garfield, J., & Ben-Zvi, D. (2008). *Developing students' statistical reasoning. Connecting Research and Teaching Practice*. The Netherlands: Springer.

Pfannkuch, M., & Ben-Zvi, D. (2011). Developing teachers' statistical thinking. In C. Batanero, G. Burrill, & C. Reading (Eds.), *Teaching statistics in school mathematics-challenges for teaching and teacher education* (pp. 323-333). Dordrecht/Heidelberg/London/New York: Springer.

Ridgway, J. (2016). Implications of the Data Revolution for Statistics Education. *International Statistical Review*, 84(3), 528-549. doi:10.1111/insr.12110

Engel, J., Gal, I., & Ridgway, J. (2016). *Mathematical Literacy and Citizen Engagement: The Role of Civic statistics*. Paper presented at the 13th International Congress on Mathematical Education, Hamburg.



<sup>1</sup> This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. All materials are protected by copyright. They may be used as a whole or in parts under above CC License with the exception of the illustrations which may be used for educational purposes only.