Teacher training for Open-Schooling Activities in the Research-Education Collaboration k.i.d.Z.21

Target group of this document: Teachers, (educational) researchers and out-of-school partners, who aim to initiate open-schooling activities.

Introduction: In order to prepare teachers for open-schooling activities in the Austrian local network, they get the opportunity to take part at a teacher-training in a High Alpine Mountain Area, where they discuss and experience the didactical principles of the research-education collaboration.

About the research-education collaboration: k.i.d.Z.21 – competent towards the future is a research-education collaboration between Austrian and Bavarian schools and the Department of Geography of the University of Innsbruck, Austria. Furthermore, (scientific) experts of different local, regional, national and international institutions in the field of anthropogenic climate change and sustainability are involved in the full school year collaboration.

k.i.d.Z.21 was founded in 2012 between the Department of Geography and a Bavarian high school with the aim to raise young peoples' awareness about anthropogenic climate change (CC) and to prepare them for the challenges of our time. Currently, the collaboration is funded by the European Union's Horizon 2020 research and innovation program under grant agreement No. 824522 within the project Science Education for Action and Engagment towards Sustainability.

The collaborative activities base on a modular structure and are designed for students of different school types aged between 13-18 years (see Figure 1). A kick-off event, which is organized by the Department of Geography, is the starting point of the collaboration with students and teachers, where they meet the first time the university team as well as (scientific) experts and local politicians. The aim of the event is that students get to know the team as well as the sequence of collaborative activities during the school year and have first discussion with (scientific) experts and politicians about climate change on a local and global level. During the school year students have classical school lessons on CC in different school subjects and develop individual CC research projects (e.g. students collected mobility data and developed an initiative to convince students and teachers to go to school by bike; others collected climate data within a village and compared it to data within the city centre etc.). Both modules are organized and guided by their teachers.

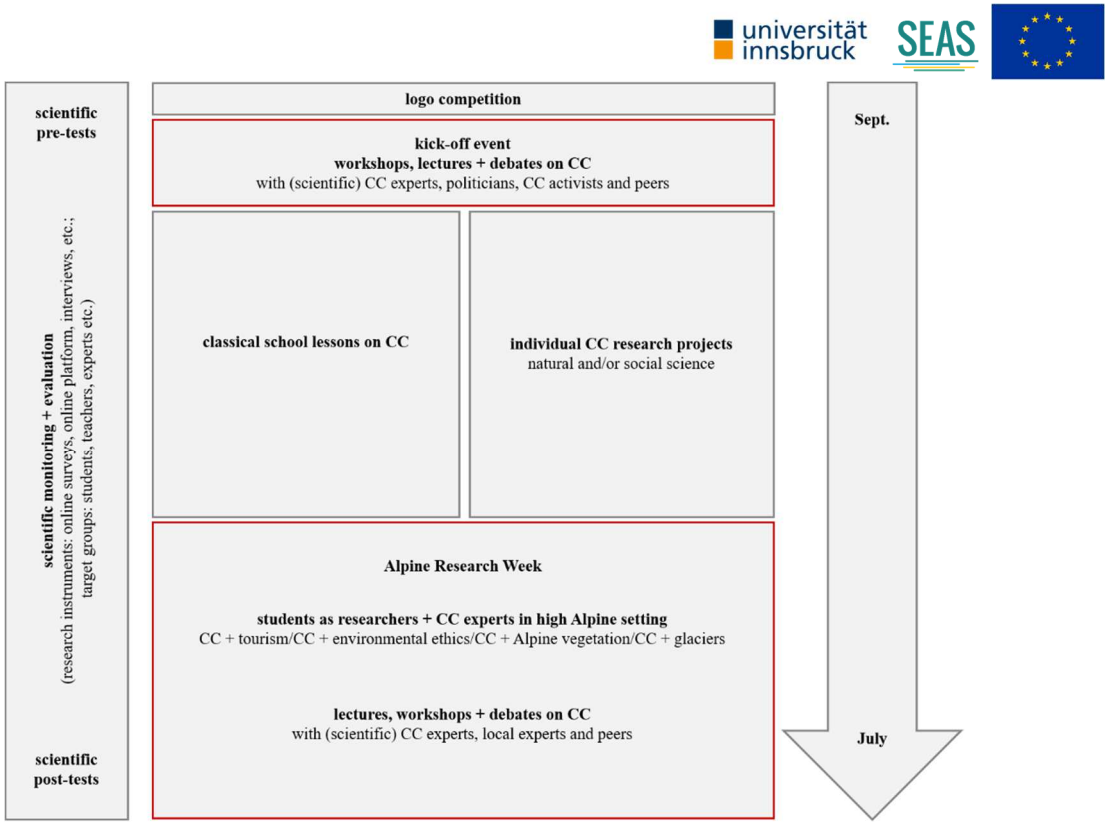


Figure 1. The modules of the Austrian research-education collaboration on anthropogenic climate change (CC). Source: Kubisch et al. 2022.

The university team organizes the last module, the Alpine Research Week, which takes place in a high Alpine Mountain area at the end of the school year. During the Alpine Research Week, students do research on CC in different fields (environmental ethics, tourism, glacier retreat, vegetation/soil/nutrition) and are supported by (scientific) experts in the respective fields. The synthesis day at the end of the Alpine Research Week is simultaneously the end of the collaborative activities during one full school year. At the synthesis day local (scientific) experts are invited to discuss with the students about CC at a local level and about still open questions. Students' learning effect is continuously monitored by the university team via a standardized online pre- and post-test.

Aims: Aim of the teacher training is an exchange between the university team and the teachers and to prepare the latter for the collaborative activities with students and the university team. The teachers get to know the modular structure as well as therewith linked organizational and content-related tasks. Furthermore, the teachers are introduced into the underlying didactical concept of the collaborative activities by actively experiencing an Alpine Research Week. The active experience should motivate and facilitate the implementation of the didactical concept in the modules which are guided by the teachers.

Didactical background of the research-education collaboration: The underlying didactical approach, which is the basis of all teaching and learning modules within the network, bases on a **moderate constructivist understanding of learning** (Basten et al. 2015; Dubs 1995; Widodo and Reinders 2004; Duit et al. 2013), which originates from the idea that learning is an active, situational, emotional, social and self-regulated process and consequently a constructive process (Reinmann and Mandl 2006). This process builds on available conceptions, originating from individual experiences and previous knowledge and is dependent on social and emotional processes and the learning environment (Riemeier 2007). From a pedagogical point of view, this understanding requires a shift from purely teacher-centered approaches of knowledge transfer to student-centered approaches of learning, since knowledge is constructed by the student. While radical constructivism parts from the idea, that knowledge transfer is impossible and that knowledge construction is a product of one person's interaction with the world, social constructivism additionally considers students' (social) environment (van Bergen and Parsell 2019). Allowing students the space to tie up with their preconceptions and experiences (Widodo and Reinders 2004), **moderate constructivism**, moreover, provides structure and support through carefully designed learning environments, which provide a balance between students' individual open space as well as instruction and support by the teachers (Reinmann and Mandl 2006).

The moderate constructivist approach is combined with **the principles of inter- and transdisciplinarity** (Lang et al. 2012) and **inquiry-based learning** (Pedaste et al. 2015). While in this context interdisciplinarity refers to cross-curricular learning within the modules **classical school lessons on CC**, **individual CC research projects** and **Alpine Research Week**, **transdisciplinarity** focusses on the collaboration and the mutual exchange between students and out-of-school stakeholders on equal footing in open schooling activities. Consequently, students not only get to know different perspectives on CC, but also critically reflect about CC and their role in climate protection through active engagement in research activities and a dialogical exchange with scientists both in the **kick-off event** and the **Alpine Research Week**. Moreover, learning environments which are aligned to the principles of **constructivism** are discussed to be more effective in raising students' scientific literacy, since they consider central aspects and aims of contemporary conceptions of scientific literacy, like participation at decision-making processes (Widodo and Reinders 2004). Furthermore, taking and tying up with students pre-conceptions, supporting students to get aware of previous hold assumptions, is a prerequisite for transformational learning, building the fundament for critically considering and questioning those in a later step (Gravett 2004). This is **where inquiry-based learning** comes in. Through **inquiry-based learning** students are empowered to follow their interest, identify problems, formulate their own research question, build hypotheses, collect data and find answers to their individual questions. From a didactical point of view, students are guided through a complex scientific process which is didactically reduced to its single phases (Pedaste et al. 2015). The active engagement with an issue in combination with the dialogical exchange with scientists and peers further creates a mutual understanding and fosters reflection of own values, attitudes and behaviors (Vilsmaier and Lang 2015). Inquiry-based learning is implemented in the **individual CC research projects** and the **Alpine Research Week**.

Procedure of the teacher training:

First day

- Participation at a scientific pre-test - standardized online questionnaire in order to capture teachers' pre-conceptions about CC
- Introduction to the teacher training - procedure of the teacher training
- Introduction to the collaborative activities - presentation of the aims, the modular structure and the didactical concept of the research-education collaboration
- Lecture: Education for Sustainable Development & Climate Change Education – overview of the demands on today's education and current discussions about effective Climate Change Education

Second day

- Field trip: Glacier & Anthropogenic Climate Change - Implementation of an authentic learning setting of the research-education collaboration about glacier retreat and CC, basing on the underlying didactical concept (see above)
- Lecture: Anthropogenic Climate Change – overview of current developments in CC research

Third day

- Field trip: Environmental Ethics & Anthropogenic Climate Change - Implementation of an authentic learning setting of the research-education collaboration about environmental ethics and CC, basing on the underlying didactical concept (see above)
- Lecture: Presentation of the research site – overview about ecological, economic and social factors of the site
- Selection of literature and discussion – the teachers have time to get insight into relevant literature and to discuss their findings afterwards. Literature about: CC, Education for Sustainable Development, Climate Change Education, Inquiry-based Learning, Moderate Constructivism, Inter- and Transdisciplinarity, Glacier, Environmental Ethics, Tourism, Vegetation.

Fourth day

- Elaboration of Possibilities of implementing the collaborative activities at the respective schools
- Participation at a scientific post-test - standardized online questionnaire in order to capture teachers' post-conceptions after the teacher training

References

Basten, S., S. Greiff, S. Marsch, A. Meyer, D. Urhahne, and M. Wilde. 2015. "Kurzskala Zur Messung Gemäßigt Konstruktivistischer Prozessmerkmale (Kurz-PgK) Im Biologieunterricht." Erkenntnisweg Biologiedidaktik, 43–57.

Dubs, Rolf. 1995. "Konstruktivismus: Einige Überlegungen Aus Der Sicht Der Unterrichtsgestaltung." Zeitschrift für Pädagogik 41 (6): 889–903.

Duit, Reinders, David F. Treagust, and Ari. Widodo. 2013. "Teaching Science for Conceptual Change : Theory and Practice." In Educational Psychology Handbook Series, edited by Stella Vosniadou. 2. Auflage, S. 487-503. New York: Routledge.

Gravett, Sarah. 2004. "Action Research and Transformative Learning in Teaching Development." Educational Action Research 12 (2): 259–72. https://doi.org/10.1080/09650790400200248.

Kubisch, S., H. Krimm, N. Liebhaber, K. Oberauer, V. Deisenrieder, S. Parth, M. Frick, H. Stötter, and L. Keller. 2022. "Rethinking Quality Science Education for Climate Action: Transdisciplinary Education for Transformative Learning and Engagement." Frontiers in Education (7:838135). 10.3389/feduc.2022.838135.

Lang, Daniel J., Arnim Wiek, Matthias Bergmann, Michael Stauffacher, Pim Martens, Peter Moll, Mark Swilling, and Christopher J. Thomas. 2012. "Transdisciplinary Research in Sustainability Science: Practice, Principles, and Challenges." Sustain Sci 7 (S1): 25–43. https://doi.org/10.1007/s11625-011-0149-x.

Pedaste, Margus, Mario Mäeots, Leo A. Siiman, Ton de Jong, Siswa A.N. van Riesen, Ellen T. Kamp, Constantinos C. Manoli, Zacharias C. Zacharia, and Eleftheria Tsourlidaki. 2015. "Phases of Inquiry-Based Learning: Definitions and the Inquiry Cycle." Educational Research Review 14 (1): 47–61. https://doi.org/10.1016/j.edurev.2015.02.003.

Reinmann, G., and H. Mandl. 2006. "Unterrichten Und Lernumgebungen Gestalten." In Pädagogische Psychologie, edited by A. Krapp and B. Weidemann, 613–58. Weinheim: Beltz.

Riemeier, T. 2007. "Moderater Konstruktivismus." In Theorien in Der Biologiedidaktischen Forschung, edited by D. Krüger and H. Vogt, 69–79. Berlin-Heidelberg: Springer-Verlag.

van Bergen, Penny, and Mitch Parsell. 2019. "Comparing Radical, Social and Psychological Constructivism in Australian Higher Education: A Psycho-Philosophical Perspective." Aust. Educ. Res. 46 (1): 41–58. https://doi.org/10.1007/s13384-018-0285-8.

Vilsmaier, Ulli, and Daniel J. Lang. 2015. "Making a Difference by Marking the Difference: Constituting in-Between Spaces for Sustainability Learning." Current Opinion in Environmental Sustainability 16:51–55. https://doi.org/10.1016/j.cosust.2015.07.019.

Widodo, A., and D. Reinders. 2004. "Konstruktivistische Sichtweisen Vom Lehren Und Lernen Und Die Praxis Des Physikunterrichts." Zeitschrift für Didaktik der Naturwissenschaften 10: 233–55.

This document was elaborated by Assoc.-Prof. Dr. Lars Keller and M. Sc. Susanne Kubisch of the Department of Geography of the University of Innsbruck, Austria within the project Science Education for Action and Engagement towards Sustainability.