Inquiry-Based Learning in Geography

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26.1 Geography – More Than the Sum of Its Parts

Global challenges such as climate change, scarcity of resources, food security or the energy transition, to name just a few, are not only central themes of the twenty-first century, but also the field of geography. In order to be able to cope with these phenomena, scientists and enlightened citizens are needed who are familiar with both natural science-related phenomena and procedures from the social sciences, and who can use resources responsibly. As a discipline, geography is situated both in the natural sciences and in the liberal arts and social sciences. Thus geography is predestined to account for the challenges in the sociopolitical dialogue, to address these, and to make an important contribution to overcoming these problems. In addition, like other subject areas, geography has not escaped efforts to define individual subfields, which have ultimately led to the German-speaking geographic system of scholarly segregation along a dividing line between the natural sciences and the social sciences (Gebhardt et al. 2011, pp. 71–83; Elverfeldt and Egner 2015, p. 319 et seq.).

Due to the complexity of the topics outlined above, as well as the variety of methods and procedures that characterize the subject, it is already clear that the approach of *inquiry-based learning* has tremendous potential, especially in geography. Moreover, this methodology could also overcome barriers within the field.

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26.2 Predestined for Each Other: On the Nature of Inquiry-Based Learning and Points of Reference in Geography

26.2.1 Points of Reference in the Field of Geography

According to the definition by the German Geography Society, the field of geography deals with the earth's surface, with landscapes, with the people and with locations, as well as with people's material and cognitive environments. Thus geography examines the physical and social world in which we live. It is also about the mutual relationships between the physical and social environment and the associated spatial impact. As we have already made clear, geographical problems arise in both the natural sciences and in the liberal arts, social sciences and economics. Looking at the degree programs offered by the geography departments in the German-speaking countries and their range of studies makes it clear that current questions in geography include the intertwined processes of "global change" and globalization, as well as global relationships between the environment, culture and economy, resource management and sustainability (especially in terms of water and soil), urban development and business development, or political ecology and vulnerability.

With this in mind, the aim of the study of geography is for students to acquire skills and methods that enable them to gain insights into physical and social processes within the concrete context of places and regions, and to contribute to solving problems. In doing so, geographic insights are generated using methods from both the natural sciences (e.g. field and laboratory analyses), and from the social sciences, as well as history (e.g. survey and interview techniques, observation or source analysis). This results in a variety of techniques used in the discipline. These include dealing with geographical information systems (GIS), remote sensing (satellite and aerial image analysis), laboratory methods, map interpretation, interview techniques and statistical analyses, as well as archival research or text and media analyses. The special characteristics of the field of geography can be summarized as follows:

- variety of topics and methods;
- interdisciplinary approach;
- multi-perspective view;
- multi-paradigmatic structure of the subject.

Based on the above, it is clear that, due to its conception, the field of geography makes the following demands on learners:

- Learning in multiple contexts: Not only must subject matter content be transferred to other contexts, but different problem statements must be developed on different scale levels.
- Learning from multiple perspectives: Subject contents must be examined from different perspectives. Because it is situated at the intersection of the natural sciences, social sciences and liberal arts, geography is particularly geared towards interdisciplinary work.

- Learning in multiple contexts: In the course of field research and project studies, learners are encouraged to develop subject content and solution strategies in multicultural teams.

Thus, essential prerequisites for *inquiry-based learning* already exist, as a result of which there are already numerous starting points for the use of this method in this subject. The following forms based on Huber (2009) are particularly suitable for geography:

- complex laboratory tasks in the field of physical geography where the paths of knowledge and results are open;
- investigation of specific individual case studies;
- excursions and field internships ("field studies") with open topics and methods;
- testing methods on problems not yet investigated within the context of courses or projects;
- planning or other simulation games, in particular for the subfields of economic and social geography;
- project studies of various sizes.

26.2.2 Experiences with Inquiry-Based Learning in the Field of Geography

As already indicated, the concept of inquiry-based learning is already practiced at various universities in different fields. The reasons for the (still) restrained application of this concept are mostly to be found in structural and practical difficulties. A survey of scientists in the field revealed that geography is facing the challenge of satisfying the autonomy requirements of inquiry-based learning in the limited time frames within the structures of modularized bachelor's degree programs, master's degree programs and teacher training contrary to instructive teaching and reproducing forms of learning. This means that time and lessons planning are very tightly organized, especially in the bachelor's degree, which does not allow a greater time expenditure for inquiry-based learning. In addition, the allotted material to be covered is strictly defined, which makes a freer topic selection for inquiry-based learning more difficult. Moreover, for some of the respondents, there is an additional difficulty in the fact that inquiry-based learning is not compatible with the forms of examination available, and thus no evaluation can take place. In addition, the lack of resources, especially in the form of staff, determines the situation in teaching at German institutions of higher learning. According to the respondents, the poor staffing of the institutions of higher learning in terms of instruction, the low value assigned teaching within the professional community, the lack of subject-didactic training among staff and uncertain prospects, especially for up-and-coming scientists, make it difficult to engage in consultation-intensive forms of teaching and learning.

Thus it is in no way surprising to find that personal involvement is often the engine that drives inquiry-based learning in higher education instruction at the cost of significant extra work for the individual(s) involved. Overall, it should be noted that the range of courses devoted to this teaching method tends to be isolated, i.e. the courses do not dovetail with other courses. Usually, they are offered as a block course or in semester-oriented seminars. In these seminars, students have the opportunity to develop their own questions and to implement them within the context of smaller studies and to search for solution strategies. In addition, the methodology was also tested during excursions and field exercises. In terms of the openness and design of the courses, the spectrum ranges from the specification of the problems up to completely open offers, in which the students must define a problem independently (variants of the inquiry-based learning in courses were tested at the geographical institutes of the universities of Frankfurt, Freiburg, Halle, Hamburg, Hanover, Jena and Potsdam, among others). Instructors provide support and advice in particular within the courses. It should also be noted that the courses are very often directed at students of teaching. It is argued that these students need to be prepared for the demands of the teaching profession and day-to-day school life. Practical experiences in the field of cooperative learning and work contexts are more important for these students than they are, for example, for master's students.

The results of the evaluation of the research-oriented courses at the geographical institutes at the universities mentioned above show that the students are very satisfied with this form of learning. It turned out that managing a thematic and/or methodological complex independently not only can lead to a deepening of technical and methodological competence, but can also train competencies such as teamwork and cooperation skills in particular. In this context, instructors have repeatedly pointed out that well-functioning and harmonizing groups have developed in courses of this sort that have developed a special group knowledge and strongly subsisted from one another's perspectives, a circumstance that is rather rare in "traditional" courses.

26.3 From Theory to Practices: Experiences with the "Freiburg Research-Oriented Teaching/Learning Approach"

How can students be specifically involved in research processes as suggested by Jenkins and Healey (2010)? And what would participation in research even look like? These and similar questions keep coming up regularly when preparing courses. At least according to the theory, the inquiry-based learning approach systematically introduces the way in which scientists think and work, and can enable students to understand and evaluate research processes and to apply the knowledge gained thereby. What this might look like in geographic teaching practice has since been tested over a ten-year period and manifested as a research-oriented approach to teaching/learning (see Fig. 26.1).

The Department of Physical Geography in Freiburg has maintained research partnerships in North, West and East Africa for many years. For this reason, it made sense to

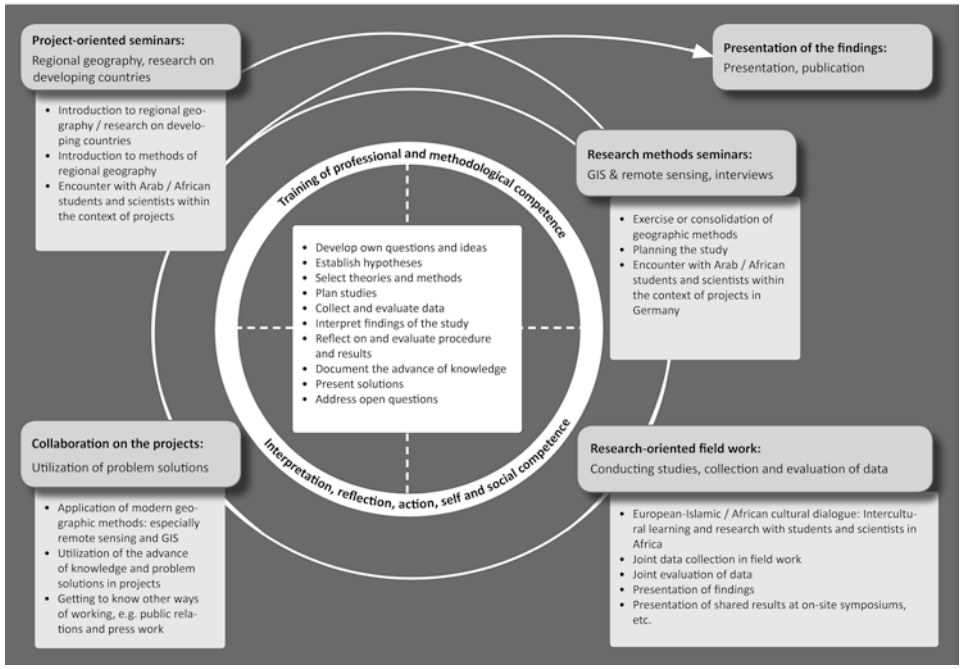

Fig. 26.1 The "Freiburger forschungsorientierte Lehr-/Lern-Ansatz" ("Freiburg research-oriented teaching/learning approach"). (Modified in accordance with Passon and Braun 2013, p. 42)

integrate the research projects in this field into teaching and to combine them with the inquiry-based learning method. The foundation for the approach to teaching/learning described here was laid with the project "Learning Through Dialogue" ("Lernen durch Dialog"), a research partnership funded by the DAAD and the Center for National Archives and Historical Studies in Tripoli (Libya) (Passon and Braun 2013). After successful testing, several modules were integrated into further exchange projects with West and East Africa with the intention of involving master's degree programs and teaching degree programs in research processes.

26.3.1 Preliminary Considerations

Since there is no unified theory or didactics of inquiry-based learning related thereto (Koch-Priewe and Thiele 2009, p. 271), it is necessary to draw on other learning theories as a background. Here, the approach of *discovery learning* is appropriate, which Bruner (1981), for example, defines as the self-learning interpretation of a knowledge area, whereby the instructor has only an observational and helping function. Learners should be trained to acquire knowledge independently and to solve problems that arise themselves. As a rule, discovery learning tends to handle problems rather "artificially" and allows

learners to review and reflect on their solutions using model solutions (Bruner 1981). Ideally, inquiry-based learning goes one step further by focusing on unresolved research problems. Inquiry-based learning is also in no way merely a didactic trick to motivate students. Rather, the goal is to achieve "education through scholarship" (*Bildung durch Wissenschaft*, Huber 2004, p. 34) and to impart frequently required key competencies to the students (ibid.).

In considering which competencies should be taught in the research-oriented approach to teaching/learning, the following categories of competencies were formulated (for the structuring of the content, see Fig. 26.1):

- professional competence,
- methodological competence,
- analytic, reflective and occupational competencies, as well as
- self-competence and social competence.

A central concern of the approach to teaching/learning presented here is that it be possible to make the individual projects which are subsumed under this approach tangible to students in terms of the cultural and social dimensions, as is required for inquiry-based learning according to Huber, for example. In addition, these projects are to address the cognitive, emotional and social dimensions of learning (Huber 1998, 2003; Euler 2005). It is also important to create free space for students in terms of content. Individual teaching/learning projects should be designed so that students are actively challenged (Knowles 1975). They should be supported in thinking, planning, researching, learning, investigating and communicating with the lecturers or visiting scientists from countries such as Libya, Namibia, Cameroon or Ghana and other experts from different countries, as well as in connecting with other students.

26.3.2 Implementation

In concrete terms, research-oriented teaching/learning projects at the University of Freiburg extend over several semesters. As shown in Fig. 26.1, the projects are comprised of various modules, some of which are compulsory and some of which are elective. In addition, care is always taken to integrate the individual elements into the course of study in such a way that it is possible to accredit the seminar and project reports submitted by the participants as study-related achievements.

Project-oriented seminars with a regional focus or those that can be assigned to the subject area "Geographical Development Research" initially comprise the basis of the research-oriented teaching/learning projects. In addition, methodological seminars (e.g. introduction to or deeper look at geographic information systems, preparation of remote sensing recordings, preparation of interview guides or questionnaire) can be selected, in which the methodological knowledge required for the field visits is imparted or enriched.

The tasks set in these seminars are already directly related to the subsequent fieldwork. These courses also help students acquire the necessary theoretical, methodological and regional knowledge. Even in inquiry-based learning, the learner needs a solid foundation of knowledge in order to be able to think and act in a differentiated and creative way (Nuissl 2006, p. 222). Often, these seminars are already facilitating initial encounters with students and researchers in the country involved in the project cooperation. This is followed by the option of participating in the data collection for the respective research project at the institute during research stays in the various African countries, as well as of working on their own research question. To this end, attendance at block seminars that include project-specific preparation and intercultural training is required.

All research begins with a question, an idea or a problem. For this reason, practical questions form the starting point of the teaching and learning projects. The objective is to involve students in the implementation of research projects and to work with them to develop solutions that can also be applied in practice. A first task is to formulate research questions with the instructors and to define a study design, which requires intensive consultation and support from instructors. In so doing, hypotheses must be formulated, the research subject described and the research process defined. A research design is needed in order to move from a question to knowledge. Students must first acquire knowledge about the sequence of individual research steps as well as about research-related decisions that arise within the process. They must also be made aware that these research processes are variable and in reality rarely follow a fixed pattern:

1. impetus to conduct research
2. research subject and question
3. levels of analysis
4. project design
5. project implementation
6. reflection

In order to be able to work on the research questions, students must assess, select and apply models of research and research methods based on their suitability for the chosen problems. In addition, concrete research tools need to be developed (including interview guides, questionnaires, remote sensing data such as panchromatic and multi-spectral satellite scenes or aerial photographs), and preparations made for conducting the research. In concrete terms, this means that the research question has been found and the research design created in advance of the field work. Afterwards the data will be collected during the field work, and plans, sketches and/or maps will be developed. Collected data is evaluated by students using statistical software (R, SPSS), remote sensing programs or geographic information systems (GIS).

With regard to strengthening personal competencies, it should be noted that students work closely together with the partners, authorities or non-governmental organizations on-site at the respective projects. Autonomously planned and team-oriented or

multicultural projects and case studies are created in this way. Some of the examples below are intended to clarify these explanations:

- GIS-based mapping of a section of the medina of Tripoli, Libya ("Learning through dialogue"): Mapping central commercial districts in Tripoli's Medina. The results of the mapping were made available to local urban planners.
- Film project on intercultural encounters in Libya ("Learning through dialogue"): Short film project on intercultural collaboration with scientists and students in Libya. The submission by three students won the DAAD Youth Award.
- Crowd sourcing of spatial data in practice in Cameroon ("LUNA project"): the OpenStreetMap (OSM) platform has made data accessible to the public with the assistance of interested citizens.
- Inventory and preparation of traditional recipes in Cameroon ("LUNA project"): Book project on the importance of indigenous vegetables for food security in an urban context. A book of recipes was developed in collaboration with peasant farmers and cooks; it deals explicitly with indigenous vegetables, their significance and use. The book was published by the World Vegetable Center, a project partner.
- Participation in a continuing education program for Ghanaian partners ("Urban Food^{Plus}"): Students took on the role of instructor and passed on their acquired knowledge within the context of continuing education programs. The "Urban Food^{Plus}" project also offers students the opportunity to carry out geodata acquisition using state-of-the-art technology.

In addition, engagement with students and partners from other cultures offers the opportunity to become familiar with and understand one's own culture or oneself better. In addition, the students participate in international symposia and meetings with representatives of German authorities abroad (e.g. embassies) or carry out press activities. In addition, they have the opportunity to work on the project as student assistants and to continue to apply or deepen what they have learned, especially in the field of remote sensing, GIS and cartography.

As shown in Fig. 26.1, at the heart of the teaching and learning projects is the development of interpretive and reflective competencies, as well as the training of specialist and methodological skills. Critical reflection on the research process in particular plays an important role. Students should learn to draw conclusions as to whether and how future work can be done more effectively in similar research and problem-solving situations. The emergence of reflective competence is certainly the biggest challenge and should be targeted, systematically guided and instrumented accordingly (Korthagen et al. 2002; Kroath 2004). Reflective moments should be like a "common thread" that runs through the entire process, and space and time must be provided for reflection. This can be done by creating an e-portfolio in which learners can visualize the development of their learning progress (Fichten 2010).

26.4 Summary and Outlook

The structure and implementation of the various courses (see Fig. 26.1) shows that the acquisition and deepening of specialist knowledge associated with student activity and the learning of methods through their application are central aspects of the teaching/learning projects. Controlled and autonomous learning phases alternate repeatedly, with the role of instructors constantly changing between acting as knowledge facilitators and as consultants. The systematic appropriation of the ways in which scientists and experts in professional practice think and work requires a high degree of independence and self-guidance.

The results of the course evaluation show that the students have chosen this form of learning for self-determined motives in particular (for example to achieve professional goals). In addition, it became clear that longer-term and more in-depth study of a complex of topics not only leads to more profoundly developed technical and methodological skills, but also makes it possible to acquire a kind of expert knowledge that is often neglected in university life due to the focus on output. However, the students emphasized two soft skills, "a capacity for teamwork" and "intercultural competence," that they have acquired in particular, which are more important than ever in a globalized work environment. By contrast, however, there is the enormous time expenditure that needs to be spent on such a course.

For geography, this very specifically raises the question as to how inquiry-based learning can be structured in a curricular and didactic-methodical way under the conditions of the current study structures, so that there can be a meaningful reciprocal relationship between research and teaching while simultaneously counteracting the current tendency to reduce university instruction to the level of school instruction. Consequently, further didactic-methodical considerations are required in order to permanently establish the developed procedure under the conditions of the current study structures. For technical and didactic reasons, it is worth strengthening the initiative of students by creating appropriate teaching/learning arrangements and disclosing their expectations. With the help of well-thought-out coaching, students' "own" research ideas and questions arise automatically.

Only if these conditions are fulfilled can students contribute to the development of geography by participating in real research questions. Last but not least, this methodology could also overcome barriers within the field. Kindling this fire is worth the effort.

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