Open Science Methods in Teaching

Dr. Johanna Gereke (Mannheimer Zentrum für Europäische Sozialforschung, MZES)

Dr. Anne-Sophie Waag (Mannheim Center for Teacher Education and Educational Innovation, ZLBI)

27 September 2022, 13:30-15:30

8th Trifels Summer School on Open Science, 2022

Roadmap for today

1. Introduction: Who are we and who are you?
2. Open Science Practices
3. How to incorporate Open Science Methods in teaching?
   Example: Replication Seminar (MA/PhD Social Sciences)
4. Discussion: Exchange of ideas and experiences using Open Science in teaching
5. Group Work: Designing a Course or OER
6. Poster Presentations / Pitches

Since December 2018 MZES Fellow

- Prior: Postdoctoral Fellow at Bocconi University (2016-2018), PhD at European University Institute (2012-2016)
- Research interests: intergroup relations, discrimination, physical attractiveness, trust and pro-sociality
- Methodological interests: all kinds of experiments; replication(s)
- Junior Fellowship in Innovations in Teaching from the Baden-Württemberg Stiftung and Stifterverband (2019-2022)

  Contact: johanna.gereke@uni-mannheim.de

Since January 2021 staff for Educational Innovation

- Prior: PhD at the chair of Educational Psychology, Mannheim (2016-2021)
- Research interests: campus-community-partnerships, organizational development and collaboration formats
- Teaching interests: learning psychology, situated learning, scientific working and writing, teaching and learning with digital media

Contact: waag@uni-mannheim.de

Why do we care about Open Science in Teaching?

1. Teaching students about open science is a crucial component of the credibility revolution to make science transparent & self-correcting
   - Open science has the potential to improve learning & teaching in higher education
   - → Teaching open science as a **subject** and a **process** and **using Open Science practices** in teaching helps to train the next generation of scientists & fosters norms of this research culture

2. Sharing teaching resources reduces barriers to spreading open science knowledge throughout the field

3. Institutional efforts and comprehensive curriculum development should ensure students learn about and how to do open science

   (E.g.:Open Science Semester, Chemnitz University; Open Science Module at TU Dresden (Psychology), e-learning plus 3 workshops for postgraduate training: Good Scientific Practice, Open Science Practices, Research Data Management)

**Who are you and what are your experiences with Open Science in Teaching?**

Which Open Science Practices are relevant to teaching?

Open Science as umbrella term

- Open means extending the principles of openness to the whole research cycle and teaching, fostering collaboration and co-creation to increase transparency, reproducibility and understanding for research as a method.
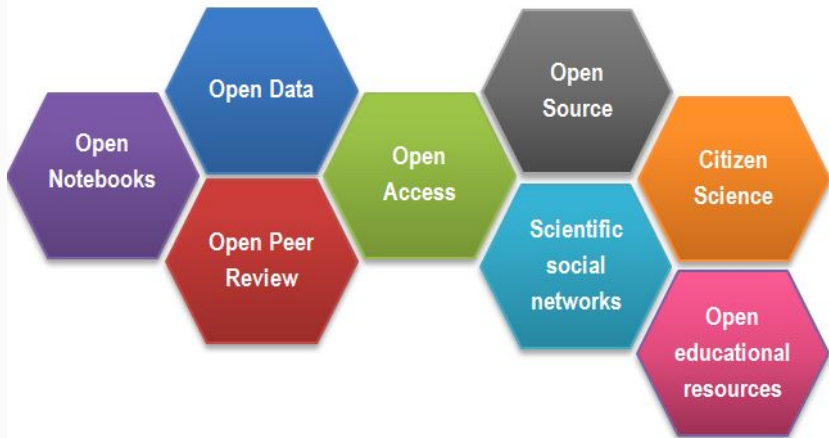
New Teaching Formats – Things to consider

01	**Reuse**	• Use in different ways
02	**Revise**	• Adapt, modify, update and otherwise change
03	**Remix**	• Combine with other resources
04	**Redistribute**	• Share with others
05	**Retain**	• Keep access to the materials

David Wiley: https://opencontent.org/blog/archives/3221

Rima-Maria Rahal I Teaching Open Science I MZES

- Teaching about open science as a **subject**
  - Terminology, principles, philosophy of science, etc.
- Teaching open science as a **process**
  - Preregistration, publishing data, producing OER, etc.
- **Practicing** Open Science while Teaching
  - Using OER, open source, open syllabus, open data, etc.

How to incorporate Open Science in teaching?
Open Educational Practices

Open Educational Practices: What's that?

"OEP is about creating frameworks that promote the use, design and management of Open Educational Resources." (Koschorreck, 2018)

- Practicing Open Education means
  - ✓ sharing ideas and experiences
  - ✓ sharing concepts and materials
- There a two related dimensions
  - ✓ open scholarship, open learning, open pedagogy, ...
  - ✓ open educational resource (OER) creation, adoption and use

Sources: Bellinger, Bettinger Dander (2018), Koseoglu Boskurt (2018), Mayrberger Hofhues (2013), Thielsch (2022)

Open up your pedagogy

- ...towards your students:
    - ✓ e.g., develop the course plan in a participatory way
    - ✓ e.g., elaborate on course topics in a common blog or wiki
- ...towards the community and/or public
    - ✓ e.g., publish your syllabus and course concept (GitHub, ZOERR, ...)
    - ✓ e.g., let students publish their final course products (Wikipedia, Zenodo, ...)

More sources: <u>OEP in Action Hub</u>

Repositories

Where to upload and find OER?

- <u>ZOERR</u> (BW)
- <u>twillo</u> (NI)
- <u>HOOU</u> (HH)
- <u>Zenodo</u>
- <u>MADOC</u> (UMA)

More teaching resources

OSF: consolidating teaching resources

Example I: Opening-up teaching

Example II: Teaching Open Science

Teaching Open Science

https://rimamrahal.wordpress.com

How to incorporate Open Science in teaching?
Applications

Teaching as a Component of the Credibility Revolution

✓ effective tool to teach . . .
   - students awareness of the 'reproducibility crisis'
   - how to conduct methodologically sound and ethical empirical research

✓ Facilitate lasting change in research norms and open science practices among the next generation of social scientists

✓ Promote open and transparent scientific knowledge production

Some of the benefits for students and instructors

Students can learn to. . .

✓ summarize the literature relating to their replication project

✓ understand the design of the replication study

✓ independently carry out the necessary statistical analyses and evaluate a replication result

✓ document the research process in a replication report

Strengthening students' core competencies: Students will . . .

✓ become able to actively reason based on verifiable evidence

✓ improve quantitative literacy by replicating cutting-edge empirical research

✓ learn how to develop an own (replicable) research workflow

✓ get a deeper understanding of the complete research cycle that builds the foundation of any published work, including the often difficult choices authors face along the way

Open Science Teaching can happen in...

- ✓ methodology classes
- ✓ applied research classes
- ✓ theses as replications

at all levels: BA, MA and PhD

Curriculum integration $\rightarrow$ no isolated course, rather make open science concepts and principles pop up in different relevant contexts (e.g. Master of Science in Epidemiology, Johannes Gutenberg University Mainz with a focus on replications)

Example: Replication Seminar

My course design on experimental methods (1)

- **Course Title**: Replication & Reproduction in the Social Sciences
  - Junior-Fellowship der Baden-Württemberg Stiftung / Stifterverband (2019-2021) [15.000 EUR, More info]
  - For advanced Master and PhD students in Sociology, Political Science & Psychology
- **Aim**: students get to know scientific work processes and are involved in the creation and further development of sustainable knowledge
- **Scope**: Replication and reproduction of an experimental study published in a high-impact journal (e.g. ASR, Sociological Science)
- **Goal**: achieving the concept of "research-based learning" (i.e. teaching **process** as well as **subject**)

My course design on experimental methods (2)

- During the course, students will gain hands-on experience:
    - Developing research (extension) ideas
    - Reviewing & critiquing scholarly work
    - Learning about open science concepts & best practices
    - Writing and posting pre-registration & analysis plan on OSF
    - Learning how to apply for ethical approval
    - Programming survey software
    - Completing a pilot test
    - Conducting data analysis
    - Writing a publication-ready paper
    - Completing a learning portfolio

My course design on experimental methods (3)

- Procedure
  1. First duplicate (using the same data and methods as the original study)
  2. Replicate with a new extension, i.e. collect new data with the same methods but new context

- Focus on recent experimental studies on ethnic boundaries[1]
  - Initial Extension: translating findings on ethno-racial boundaries in the U.S. to national boundaries (migration background) in Germany: Gereke et al. (2022) "Demographic Change and Group Boundaries in Germany: The Effect of Projected Demo-graphic Decline on Perceptions of Who Has a Migration Background" *Sociological Science*
  - Our extension: "Demographic Change, Muslim Immigration and Group Boundaries in Germany: Does information about threat vs. positive consequences of immigration lead to boundary changes?"

[1] Abascal, M. (2020). Contraction as a Response to Group Threat: Demographic Decline and Whites' Classification of People Who Are Ambiguously White. American Sociological Review, 85(2), 298–322. https://doi.org/10.1177/0003122420905127

What is a replication?

Replication is part of science:

- The construction of social science knowledge depends on the **generalizability** of research.
  - The goal is to establish general truths within certain scope conditions (like common features of neighborhoods, voluntary civic organizations or an entire society).
  - The development of "truths" comes from testing and re-testing to ensure "we are not dealing with a mere isolated 'coincidence'" (Popper, 1935, p. 45).
- Testing and re-testing is by definition a process of replication. The replicator is simply a scientist using previous knowledge to design a current study. Testing and re-testing (i.e. replication) is a well established scientific method.

No replication anxieties

- There is nothing unusual about replicating work done by prominent researchers.
- Pictures for replication:
  - Replication is like cooking with a recipe: Take the exact same steps and get the same results (narrow approach)
  - Replication is like a treasure hunt (in case of a wider approach, or when the students replicate less transparent pieces of research)
- "What's published is perfect"? Mistakes are ever-present in research, e.g.
  - example reverse coding a dichotomous variable for biological sex so that regression coefficients are reversed (Taylor-Gooby, 2011)
  - leaving in missing values that bias estimates of a behavior's frequency (Kahn & Udry, 1986 and Stojmenovska, 2019)
- Making mistakes is okay, even the best scholars make them.
- Just stay constructive and follow the "golden rule": Replicate others as you would like to be replicated yourself.

- There are many definitions in the literature

Table 1: Types of "Replications" in the Behavioral, Social, and Cognitive Sciences

	...Using the same data	...By collecting new data
Same materials, methods, code (i.e., no deviation)	Reproducibility Analysis	Direct/"Exact" Replication
Different materials, methods, code etc.	Robustness Analysis	Generalizability Analysis (Extension; "Conceptual" Replication)

- Duplication: Verification of research results
  -> same results expected

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- **Replication**: Robustness test of research results
  - -> diverging results unsurprising

Using a Pre-registration

- What is a pre-registration?
  - Report of hypotheses, data, and planned research design written *before* data collection or analysis
- Why pre-register?
  - Prevents selective reporting and p-hacking
  - Discloses confirmatory vs. exploratory analyses
  - Helps you plan and motivate your research
- Where to pre-register?
  - OSF: `https://osf.io/`
  - AsPredicted (UPenn): `https://aspredicted.org/`

Learning portfolio

- The application of the learning portfolio (Braeuer 2016):
    - A self-reflection tool
    - A tool to collect and document the learning progress
- Advantages of the learning portfolio:
    - Help students reflect on their learning experience
    - Focus on individual learning progress during the process rather than final outcome only

Student feedback

- ✓ "Now **I feel prepared to construct an online survey experiment myself** according to scientific standards."

- ✓ "It is also a very good experience to see how a research project in a larger team works. **It is so rewarding to see all the pieces coming together of all the work every person put into this project.**"

- ✓ "I also liked the group work since **I learned a lot from my fellow students**... like smarter coding approaches or even just new possibilities for presenting results."

- ✓ "**I think that the most important things I have learned were the practical implementations** e.g. - How to preregister a study, How to simulate power, How research funds influence the sample size"

- ✓ "I think that similar courses, which are practically oriented and organized like a small project, should be offered more often. They are **a great opportunity for students to see how working as a scientist may look like.**"

Multi-lab/Multi-site Course

The Hagen Cumulative Science Project I

- is a large-scale replication project based on students' thesis work
  AIMS:

  (a) teach students to conduct the entire research process for conducting a replication according to open science standards

  (b) contribute to cumulative science by increasing the number of direct replications

- 80+ direct replication studies to realize their BA and MA theses
- FOCUS: direct replications of studies published in the journal *Judgment and Decision Making (JDM)*

WHY JDM?

(a) includes topics and methods highly relevant to the expertise of the academic chair supervising the replication projects (chair of cognitive psychology: judgment, decision-making, and action),

(b) open-access journal providing data sets and supplemental material on the website for each article to easily reproduce the results with the original data (description see below), and

(c) topics are sufficiently diverse in content and methods to allow more general claims than in extremely narrow journals

students gained deep insights on

- ✓ real, purposeful scientific work and acquired special competencies in the following skills:
- ✓ evaluating research questions critically by understanding an original study in detail to prepare its replication,
- ✓ reflecting whether the applied methods of the original study allow to answer the posed research question, and
- ✓ obtaining firsthand experience concerning what it takes to conduct and document an empirical study in such a way that other researchers can potentially replicate it.

- The format integrates aspects of open science within the individual steps of conducting the empirical project.
- Students develop concrete skills such as conducting a power analysis and preregistration but also gain a broader understanding of the nature of accumulating knowledge in empirical science.
- MORE INFO at OPEN SCIENCE DAY UMA, Monday 10 Oct, Keynote (1-2pm): How to Teach Open Science Principles in the Undergraduate Curriculum—The Hagen, Dr. Marc Jekel, Faculty of Human Sciences, Social Cognition Center Cologne

Open Science Introduction Course

Example: Open Science in Social Sciences: Controversy, Crisis and Change, by Nate Breznau

- University of Bremen and the University of Zurich, Nate Breznau

  "This interactive seminar will introduce students to two concepts that are regularly heard across social science disciplines today: the "reproducibility crisis" and the "open science movement". We will start with a review of the events and discussions that cause many scholars, policymakers and the public to have negative views of science, or imagine it is in a crisis. We will start with science in general, and then focus on the social sciences including psychology, political science and sociology; and interdisciplinary related fields. Next, we will discuss empirical evidence supporting and opposing a crisis in the social sciences. Midway the course will shift focus to the various movements to change science. This review of the open science movement will eventually shift to how students can practice open science, or what we could simply call 'better science'. The course requires a final project in which the students must develop a way to make a contribution to science now."

Group Work: From theory to practice

As a group, think about how to...

- ...design an Open Science introductory course
- ...design a replication course
- ...design a Multi-Lab study course
- ...use OER for designing a new course
- ...open up the course process
- ...open up the course exams / final products
- Other

Feedback: One thing that you have taken away from today and one wish concerning the future of open science in teaching?

Open Science Resources

- Open Science Resources at UMA can also be used for developing/sharing teaching materials:
  - Open Science Office (grants, publication OA, etc.)
  - Mannheim Open Science Meetup (@MAOpenScience): grassroots initiative that brings together Mannheim-based academics from diverse backgrounds with a shared interest in transparent, reliable research (Mailing list).
- Project Tier (Teaching Integrity in Empirical Research): promotes the integration of principles and practices related to transparency and replicability in the research training of social scientists.
- Berkeley Initiative for Transparency in the Social Sciences
- Zotero bibliography on open science for teaching
- All you ever wanted know about OER: OER FAQ

Reference links on teaching replication

- Stojmenovska, D., Bol, T., Leopold, T. (2019). Teaching Replication to Graduate Students. Teaching Sociology, 47(4), 303-313.
- Johanna's course design on Experimental Methods: Replication Reproduction in the Social Sciences
    - Link: Johanna Gereke, Stifterverband
- Teaching Replication Workshop UMA 2020, materials on OSF
- WP MetaArXiv Preprint/Paper (under review):
  Teacher's Companion: How to teach constructive replications in the social sciences