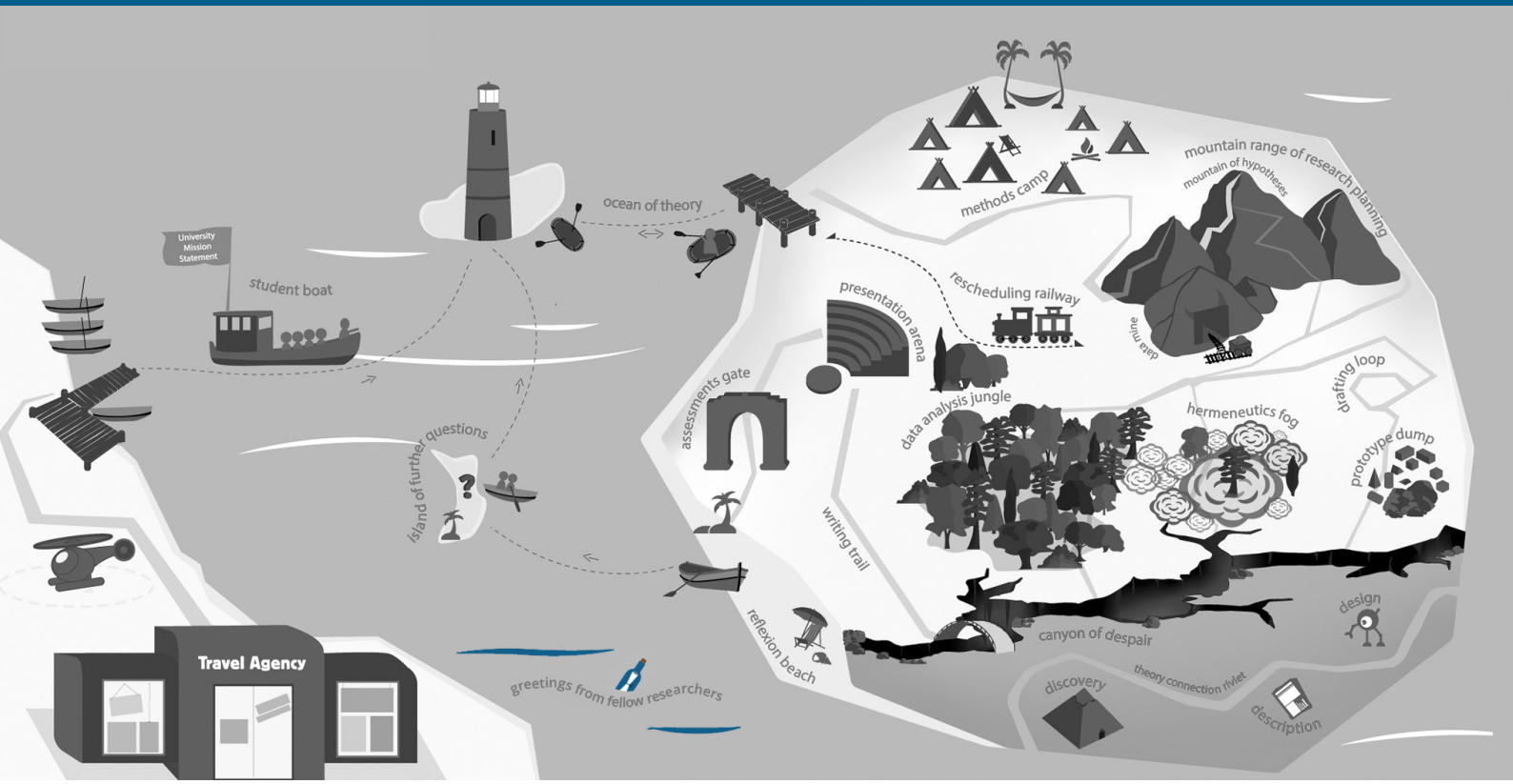
Examples & Good Practices

Research-based learning in the field of open science



KEYWORDS:

OPEN SCIENCE, REPRODUCTION OF SCIENTIFIC STUDIES, ETHICAL ISSUES

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Metadata

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Subject: Digital Science & Library and Information Science

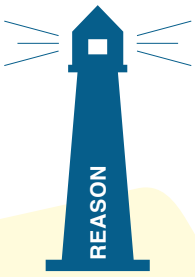
Abstract: The research-based learning opportunity presented here takes place in the Digital Science & Library and Information Science degree programmes and shows how students go through various research steps by reproducing a scientific study.

Special feature: 2 Master's courses, Reproducibility of Research Results

- Technical College Cologne
- Digital Science & Library and Information Science
- Master students
- Implementation: more than 3-times
- 6 CP & 4 SWS
- Number of students: 10-12

ENVIRONMENT:

Our research-based learning programme is offered in two modules, Open Science and Open Science & Science Communication, in the two Master's programmes Digital Science & Library and Information Science at the TH Köln University of Applied Sciences. The modules are designed to enable students to conduct research by simulating, expanding, and critically examining the research steps of a previously published scientific article of their choice. Students are free to choose the focus of their research and can explore a wide range of topics. They work on these in groups of two or three. In addition to their own research, students receive input from us on research data management and publication processes. Since some of our students have already completed another Master's programme, they are characterized by a high degree of independence and commitment.



- Personal professional concern
- Deficit or conflict

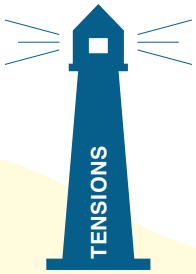
REASON:

The main reason for this type of module design and the focus on students' own research is partly based on a past deficit among students when writing their theses. We noticed that many students did not document their research steps 100% clearly and comprehensibly in their scientific projects, which is important in Open Science programmes. In order to convey to students the importance of transparent and comprehensible documentation of the individual research steps, we decided to organize our research-based learning programme so that students independently go through the individual research steps by reproducing a research study and thereby see how important a detailed and transparent presentation of the research results is. In addition, we had a fundamental interest in implementing the principle of research-based learning in one of our courses and linking it to topics related to Open Science.

- 1 semester
- Embedded in a course
- Curricular & mandatory
- Research process: instructed
- Feedback: peers, lecturers
- Research results: partly public

IMPLEMENTATION:

Our research-based learning programme can be described in three phases which merge into one another and are mutually dependent.
In the preparation phase, we provide an introduction to the topic with input on research data and publication processes. At the same time, students begin the search for a suitable topic and an academic study for their own research process. Systematic literature research or quantitative studies are particularly suitable here. Thematically, the students are very free in their choice of a scientific paper and can, for example, draw on psychological or scientific studies. For example, studies on psychology or artificial intelligence have already been reproduced in this course. In addition to the topic, the decisive factor for the selection of the studies is whether the individual research steps in the studies were presented transparently and in detail and to what extent the data and the software for data evaluation are freely available. These are important factors that are not given in many studies, so that the search for a suitable study can take some time or the student research teams may decide against the selected study after a thorough review and have to start the search again. After the research teams have decided on a study, they familiarise themselves with the theory and the chosen method of the study largely independently. In plenary sessions and one-on-one discussions, students discuss their selected studies and receive feedback and tips from us teachers and their fellow students on topics ranging from communication with the original researchers to data and software licences and criteria for aborting the reproduction attempt. All groups also present their initial results in a short interim presentation, which leads to further exchange, feedback and discussions.
In terms of research-based learning, students are given a great deal of freedom to decide on the topic and the study, while they orient themselves on the study in terms of the theoretical examination and the methodological approach. Nevertheless, students can use these criteria for further theoretical considerations and, if necessary, reflect on other methodological approaches that they can apply to replicate the study after reproducing it.
In the implementation phase, the individual research groups then begin to reproduce the study and independently evaluate the data. Often, they encounter problems, do not achieve their goal or come to different results than in the original study and then have the task of identifying possible errors in their data evaluation or interpretation or of proving errors in the original study. In this context, they discuss the results and compare their results and interpretation with those of the original study. Since reproducing studies can present a wide range of challenges, the extent to which students' progress in this research phase varies greatly.
Some research groups are not even able to completely reproduce the study in the time available because, for example, the data situation is unclear, the research steps in the study were not described in sufficient detail or familiarisation with the data evaluation tools took considerably more time than expected. Other students, on the other hand, can quickly reproduce their study and then use it to theoretically or empirically investigate further related research questions. For us as teachers, it is not important at this point how far the students get in their research; instead we evaluate only how intensively they have dealt with the study and the related data analysis and all the hurdles. In comparison to traditional research-based learning formats, the focus of the research work in our seminar is on data analysis, while data collection is only occasionally pursued as further research. During this phase, there are also various opportunities for students to exchange ideas, both in plenary sessions and in one-on-one discussions. This allows us to reflect on the research process together and support students who are stuck at a particular point in the data analysis. It is important that we, as teachers, take on a moderating role.
The presentation phase is characterised by two important aspects. Firstly, the students summarise the original study and its results in a presentation and describe how they reproduced it, what challenges they faced in doing so and what insights they gained. On the other hand, the students present their research in plenary for discussion afterwards. In this phase, we also reflect on what constitutes a transparent and detailed description of research and why this is so important in the field of Open Science. In addition, we encourage students to publish their results and data sets themselves and according to the self-developed standards of open science (e.g. on GitHub), although this decision is left to the students.

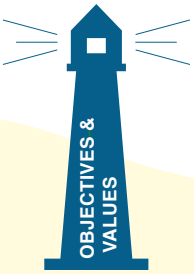


Tensions between demands for …
- Student heterogeneity and equity issues
- Student skills development & demands of the research process
- Changed instructor role and the existing teaching tradition

TENSIONS AND CONTRADICTIONS:

A fundamental tension arises from the different studies that the students choose themselves. On the one hand, this allows students to pursue their interests and emphasises the freedom of choice of the seminar. On the other hand, the different studies lead to very different research paths. Thus, some groups can very easily reproduce the research of the original study and then move on to more advanced questions or methods, while others have to overcome many challenges in reproducing the original study, which can lead to frustration and a feeling that the others are working faster or more efficiently. We try to communicate these tensions and the diversity of our seminar right at the beginning of the semester and throughout the semester and also show in the grading that we primarily assess the process and the depth of the discussion. In this way, we can counteract this tension, even if we cannot, of course, resolve it completely. For us as lecturers, there is also an area of tension at this point, as we naturally have different experiences depending on the topic, research method or data analysis tools and can therefore advise students better or worse depending on the chosen study and the associated research approach. This means that we, as lecturers, are constantly having to deal with issues of equity and must consider how we can supervise student research groups whose topic, research methodology or data sets have little to do with our specialities. Even if this task is time-consuming and labour-intensive, it still offers us as lecturers the opportunity to learn new things and familiarise ourselves with interesting topics and approaches as part of our teaching.

A further potential for tension can arise from the findings that are obtained when reproducing the original studies and lead to ethical conflict situations. For example, students may recognise errors in the original study during reproduction and then have to consider how to deal with this situation. This is particularly problematic if the study was conducted by experienced researchers or if the students plan to continue working in research. They are then often afraid of making enemies in the scientific context by discussing the error or fear that they have misunderstood something and that the actual error lies with them. Our task as lecturers is then to advise the students and check with them whether it is actually an error. However, we leave the final decision on whether and to what extent to contact the authors of the original study to the students. If the students decide to address the discovered error, the reactions can vary widely. While some researchers are very grateful for the information and have even published a new, revised version of the study together with the students, others do not react at all, which can lead to further tensions. At this point, both the students and we have to endure the tension and weigh up on a case-by-case basis whether taking risks or openly communicating mistakes is the right approach. Although this is stressful for everyone involved, the topic also leads to students thinking about research management, good scientific practice and scientific integrity at an early stage and understanding the importance of comprehensible and transparent research.



- Developing and acting on a scientific curiosity
- Dealing with mistakes and failure
- Discussing specialist literature
- Building on existing research

EFFECTS:

The main effect of participating in research-based learning is that students get a real idea of what is behind the term Open Science and how important the transparent and detailed presentation of research steps is. This realisation is reflected both in the moments of reflection within the seminar and in the presentations and other research work, in which the students place much more emphasis on the transparent presentation and publication of their research. In addition, the desire for transparent and detailed presentation also leads to students conducting more precise and clean research and also sensitises them to good scientific practice. They engage more intensively with the individual research steps and also recognise how these are interlinked.
The various reflections in the course and the ethical discussions on open science also show students how complex research is and what challenges are associated with it. In this context, we discuss how it can happen that some researchers do not follow scientific standards and talk about conflicts in the scientific community, which manifest themselves, for example, in the high pressure to publish. This gives students a deep insight and introduces them to tensions and conflicts in science during their Master's degree programme, which presents them with a more realistic picture and at the same time sensitises them to the importance of open science and conscientious research.