

## Research Article

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## **"This question is too personal!" Guided Inquiry as Part of Teaching Human Geography Research Methods**

Günther WEISS<sup>1</sup>*University of Cologne, Cologne, GERMANY*Elisabeth GOHRBANDT<sup>2</sup>*University of Cologne, Cologne, GERMANY*

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### Abstract

Although inquiry-based learning is connected with a number of advantages, especially in the field of human geography, very little research has been carried out in lessons by the learners themselves to date. The aim of the study at hand is, therefore, to facilitate the process of solving problems from the sphere of human geography through the use of guided inquiry in geography lessons. To encourage the learners to recognise the purpose of the rules of research, two distinct teaching concepts were developed and empirically tested: selection decisions and a simulated pre-test. The assessed instruction was prepared and realised in two 5<sup>th</sup> form classes at a grammar school with 47 learners in total. The evaluation of the lessons was done through a standardised test to determine accrued learning and partly standardised observation of learners' performance and motivation. The observation confirmed that the learners welcomed the opportunity to conduct research independently and that they engaged enthusiastically. Nevertheless, details of the research design tended to be dealt with intuitively or based on previous knowledge. There is no clear evidence of success of the methods training. The observations allow the conclusion that the simulated pre-test passes by too quickly and harbours too many distractions. Meanwhile, the selection principle with a parallel discussion are more likely to lead to success.

### Keywords

Inquiry-based Learning, Human Geography Research Methods

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<sup>1</sup> Corresponding author: Senior Lecturer, Institute for Geography Education, University of Cologne, Gronewaldstr. 2 D-50931 Köln Germany, e-mail: [g.weiss \[at\] uni-koeln.de](mailto:g.weiss[at]uni-koeln.de) +49221 470 4627

<sup>2</sup> Senior Lecturer, Institute for geography, University of Cologne, e-mail: [e.gohrbandt \[at\] uni-koeln.de](mailto:e.gohrbandt[at]uni-koeln.de)

School-based instruction faces the problem that pupils often only study for examinations. Knowledge gained during lessons frequently cannot be transferred to everyday situations, is not perceived as meaningful, and is therefore soon forgotten. The problem-oriented learning approach is specifically concerned with this phenomenon: In order to prevent inert knowledge, which is perceived as useless, and thus to prepare learners more appropriately for the professional, social and private reality of life, the application of knowledge to everyday, real-life situations is given greater emphasis. When, as a result, learning makes sense to the pupils, the transferability of the knowledge is supported, the motivation is enhanced (Hmelo-Silver, 2004, pp. 240-241).

In didactics of geography, various approaches adopting a problem orientation have moved to the fore since the late 1990s. Amongst them are, in particular, problem-based learning (e.g. Spronken-Smith, 2005), inquiry-based learning (e.g. Spronken-Smith et al., 2008), enquiry-based learning (Roberts 2013) and the concept of "thinking through geography" (Leat, 1998). What these approaches have in common is that the focus is placed on the process of problem-solving by or with the learners. Taking the problem as a starting point aims to pre-structure the approach and evoke the intrinsic willingness to want to arrive at a solution in an active and self-directed manner. The concepts differ mainly in how the solution to the problem should be sought. A first fundamental difference lies in the question whether the finished solution needs to be merely detected or devised. "Detected" means that it primarily involves gathering pieces of information and identifying amongst them those which are suitable for solving the problem (this applies to problem-based learning and enquiry-based learning). "Devised" focuses on the objective that the solution itself should be explored, the solution process should be tested (this applies to thinking through geography and inquiry-based learning). A second difference can be seen in the degree of independence of the learners. The spectrum ranges from extensive pre-structuring by the teacher (this applies to thinking through geography) all the way to learners broadly operating freely in inquiry-based learning (Savin-Baden, 2006, pp. 15-19). The "devising" of solutions by pupils in inquiry-based learning, in other words, research that is as independent as possible, is necessary when the aim is not merely to solve a problem, but also to gain competence in applying subject-specific scientific methods. For, it is only by doing so that learners can understand why a scientist proceeds in a specific way. In order to avoid frustration and inefficiency, the teacher should steer the research conducted by the pupils in a "guided inquiry". However, opinions differ about the optimum degree of steering and appropriate procedures for accompanied research.

Especially in the field of human geography, very little research has been carried out in lessons by the learners themselves to date; the conveyance of specialist methods, if it occurs at all, tends to happen in isolated units of instruction, without being linked to a problem requiring a solution, which would provide a meaningful backdrop. The aim of the study at hand is, therefore, to facilitate the process of solving problems from the sphere of human geography through the use of guided inquiry in geography lessons. The challenge here lies mainly in achieving active research that lends real meaning in a relatively small window of time. In order to promote methodological skills in the research process, learners, starting from a pre-formulated presentation of a problem,

should independently reach an understanding that the solution of the problem requires their own research effort, which research tools are appropriate for solving the problem, and how these can be designed, implemented and evaluated in a meaningful manner. One central objective of the guided unit of instruction is to encourage the pupils to recognise the purpose of the rules of research, so that they are subsequently in a position to construct useful research instruments themselves, which are compliant with the rules. To achieve this, two distinct teaching concepts were developed and empirically tested: selection decisions and a simulated pre-test. The condition stipulated here was that it had to be feasible to carry out the research project on a normal school morning (5 hours).

While a series of studies exists investigating natural science research by pupils, including geography lessons, and particularly in relation to experiments, inquiry-based learning with methods of human geography is given less consideration. Consequently, the study at hand places its focus on standardised interviewing and mapping as classical working methods applied in human geography.

The study explores the following research questions: (1) Can 5<sup>th</sup> form pupils grasp the fundamental rules of research methods pertaining to human geography, which are conveyed and practically applied in a taught unit lasting 5 hours, and can they transfer these to similar research problems? (2) Are there differences in the retention and transfer of research rules relating to the standardised interview as compared to the rules of mapping? (3) Are there differences in the retention and transfer depending on the teaching concept selected (selection decision or simulated pre-test). In order to address these questions, pupils receive training in the methodology of either the standardised interview, or of mapping. In each case, the training is delivered to a number of pupils using the teaching concept of selection decision, while a simulated pre-test is used for other pupils.

Prior to presenting the design and the results of the study, the first step is to introduce the inquiry-based learning approach and the utilised delivery concepts of a guided inquiry.

## **Theoretical Framework**

### **Inquiry-Based Learning**

Inquiry-based learning means giving central importance to the path along which scientists acquire their knowledge, to how they study their environment and how they gain explanations. In other words, it is about scientific literacy (Colburn, 2000, p. 42; Mayer, 2007, p. 76). This method serves as a general preparatory scientific instruction; it introduces the fundamental notion that all scientific findings were achieved through the application of empirical methods. For the learner, the insight that facts do not exist *per se*, but were gained empirically, opens up the perspective to carefully scrutinise knowledge on principle and to develop it further herself or himself. Not least, active research signifies an action orientation; the learner must become active in order to achieve a result (the solution to the problem) (Crawford, 2007; Anderson, 2007). It is about the acquisition of primary knowledge by the means of a methodology that should

meet the criteria of scientificity. Here, it makes no difference whether previously existing insights are researched once more, or whether it involves genuinely new insights. What is crucial is that the insights won in the process of addressing the problem are themselves an incentive to learn, and it is not a matter of applying previously learned knowledge to the problem (Jonassen, 2011, p. 101). Learners are encouraged to solve the problem through contemplation and experimentation, and thus arrive at new insights themselves.

Based on a literature review, Martius et al. (2016) identified fundamental characteristics of inquiry-based learning (c.f. also Mandl, 2003, p. 9; Mayer & Ziemek, 2006, p. 7; Hasselhorn & Gold, 2013; pp.262-264.): A course in phases of a simplified, ideal-type scientific cognitive process (definition of the problem, planning of the solution, implementation, documentation, evaluation), independent activity of the pupils, the teacher as a tutor who exercises restraint, cooperative learning, complex, realistic situations as initial problem, authentic and relevant topics, as well as subjectively new insights for the pupils.

Inquiry-based learning is said to have a number of advantages: Authors representing moderate, knowledge-based constructivism are of the opinion that knowledge is fundamentally constructed by the human being (Meixner & Müller, 2001, p. 7; Reinmann & Mandl, 2006, p. 626). Here, learning is the classification of new information into existing knowledge structures within a coherent context. According to this, the primary objective of human activity is to organise the information gained from experiences, and to invest it with meaning. The process of constructing meaning gives rise to questions and these prompt the human being to engage in research efforts, in order to find an answer to these questions (Doherty et al., 2002). Learning is consequently active, self-directed, it builds upon what already exists, it is situational and contextual, and it is influenced by interaction. Furthermore, the constructivist theory of learning assumes that that which has been discovered personally is more successfully retained than knowledge which is merely imparted and comprehended in a receptive manner. In addition, problem-solving through detection allows the acquisition of heuristic methods at the same time, both qualifying and encouraging schoolchildren to seize upon new questions through the transfer of methods (Hasselhorn & Gold 2014, p-189ff.). Thus, learners are introduced to research in a given discipline in a more appropriate manner (Spronken-Smith & Walker, 2010). This process is intended to yield questions devised by the learners themselves, in which they ask the initial question anew and in accordance with their needs. This questioning attitude creates motivation, which in turn is significant for maintaining the necessary level of concentration during testing (Hasselhorn & Gold, 2014, p. 290). In contrast to traditional instruction, inquiry-based learning achieves a more effective form of learning, particularly in terms of creativity, analytical and critical thinking, as well as a more profound understanding, and furthermore it makes learning more pleasurable (Spronken-Smith et al., 2008, p. 78). Many learners think in concrete terms and struggle with abstract concepts. These individuals find a process, which approaches a question directly through an examination with concrete, observable objects, very helpful (Colburn, 2000, p. 43). Kuhlthau et al. (2015, p. 6) fear that while modern information technologies provide quick answers, the

use thereof leads to a withering of the ability to ask detailed questions and to search for satisfying answers. The abundance of information that is only valid for a brief period of time or is incorrect, makes the search for information, which is truly relevant in order to cope with daily life and with a job, more and more important.

Disadvantages arise particularly when exploring and experimenting is carried out through aimless trying, when objectives are not lined up with gaining insight but with activities, and when the absence of a reference to existing knowledge means that inappropriate subjective theories are not amended (Neber, 2006, p. 118). Further points of criticism mentioned include a high expenditure of time, low efficiency compared to instruction due to the open-ended problem solution, problems with the group dynamics in relation to cooperative approaches to solving problems, the expectation of the teacher to deliver a teaching performance, the notion that learning involves the transfer of information and the expansion of knowledge, the loss of the accustomed security of traditional instructional learning, as well as the feeling of insufficient efficiency, measurability, productivity, and standardisation amongst teachers and learners (Pawson et al., 2006, p. 108 and overview table p. 107).

Inquiry-based learning is traditionally firmly anchored in natural science instruction, where it serves for the development of science-related methods of thinking and working (Mayer, 2004). In the model of scientific discovery as data search by Dunbar & Klahr (1988), the stages of the cognitive process comprise the generation of hypotheses through correlations, the construction of a design of hypothesis testing with the identification of relevant and exclusion of irrelevant variables, and the analysis of the findings. Other authors (e.g. Otto et al., 2010, pp. 42-43) first add the independent formulation of a question by the learners. Depending on the degree of independence of the learners, inquiry-based learning is usually divided into three separate steps (Herron, 1971; Colburn, 2000, p. 42; Bianchi & Bell, 2008; see also degrees of opening according to Furtak, 2006): In the structured inquiry, the learners are provided with the problem, the procedure, and the material; merely the result is left open. In the guided inquiry, only the problem is described; the solution approach and the result remain open. In the open inquiry, the learners themselves formulate the problem and the approach to solving it. As experimenting freely through trial and error is a direct contradiction to the endeavour of the school to guide the learners (Bertsch et al., 2011, p. 175) and the advantages a free form of learning without instruction have not been proven (Mayer 2004, p. 17), this form of open inquiry is only suitable for experienced learners. The difficulties for the learners lie mainly in the planning. In other words, it is not easy for them to identify a system, and to discern relevant variables and control variables (Mayer et al., 2006).

Inquiry-based learning is at its most effective, if there is clear structuring and area-specific prior knowledge (Loyens & Rikers, 2011), because the formation of hypotheses is contingent upon foreknowledge, on an intuition of what the causes and reasons might be (Martius et al., 2016, p. 3). This is why the coaxing of the learners by the teacher towards research is of central importance. There are no fixed rules for guiding inquiry-based learning, but rather there are different opinions. In the hybrid form of the

“discovering presentation”, for example, inductive discovery prepares for the consolidation of contents through instruction (Blessinger & Carfora, 2015; Schwartz & Bransford, 1998). In the learning circle (Colburn, 2000, p. 42), the pupils establish a new correlation through guided inquiry, find out the matching technical term and the official formulation from the teacher, and subsequently apply the correlation in a variety of different contexts. One basic strategy to support learners with inquiry-based learning is to follow a path of strongly structured forms of problem-solving (including the provision of training for individual skills and research stages) at the outset, using forms of increasing degrees of openness. Furthermore, it is helpful to carry out research in small groups and to reduce the complexity of initial problems (Neber, 2006, p. 118; White & Frederiksen, 1998).

### **Research-Led Problem-Solving During Geography Lessons**

Dealing with problems in order to focus on geospatial social problems (e.g. environmental pollution) has a long tradition in geography lessons. Geography instruction is generally regarded as very suitable for applying a problem-oriented approach. Providing reasons for this, Spronken-Smith (2005, p. 206) lists the interdisciplinarity of the subject, the tradition of the application of methods in fieldwork, the tradition of cooperative forms of instruction, and the great importance of geotechnologies as a professional field of the future (see also Gerwin, 2004, p. 376).

Nevertheless, in the context of geography lessons at secondary schools, inquiry-based learning plays a subordinate role. A number of examples for primarily self-directed, inquiry-led problem-solving by learners in geography lessons (e.g. the search for contaminated sites, environmental audits for industrial corporations) are presented by Spronken-Smith (2005) Spronken-Smith et al. (2008), as well as Roberts (2013), though these are usually taken from a university context. Boesch (2015) evaluates the exploration of environmental conflicts by students. For the purpose of these studies, the data collection for each problem was generally performed by conducting searches on the Internet, as well as by means of books and experts, in other words, without acquiring any primary data. Simm & David (2002) evaluate practical, investigative fieldwork carried out by 30 students, applying methods drawn from physical geography. The test subjects confirmed a subjective accrual in knowledge and understanding about the research process, as well as improved skills in working both in a team and independently.

Very few studies address the application of problem- and inquiry-based learning to topics from the field of human geography at schools: Tulloch & Graff (2007) chronicle a 4-week voluntary summer course offered to pupils in year 12, during which the participants' objective was to create a Green Map for the school setting. The process involved the pupils exploring the school environment, documenting the results, and implementing these in a map of their own design. Based on their observations, the authors confirm that the participants were highly motivated, though no mention is made of the pupils' understanding of the rules of mapping. Overall, there is rather scant empirical information about the use of problem-oriented inquiry-based learning or related approaches in geography teaching (Pawson et al., 2006, p. 110).

Similarly, according to research by the author, the field of study focused on pupils' expectations (e.g. Duit et al. 2008) does not yield any studies on the pre-conceptions of pupils under the age of eighteen about good or appropriate approaches when studying human geography or social science issues.

Studies focusing on social science research methods education in general tend to concentrate on higher education. Reviewing the state of research, Easley (2014) analysed 89 studies and attested to a lack of assessment on what and how students learn in research methods courses. Thus, this area also reveals a deficit of insight about the effectiveness of certain teaching concepts. Lewthwaite & Nind (2016, p. 413) conclude that the pedagogy involved in social science research methods remains under-researched and the pedagogical culture under-developed.

The scarcity of pupil-led research in geography lessons is contingent, on the one hand, on the fact that genuine current geographical problems are considered to be too complex in terms of the pattern of conditions and effects. On the other hand, they usually follow an interdisciplinary design and draw upon bodies of knowledge from neighbouring disciplines, thus it is believed that their vast expanse makes it impossible to fully comprehend them and to develop appropriate solutions. In addition, the timeframe of the lessons and the subject-specific knowledge of the pupils is frequently considered to be insufficient (Reuschenbach, 2011, p. 14). Not least, the objects of geography instruction are often situated in distant locations and therefore they are not available for any immediate empirical access. Modelling by way of experiments is also only possible for a limited section of topics.

The slight significance given to inquiry-based learning is due, in part, to the generally timid anchoring of the teaching-learning approach in the curriculum. Admittedly, according to the educational standards of various countries, in addition to extracting information from the media, pupils should also acquire their own data from the geographical reality, as well as from simple research methods such as observing, interviewing, mapping, counting and measuring (Brown & LeVasseur, 2006, Department for Education, 2013). Occasionally, it is also demanded that pupils learn how geo-scientists gain their findings through their research activities. However, the intention is only to initiate the development of the ability to approach the search for solutions and insights in the same way as scientists (Deutsche Gesellschaft für Geographie DGfG, 2012, pp. 19-20). Explicit training in scientific procedure through the formation and testing of hypotheses in the context of geography lessons, if it happens at all, is usually restricted to natural science experimentation on topics pertaining to physical geography (Mönter & Hof, 2012). Yet, it is not only the standing of active research that is insignificant among teachers; a survey of German schoolchildren covering excursions as part of geography instruction by Bette et. al. (2015) revealed a substantial lack of interest in the working methods of data generation in the field.

The aim of the study at hand was to promote and evaluate the hitherto barely considered utilisation of human geography methodology in geography lessons in a guided inquiry approach. In order to accomplish this, two teaching concepts were tested,

which were designed to encourage pupils to discover selected rules of research and their purpose within a relatively short timeframe, subsequently using this rules as the basis for constructing, implementing and evaluating an independent research design.

## **Methodology**

### **Methodological Competencies Pursued Within the Context of the Guided Inquiry**

Inquiry-based learning means that a problem, which serves as a starting point, should be solved independently by the learner through the acquisition of primary data, in order to gain methodological competencies in the process. The ideal of inquiry-based learning attaches value to the fact that it is permissible here to wander down wrong tracks and that mistakes can happen. These should subsequently be reflected upon in order to learn from them, and to test new and improved research designs. Considering the limited number of lessons, it can prove difficult during the normal course of instruction to realise a research project that has been entirely conceived, carried out and reflected upon by the learners.

However, to allow the acquisition of methodological competence, not merely in isolation through rehearsing individual procedures, but rather in a problem-solving context, it is of core significance to retain the complete research process, from the question formulation all the way to the answer, and instead to shorten only the individual steps. In the investigation described here, the free experimentation is replaced by teaching concepts, which should allow the learners to come to regard the rules of research as meaningful by their own efforts. In other words, the teacher does not prescribe an established, proper procedure, but instead allows the learners to arrive at independent insights within a certain bandwidth. Based on these insights, the learners are encouraged to construct, deploy and evaluate their own research instrument. The primary aim of such a partially guided form of autonomous research is that – in accordance with the postulate of constructivist didactics – the learners should recognise the purpose of the process and select a solution approach, because they perceive it to be appropriate to the matter at hand. In this way, learners should come to the fundamental understanding that research is a process, for which there are numerous rules of the game.

In a typical research process pertaining to human geography, the following factors are each subordinate to different sets of research rules from empirical social research: First, a method of data collection must be selected that is appropriate for the research question. The selection can be made from observation, standardised interviewing, open interviews, media analysis, and experiments, amongst others. When choosing test subjects, the rules of representativeness apply. The process of shaping individual research instruments usually requires that empirically won rules of design are observed (e.g., for a standardised questionnaire these might require that questions must be worded in a way that is unambiguous, comprehensible, one-dimensional, and not leading; predefined answers must be complete and without overlaps, and a typical arc of suspense should be maintained in the sequence of the questions).

During the evaluation, the rules of logic (absolute frequencies, cross tabulations) or the rules of mathematics (relative frequencies, correlation coefficients) are brought to bear (McQueen & Knussen, 2002). Mapping demands that relevant features to be mapped and a map basis on an appropriate scale must be found. To implement signatures, the rules of perception and logic must be complied with. These state that the shape separates different sets of circumstances, which in turn are distinguished by colour and pattern, while the size of the signature and the intensity of colour represent a set of numbers (Slocum et al., 2005). Every one of these rules serves the purpose of finding answers to the initial question, which are as accurate as possible and which are not falsified by methodological weaknesses.

In the study documented here, the main focus was placed on the methods of standardised interviewing and mapping. Standardised interviewing is a research instrument that is frequently deployed in various contexts (e.g. opinion polls, market research) and subjects (e.g. social sciences). For this reason, learners at secondary schools should gain a solid basic knowledge of the matter. Mapping, on the other hand, is a genuinely geographical method, which gives central importance to the aspects of spatial distribution.

### **Methods of Teaching Used In the Guided Inquiry**

In order to coax the learners towards independently gained insights in a relatively short span of time, two different teaching concepts of a guided inquiry were developed and compared with regard to their effectiveness in classroom projects.

*Selection decisions.* Efficient autonomous research presupposes knowledge about possible interrelations as well as about available methods. This kind of previous knowledge, for instance about methods such as surveys or experiments, commonly exists among pupils in a rather vague form, delivered by everyday contexts (TV information programmes, edutainment for children). However, there is frequently a lack of precision, both in the formulation of causal or final contexts and in the precision of the methodological research design. One way to avoid extensive instruction by the teacher as well as haphazard experimentation is to allow a justified selection from a set of different process options. A valuation of different options gives due regard to the scattered previous knowledge of the learners, without demanding a completely autonomous formulation of research questions and of research design. The pupils can deploy their raw prior knowledge during this selection process, as drawing comparisons allows them to recognise which options promise to be more useful than others. This principle of selection can be applied to every phase of the research process. The number of elements must exceed the number required overall, in order to be able to substantiate the necessary selection. Due to the options then presented for selection, it is possible to adapt flexibly to the knowledge of the group of learners: Offering a small number of useful alternatives makes the selection easier, while variations which only differ in the details represent a greater challenge. The selection task must be mastered by learners working cooperatively in small groups, to promote discussions about the selection of appropriate alternatives. In the case of controversies, which cannot be immediately resolved, it is possible to carry out two alternatives, which can be contrasted afterwards,

based on the experiences gained during the data collection or data evaluation. For the interview method, items were presented for selection, which partly contained the following errors: did not match the topic, leading questions, double questions, insufficient clarity, and incomplete or overlapping alternatives among the predefined answers. For the mapping method, pupils were asked to recognise and assign main categories and subcategories in a mixture of sector denotations. They were allowed to choose between different shapes, colours, patterns and gradations of a colour for the signatures pertaining to the main categories.

**Simulated pre-test.** A number of rules of empirical social research are determined through empirical tests of various kinds, and in every scientific investigation, a newly designed research instrument must first prove itself in a pre-test. To identify potential weaknesses of a research instrument constructed during lesson-time, it can also be subjected to an abridged pre-test. As there is insufficient time to explore the actual research situation, this teaching concept involves carrying out the pre-test in the classroom. It would be ideal to invite an external test subject who corresponds to the target group to join the lesson. However, for issues taken from daily life, fellow learners can also serve as test subjects. The test subject is confronted with methodological decisions made by the learners (e.g. items in a questionnaire) and spontaneously expresses which difficulties she/he may have with this specific methodological element. In this way, the learners receive feedback including an explanation from a (simulated) party concerned. Taking the feedback, they then abstract simple rules defining what should be done and what should be avoided. For instance, in the case of a double question, the test subject might provide the feedback that she/he does know which question to respond to. This allows the learners to conclude that it is more useful to ask one question at a time. In the study presented here, the teaching concept of the simulated pre-test was only used once for the method of interviewing. For this purpose, the teacher asked a female learner a mixture of good and flawed questions in front of the whole class. The mistakes that the learner were expected to identify included unsuitable questions, double questions, leading questions, and missing prerequisites, as well as personal questions during the set-up at the beginning.

### **Organizational Framework**

The fifth grade was chosen for the empirical study for two reasons: The first reason was to guide learners towards basic scientific methods in the subject of geography as early as possible. Secondly, the problem to be investigated by the learners had to be a typical example of a geographical issue. It also had to suggest the use of the methods of interviewing and mapping, and it had to be feasible at the majority of schools. Moreover, the topic had to be close to the everyday experience of the learners and could not presuppose extensive previous knowledge. All of the requirements were met by the topic of local amenities, i.e. the supply of fast-moving goods and services in small retail centres. Shopping agglomerations of this kind can frequently be found near schools. This topic (Labour and Supply in Differently Configured Economic Spaces) is prescribed by the core geography syllabus for the 5<sup>th</sup> form in North Rhine-Westphalia.

A problem had to be identified in relation to this topic, which can only be solved by the original research effort of the learners. On the one hand, the evaluated research projects took as their starting point the question whether a retail centre located in the vicinity of the school and offering daily necessities adequately met the needs of the elderly in the face of an increasingly ageing society. On the other hand, projects set out from the question whether the existence of the neighbourhood retail centre was endangered by the growing electronic commerce.

The assessed instruction was prepared and realised in two 5<sup>th</sup> form classes with 27 and 16 pupils aged between 10 and 11 years at a grammar school in Bergisch-Gladbach (Germany, State of North Rhine-Westphalia) by students training as geography teachers. Groups comprising two or three students each decided to implement one of the two teaching concepts for one of the two research methods (interviewing or mapping).

Enquiries were made at a school that cooperates with the University of Cologne to ask whether any of the geography teachers would be willing to volunteer their 5<sup>th</sup> form class for a research project; consequently, it represents a convenience sample of pupils. The geography teachers were in attendance throughout the entire research day. The research project was carried out within the framework of a university event designed to provide training for advanced students enrolled in the teacher training degree for geography as a teaching subject. This meant that it was possible for the students to hone their skills in carrying out and reflecting upon a taught lesson, and at the same time, the study was able to gain trainers for each of the groups of pupils participating in the research project. This allowed the two researchers to focus fully on observing the lesson. During the preparatory seminar sessions held in advance, the students were trained in the relevant scientific methods (interviewing, mapping) and teaching concepts (selection principle, simulated pretest). The typical sequence of events during a project day is depicted in figure 1 below.

During a questioning-developing conversation the members of a class jointly considered how the respective initial problem concerning local amenities, which was introduced by the teachers, could be resolved. With both questions it was soon evident to the learners that ready-made answers were unlikely to be available in the shape of official statistics or scientific studies. In other words, the solution can only be found through new, original research. When talking about the different approaches that can be taken to research an answer, the learners rapidly came up with the idea that it would be advisable to interview customers or retailers in the local shopping agglomeration. It seemed less obvious to the learners to use the method of mapping. Clearly, the notion that the precise location in a small retail area (e.g. the proximity to parking spaces or to the bus stop) might be significant, cannot be taken for granted. This consideration had to be introduced by the student-teachers during the discussion. Once the teachers had initiated the approach to solving the problem, the classes were divided into subgroups comprising 8 to 15 learners for the methods of interviewing and mapping, respectively. Within the groups that followed an identical research methodology, further subgroups were formed in accordance with the different teaching concepts (selection principle or simulated pre-test). Over the course of nearly two hours, the subgroups each received an

introduction to their research method and they designed their own research instrument. Subsequently, they spent one hour in the local retail centre in order to collect their data, after which they were given slightly one hour to evaluate the data. At the end, the classes reassembled, and each subgroup presented their results using posters or slides. The round of presentations took approximately 30 minutes. Due to the limited time, the focus in terms of results was on the content. The methodological process was only briefly touched upon by each of the groups, with the design of the research instrument including the rules that were observed hardly being mentioned at all.

Duration	Phase of Research Project				Role of Researchers
0:15	Pretest (whole sample) – one week before the project				
0:30	Introduction of the problem + discussion of methods to solve it, lead by students (whole sample)				observation
1:30	Introduction to rules of interviewing + design of research instrument		Introduction to rules of mapping + design of research instrument		observation of selected sub-samples
	selection principle (2-3 students, 4-6 pupils)	simulated pre-test (2-3 students, 4-6 pupils)	selection principle (2-3 students, 4-6 pupils)	simulated pre-test (2-3 students, 4-6 pupils)	
0:20	Transfer to area of data collection (whole sample)				
0:50	Data collection (within the sub-samples of 4-6 pupils) including a short break for lunch				observation of selected sub-samples
0:20	Transfer back to school (whole sample)				
1:00	Data evaluation (Interviews)		Data evaluation (Mapping)		
	(2-3 students, 4-6 pupils)	(2-3 students, 4-6 pupils)	(2-3 students, 4-6 pupils)	(2-3 students, 4-6 pupils)	
0:30	Presentation of results (by sub-samples)				observation
0:15	Post-test (whole sample) – one week after the project				

Figure 1. Sequence of events for the research project involving two 5<sup>th</sup> form classes (identical sequence for both classes)

### Evaluation Methodology

The evaluation of the lessons was two-fold: Through a standardised test to determine accrued learning and through partly standardised observation, in order to understand the pupils' comprehension problems and motivation during the course of the lesson. Thus,

the research design reflects a combined quantitative/qualitative design. This combination was selected because the most precise verification of accrued learning can be achieved by conducting a post-test in relation to the learning content. Observation is the most suitable method for identifying the dynamics that emerge during the process of teaching. The study authors deliberately refrained from including an evaluation of the teaching by the pupils, as experience has shown that pupils are unable to recall all of the great number of details in terms of teaching methodology.

**Pre-test/Post-test.** In order to assess the pupils' gain in methodological competencies, an informal test of these was developed and carried out with the two classes. The idea of this test was that the pupils should advise an individual who wanted to carry out a research project on a different topic (the evaluation of the theme park "Phantasialand" by its visitors), but using similar methodology (interviewing plus mapping). The fictitious advice situation was intended to stimulate the transfer of insights in a similar research context, and would thus emphasise the application, rather than merely retrieving pure knowledge. In order to reduce the amount of writing by the learners, it mainly took the form of 14 multiple choice questions to tick. The following aspects of research methodology were addressed: The first block contained questions about the principles of the research process and the choice of methods: The stages in the research process (task: bring them into the correct order), the purpose of interviewing and mapping (task: deployment of methods is suitable for which question?). The second block addressed the rules governing the formulation of questions, the structure and the evaluation of a standardised questionnaire: The structure of a questionnaire (task: placement of the question asking about age and level of education), leading question, double question, lack of clarity, lack of comprehensibility (task: recognise flaws in predefined answers), open versus closed questions (task: explain which advantages these have), as well as checking for correlations during the evaluation using cross-tabulations (task: identify a useful evaluation mode). The final block looked at the rules applicable to mapping: The procedure for mapping (task: identify a meaningful procedure), the rules for designing the signatures with regard to form, size, colour/pattern (task: recognise useful signature designs) as well as evaluating a map (task: determine a meaningful commentary text). Thus, the test only addressed selected aspects, which served as indicator to reveal whether the purpose of rules relating to research in general, to interviewing and to mapping had been properly comprehended. The pre-test was conducted one week ahead of the day of the lesson, the post-test followed one week after the lesson. The questions contained in both tests were identical; only the specific theme park, the study of which the pupils were asked to advise on, varied. The items were discussed with fellow specialists in the field, and were tested in advance on two pupils of the same age drawn from the circle of acquaintances. The specialist subject teachers in charge of the participating pupils were keen to ensure that the test did not encroach too heavily on the lesson time. Consequently, the assessed method rules were only addressed with one item each. In total, representing two classes, 24 pupils participated in the pre-test, and 43 participated in the post-test. Because some of the post-tests were not collected, a direct comparison of the pre- and post-test can only be made for 13 pupils. The sub-samples for the two teaching concepts (selection

principle, simulated pre-test) serve as mutual control groups. Due to the limited number of participating pupils and student teachers, the use of a real control group without innovative teaching method was omitted. Among other concerns, it would have been a significant challenge to define what a "normal" procedure for this control group would be (traditional teacher-centred classroom teaching? Teaching by means of a text book? Waiving the application of the methods in the field?).

**Qualitative classroom observation.** In order to validate the test results, the student teachers and the pupils were observed by the two research scientists during the course of the research project. On the one hand, this methodological triangulation served the purpose of controlling the extent to which the student teachers correctly applied the respective teaching concepts. On the other hand, close attention was paid to the pupils' reactions (event sampling): This involved logging key utterances of the learners (responses, questions, comments). These utterances represent an indicator for ideas and prior knowledge, on the one hand, as well as for misconceptions and ambiguities on the other hand, in relation to the procedure of the research process. However, this only comprises those learners who publicly participate within the framework of the lesson, and even here, it only captures those cognitive processes, which are expressed verbally. Unofficial conversations with seatmates or within working groups were either not recorded at all, or only rudimentarily. There was a continued effort to record the general motivation of the learners. Indicators for this included the occupation with the topic (i.e., the absence of signs of boredom, or the preoccupation with other things), the willingness to introduce own ideas or to discuss the ideas brought forward by others, and the endeavour to make progress with finding a solution (asking for additional information, suggesting improvements, creative further developments, the desire to complete the tasks properly). The indicators listed were neither counted nor was their duration measured. Instead, the objective was to gain a general impression of the performance of the learners.

## Findings

### Which Research Rules Did Learners Recognise During The Guided Inquiry?

**Results of the tests.** Table 1 below provides an overview of the results from the post-test for the learning achievement. Most sub-samples from both classes only touched upon the stages of the research process in an implicit manner (see table 1, item 1). This means that the pupils experienced the individual steps, but the sequence was not specifically addressed as a learning unit in its own right. The extent to which a certain sequence of steps in the research process appears plausible to the pupils was ascertained during the test, where 5 steps had to be brought into the correct order. In the post-test, more than half of the 43 pupils managed to arrange all or up to three steps correctly. However, 16 percent of the pupils did not sort a single step or only sorted one step correctly. This permits the conclusion that even if a certain sequence appears logical and is executed in practice, the need for this sequence does not become clear to all learners, and should therefore be addressed more thoroughly. In the lesson, the purpose of conducting an interview and of mapping was not picked up through the use of a special process of conveyance, but instead was jointly elaborated at the start

through a conversation about the given problem of local amenities. The pupils were encouraged to think about the best possible way to answer the research question. While the pupils themselves suggested interviewing as one approach to solving the problem, the option of mapping had to be brought into play by the teachers.

To test the comprehension regarding the appropriate use of methods, pupils were asked to tick the question for which it makes sense to conduct a visitor survey in the leisure park Phantasieland, or where to select the mapping approach. In relation to the need to conduct interviews (item 2), almost all pupils ticked at least one correct reason in the post-test, and some pupils even ticked both correct reasons. With regard to the mapping method (item 3), three of the four questions provided were inappropriate. Mapping is only necessary, if the information sought is whether the number of visitors to an attraction is somehow linked to its location. Yet only 9 percent of the 43 learners identified this correct question concerning mapping. The purpose of producing a separate map beyond the classical “what is where?” evidently did not emerge clearly, either within the context of solving the problem, or in the course of the practical process itself. This, despite the fact that the learners themselves had worked on just such a further-reaching task when addressing the feature “Shop affected by online retail”. Many pupils had selected the alternative “if you want to know where which attraction is located”, and thus had the usual purpose of a map in mind. It follows that only a few of the pupils had properly understood that mapping is necessary when the aim is to examine whether the actual position in a given space has any relevance. This reflects that it was not possible, with regard to the questions about local amenities, to sufficiently impart the necessity of mapping in an explicit manner to the learners, nor did this emerge as plausible in an implicit manner through working in the field. The conclusion to be derived for geographical research projects is that the deployment of the mapping method must be accompanied by presenting learners a question formulation in which the location of objects is significant on the one hand, in order to answer the research question, but cannot simply be gathered from existing maps (e.g. city maps), on the other hand.

Table 1

*Results of the post-test on learning achievement and comparison of the results of pre- and post-test (/ = not relevant).*

Item	Post-test – complete sample in percent (n = 47)			Comparison pre-/post-test in percent (n = 13, some only 11)		
	answers correct	answers partly correct	answers not correct	post-test better	post-test same	post-test worse
1) Steps in the research process	28	56	16	15	31	54
2) Purpose of interview	30	51	19	8	69	23
3) Purpose of mapping	9	/	91	23	62	15
4) Method recording reasons for visiting	79	/	21	31	38	31

5) Placement of the question about age	33	/	67	0	91	9
6) Question error: suggestion	14	/	66	18	82	0
7) Question error: duplicate question	5	/	95	0	100	0
8) Question error: ambiguous	5	/	95	0	100	0
9) Question error: incomprehensible	38	/	62	18	73	9
10) Test assumed correlation	45	29	26	36	45	18
11) Signatures for restaurants	33	39	28	38	54	8
12) Aspects of interpretation for mapping	16	33	51	39	46	15

The choice of the appropriate approach for a concrete question formulation was of central importance for item 4. Here, the majority of the pupils (79 %) clearly understood that the visitors themselves were best able to provide information about their reasons for visiting, even if asking the manager represented a simpler option. Obviously, in view of the question, the pupils did not deem the other alternatives helpful. With regard to the rules about the sequence of questions on a questionnaire, only one aspect was inspected closely during the lesson as well as during the post-test, namely that questions relating to social statistics (age, income, etc.) should be asked at the end, in order to avoid irritating the interviewees. During the test, approximately two thirds of the learners failed to tick the correct placement (item 5). Clearly, this rule is not immediately obvious and should be addressed more intensively. It was noted that even during the simulated pre-test not a single child critically mentioned that the questionnaire began with the question "How old are you?" Particularly with regard to the construction of the questionnaire, the post-test delved into the rules governing the formulation of questions. Here, four questions were listed, for which the pupils had to explain what was wrong with the wording. In principle, it was not impossible to identify several deficits in relation to one question, but nevertheless, almost all pupils listed only one reason, if at all. The first question is a leading question (item 6). 27 learners mentioned a flaw, but only relatively few recognised the suggestion. By realising that knowing the Black Mamba might be a potential missing prerequisite, 5 children recognised a further applicable flaw. Other learners had additional problems with the wording (e.g. simple yes versus no question, too direct, starting the question with an interrogative), and 5 felt that the question was too personal. Only two learners managed to identify the double question (item 7) as problematic. A further 6 also correctly noted that some interviewees might not fulfil the prerequisite of having travelled by car. Most felt that this question did not match the topic (how do visitors evaluate the leisure park Phantasialand). This thought process is reasonable, even though, from a geographical point of view, the question about the search for a parking space indirectly belongs to the quality of the leisure park. 9 learners remarked that this question again seemed too personal.

Lack of clarity (item 8) was only mentioned by one child, the others mostly believed that the question asking where one is from was too personal. Some commented that the question does not match the topic or is poorly worded. A lack of comprehensibility due

to the inclusion of words of foreign origin (item 9) was clearly identified by 16 learners (38 %). Some of the 20 children who did not provide details here and the two who criticised the poor match with the topic might not have understood the question (one pupil noted “what does this mean?”). Again, 6 learners felt that this question was too personal.

In summary, it was apparent that the invasion of the private sphere through questions that were too personal emerged as an important criterion for the design of a questionnaire. What is more, questions, which were not closely associated with the topic of the evaluation of the leisure park, such as catchment area (“origin”) and choice of means of transport or search for a parking space, were criticised as not being relevant to the topic. A large share of the learners appropriately recognised and applied the criteria of suggestion, inappropriate prerequisites, and the poor comprehensibility due to foreign words. That there was nevertheless considerable uncertainty in the diagnosis of question errors is demonstrated by the invariably dominant number of missing answers. This allows us to conclude that, amongst other measures, more emphasis must be placed on the necessity of social-statistical details in interviews (age, place of residence, etc.). The issue of double questions and of ambiguous terms should also be addressed more thoroughly.

In the context of the rules imparted regarding the mapping method, alongside the categorisation, the choice of the signatures was in the foreground. This involved assigning the parameters of shape, size, pattern or colour to the mapped facts in compliance with the rules. The alternatives were described verbally during the test and were also illustrated graphically (item 11). 14 pupils (33 %) ticked one or even both correct alternatives, 17 pupils a correct alternative as well as incorrect alternatives, and 12 ticked only incorrect signature variations. This validated the impression gained during the classroom observation: When choosing the signatures, what is initially relevant to the pupils is that the signatures are clearly distinguishable and that the demand for material and drawing skills is as low as possible. These rules should be spelled out more clearly during the lesson, for instance by prescribing signatures and letting pupils guess what the statement could be, without using the legend (alternative: use foreign language maps). It should be possible here to intuitively deduce varying quantities of the same circumstance from varying sizes of the same shape of signature.

Various approaches to the evaluation of gathered data were also addressed in the post-test. For the evaluation of a questionnaire the test-problem was designed to test the assumption that older visitors were more likely to visit the PhantasiaLand restaurants than younger visitors (item 10). The correct alternative offered to create a cross-classified table and to conduct a count using a tally list. Indeed, this is how all interview groups actually proceeded. Here, 19 learners (45 %) chose the correct alternative, 12 chose a combination of correct and incorrect alternatives, and 11 chose an incorrect alternative. Consequently, it can be assumed that the majority of the learners fully grasped the purpose of testing correlations through the use of the cross-tabulation instrument.

In relation to the mapping method, the learners were supposed to decide what should be included in a commentary to a map depicting the popularity of the attractions of Phantasialand (item 12). In his context, most of the learners (51 %) only selected commentary options that were not useful, 14 ticked a combination of correct and incorrect, and 7 (16%) chose the two correct alternatives. Once again, these results prove that the purpose of creating a map was not understood by the majority of the learners.

In order to determine if there were any learners who, for the most part, had mastered the rules, and others with very limited knowledge of the rules, points were assigned for the number of mistakes. Accordingly, a learner who answered all test items correctly could achieve 15 points, someone who only selected incorrect items gained 43 points. An analysis of the point ranges revealed that of the 43 learners, 23 ranked below the 30 error-points mark, which lay approximately halfway between the best possible and worst possible result; only 2 learners achieved less than 25 points. In the case of the 23 learners who achieved better results in the test, the profile still aligned with that of the totality of learners: The purpose of the mapping, leading question, and ambiguity errors were hardly ever recognised, while the point of conducting an interview and the use of a cross-classified table was understood by almost all pupils. For all other questions there were fluctuating mean figures for the correct answers. It is important to bear in mind that each rule could only be assessed by one item due to time constraints. To heighten the validity of the test, comprehension for each rule should be assessed by means of several items, while varying the examples and wording used.

The comparison of the pre- and post-test suggests a similar conclusion (see table 1): For all questions, the majority of the 13 featured learners did not improve, and in some cases they even deteriorated. A clear improvement among more than 5 learners (40 %) was not observed for any single question. 4 to 5 learners who had previously responded incorrectly, and chose a correct answer in the post-test do exist in relation to the questions about the appropriate signature (item 11) as well as a meaningful evaluation text for the mapping exercise (item 12), and also for the question that asked how to test a correlation between age and visiting a restaurant (item 10). With regard to the sequence of the steps in the research process, and the purpose of conducting an interview, more pupils actually deteriorated, rather than demonstrating improvement. Most pupils did not change their answers in the post-test compared to the pre-test, even though these answers were predominantly incorrect. These results are also indicative of the limited learning success brought about by the methods training during the lesson. This does not preclude individual achievements: For example, after working in one of the mapping groups, one learner, having made mistakes in the pre-test, selected only correct answers for questions about the purpose and optimal signature selection in the post-test. In relation to poor wording, individual learners recognised the defects of suggestion, poor comprehensibility and missing prerequisites for the first time in the post-test. Thus, even though one cannot completely rule out the occurrence of individual accruals of competencies as a consequence of the lesson, overall the results indicate that the previous knowledge or intuition of the pupils, or coincidence involved in guessing, tend to play a greater part.

## Results of Classroom Observation

While the learners consistently appreciated the necessity of conducting an interview in order to solve the problem, the sensibility regarding the rules for constructing a questionnaire and for mapping was lower. This emerged clearly during the construction of the questionnaires and the discussion about the difficulties (relevant details are addressed in the analysis of the influence of the methods of training).

Overall, the semi-standardised observation carried out in 4 out of 8 sub-samples revealed a generally high willingness on the part of the pupils to engage with the research process. Very little off-task behaviour was identified during the methods training as well as during the design of the research instrument, the data collection and the data analysis stage. The pupils were intent upon the topic; their focus was largely directed at the teachers, the work sheets, the whiteboard, or subject-related contributions by fellow pupils. Although not all group members took an active part in the conversation during the lesson, in principle the verbal contributions that were made demonstrated a serious approach to the questions discussed. During the data collection phase, the interview groups initiated the interviews in a swift and independent manner, while the mapping groups appeared uncertain at first, and required assistance. For instance, the teachers suggested the first mapping location, and once they had arrived there, they discussed the procedure once more, by way of example. In due course, these groups were also able to work autonomously. However, at the debriefing it became evident that during the fieldwork, the learners primarily paid attention to the behaviour of the interview subjects and to other encounters, and less to a suboptimal questionnaire design, as the following transcript of a classroom conversation documents:

Teacher: How did you like it?

Pupils: It was good; some people lied; one was deaf.

T: What did you like especially?

P: We met my mother.

P: I met my mother, my brother, and my second-best friend;

P: That we got to interview policemen.

T: Is there a point that needs to be improved?

P: If you use both, online and shops, then the question of preference is pointless.

## What Impact Did The Methods Training Have?

**Results of the tests.** The extent to which the conveyance of research methods produced an accrual of learning was tested using two different approaches. First, it is possible to compare the results of the post-test in relation to the specific focus of the methods training (interview or mapping, see table 3). A highly efficient teaching method should produce the result that pupils who received in-depth training in a particular method would provide better answers to the relevant questions than members of the respective other groups of learners. In addition, for each class, the results of the pre- and of the post-test can be compared.

Table 2

Results of the post-test on learning achievement, and comparison by research methods (corr = answers correct, part = answers partly correct, not = answers not correct; / = not relevant).

Item	Interviewing sample in percent (n = 26)			Mapping sample in percent (n = 16)		
	corr	part	not	corr	part	not
1) Steps in the research process	31	46	23	25	75	0
2) Purpose of interview	31	50	19	31	56	13
3) Purpose of mapping	12	/	88	6	/	94
4) Method recording reasons for visiting	44	/	56	19	/	81
5) Placement of the question about age	77	/	23	81	/	19
6) Question error: suggestion	4	/	96	25	/	75
7) Question error: duplicate question	0	/	100	13	/	87
8) Question error: ambiguous	0	/	100	13	/	87
9) Question error: incomprehensible	40	/	60	38	/	52
10) Test assumed correlation	52	28	20	38	25	37
11) Signatures for restaurants	31	42	27	25	44	31
12) Aspects of interpretation for mapping	23	21	4	6	38	56

Table 3

Results of the post-test on learning achievement, and comparison by teaching concepts (corr = answers correct, part = answers partly correct, not = answers not correct; / = not relevant).

Item	Simulated pre-test sample in percent (n = 17)			Selection decision sample in percent (n = 25)		
	corr	part	not	corr	part	not
1) Steps in the research process	29	55	18	28	60	12
2) Purpose of interview	23	65	12	36	44	20
3) Purpose of mapping	18	/	82	4	/	96
4) Method recording reasons for visiting	44	/	56	28	/	72
5) Placement of the question about age	88	/	12	76	/	24

6) Question error: suggestion	13	/	87	16	/	84
7) Question error: duplicate question	6	/	94	4	/	96
8) Question error: ambiguous	0	/	100	8	/	92
9) Question error: incomprehensible	37	/	63	36	/	64
10) Test assumed correlation	63	12	25	32	40	28
11) Signatures for restaurants	35	30	35	28	48	24
12) Aspects of interpretation for mapping	24	47	29	8	40	52

In relation to all questions, to a significant extent, the comparison of the results of the post-tests only revealed minor differences below 10% between the learners of the interviewing and mapping groups. The basis used here are the relative frequencies. Due to the low number of test subjects, the Chi-Square tests conducted were frequently invalid despite summarising the characteristic attributes in 2x2 tables (too many cells with an anticipated frequency below 5). The valid tests failed to reveal any significant correlation with less than 5 percent probability of error. Only in the case of a few questions did more significant differences (20%) emerge clearly: The formulation flaw of the “leading question” (item 6) was recognised more frequently by members of the mapping group (25 %, interviewing group 4 %). On the other hand, the helpful commentary on a map was identified by a greater proportion of members from the interviewing groups (23%, mapping group 6%). Solely the question concerning the correct examination of a correlation between visiting the restaurant and the age (item 10) within the questionnaire was answered correctly more frequently by members of the interviewing groups (52%, mapping group 38%). These results indicate that the methods training evidently had no or a rather modest impact on the methodological competence documented in the post-test.

The comparison of the post-test data with regard to the teaching concept (table 3) also revealed similar results for selection decision and simulated pre-test. Solely the method selection decision produced results that were better by more than 20 percent for the examination of a correlation (item 10) and in relation to an appropriate comment for a map (item 12). The Chi-Square tests conducted were once again either not valid or they did not reveal any significance with less than 5 percent probability of error. In terms of accrued learning, neither of the two methods can be granted preference.

### **Results of Classroom Observation**

During the course of applying the *selection principle* in connection with the interview method, the pupils overwhelmingly identified the flawed questions and were also able to formulate appropriate rules in the discussion. For instance, one sub-sample extracted the following rules from flawed prescribed questions: “Only ask questions, which serve to answer the central question”, “Keep questions neutral, don’t lead”, “unambiguous wording, e.g. ‘frequently’ means something different to different people, use units instead, for instance per month”, “Define clear boundaries for possible answers, avoid duplication, but include all possibilities”. While applying the selection

principle to the mapping method, the pupils were relatively quick to recognise the difference between main categories and subcategories, and were largely able to assign the subcategories to the correct main terms (e.g. "pizzeria" and "McDonalds" to the umbrella term "restaurant").

The process of selecting signatures revealed that learners favoured practical considerations above the rules of cartography, which are designed for the purpose of comprehension and aesthetics. While, according to the rules, the signature shape should be assigned to the main category, and the individual subcategories should be differentiated within the shape by colour or pattern, the pupils presented a different argument: In order to depict 11 main categories and subcategories, it wasn't even possible to draw so many shapes, as there weren't enough coloured pencils to display 11 gradations, it wasn't possible to distinguish between 11 different patterns, which left the use of different colours as the only possible way of differentiating. The mapping project also included the task to show how much a shop is affected by online retail (barely, moderately, and heavily). Here, again, learners decided against using the rule (the more, the darker), and instead chose the shape, as three distinct shapes (square, circle, triangle) can be easily drawn, and the parameter colour was already spoken for.

In relation to the teaching concept for the *simulated pre-test*, pupils evidently found it more difficult to differentiate between more or less useful question variations than in the case of the selection concept. An example shall serve to illustrate: The teachers initially asked a female pupil questions about her leisure time activities, which included several rule violations, such as two inappropriate questions, one leading question, one question with conditions that did not apply to everyone equally, one double question and incomplete predefined answers.

Teacher: I will ask you a question and you say whatever comes to mind. The others will listen carefully. How old are you? – Pupil: 11. – T: Are you male or female? – P: Female. – T: Which type of game console do you have? – P: A Gameboy. – T: Are you a member in a club, in which club? – P: No. – T: 'Maths is my favourite subject', this applies completely, or this doesn't apply at all? – P: Doesn't apply at all. – T: I like listening to music, because ... – P: I like music. – T: Great, thanks a lot. I have completed all of it, and this is how it looks. You noticed that some questions were a bit odd. Now, each of you will receive one of these forms.

The volunteer test subject answered all questions willingly, without criticising "odd questions". The other pupils in the group were enthusiastic about the task; they also wanted to volunteer to be questioned, and completed the questionnaire without questioning the quality of the questions. It was only when the teacher addressed specific problem areas that it became clear that certain flaws had, in fact, been noted.

Teacher: There are lots of different things on here. Let's see what we can do with this. Were there any questions that you were unable to answer?

Pupil: I did not know what do write there. [...]

P: The questions seemed really personal to me, that's nobody else's business.

T: How did you like the questionnaire? Which parts could be deleted?

P: Ask more questions.

P: Some questions were really personal.

T: It was about leisure time. One question didn't fit very well.

P: If you like maths.

T: Then you had some problems with the statement "I like listening to music, because ...", why was that?

P: It was because it immediately asked why.

P: What if someone doesn't like music?

The observation revealed that the learners of the 5<sup>th</sup> grade did not mention inappropriate questions of their own accord. It was only when they were specifically made aware of flawed questions or, in the case of the selection principle, if they were prompted from the outset, that they broadly identified the flaws correctly.

### **Conclusion**

The observation carried out in all subgroups confirmed that the learners welcomed the opportunity to conduct research independently and that they engaged enthusiastically. Classroom observation revealed that the learners appreciated the active, partly autonomous inquiry-based form of learning. This is in line with the experts surveyed by Lewthwaite & Nind (2016) with regard to teaching research methods as well as other studies on active, problem-centred learning (e.g. Spronken-Smith, 2005, Tulloch & Graff, 2007, Boesch, 2015). The sub-samples animatedly discussed the separate subtasks, there were very few indications of boredom or alternative activities. Only when the working stages were too long, did signs of fatigue emerge, which could be compensated by taking a short break. The enthusiasm was particularly apparent during the data gathering in the field, when all groups endeavoured to complete their tasks successfully. Thus, they aspired to interview as many passing pedestrians and to map as many shops as possible in the short time available to them.

The pupils learned to apply methods by themselves and to establish contact with various individuals (passerbys, retailers) within the scope of a research question. They were given the opportunity to experience a complete research process, from the initial problem definition all the way to the presentation of the data they themselves had collected. At the end of the morning, each sub-sample was able to present a meaningful research result. To have brought pupils into contact with practical research and the deployment of methods can be regarded as the central achievement of the teaching project. A markedly higher interest in interviewing passing pedestrians as compared to mapping, as detected by Bette et al. (2015), was not observed. Admittedly, in some groups, the mapping effort was combined with interviewing retailers.

Nevertheless, observation and, in particular, the post-test clearly showed that details of the research design tended to be dealt with intuitively or based on previous

knowledge. The non-verifiable learning achievement represents a contrast to the studies conducted by Boesch (2015) among students in geography about active, problem-based learning and by Caesar et al. (2016) among pupils. Admittedly, in those studies the post-tests were centred on the learning content, rather than the methodology of information accrual. In traditional teaching, pupils have learned to remember the facts, and not the path they take to acquire those facts. In order to evaluate the correctness of their work themselves, the pupils initially applied very broad criteria, e.g. whether questions match the topic, or whether signatures for different sets of facts can be clearly differentiated and can be depicted relatively easily. These pre-conceptions appear to be relatively stable and resist being subjected to conceptual change by a teaching unit, even in instances when strong emphasis is placed on the pupils discovering the purpose of scientific rules by themselves (Duit et al. 2008). In this regard, the study has revealed that some of the rules of research and their purpose cannot necessarily be grasped intuitively based on common sense, but in fact require a greater measure of guided inquiry.

There is no clear evidence of success of the methods training. Learners who previously had incorrect notions also tended to hold on to these after the research project. Some intuitive rules, such as the avoidance of "personal" questions, or of anything that is not clearly part of the same topic, to record the location of attractions through the use of mapping and to design the signatures as differently as possible, maintained their relative importance even after the guided method design; a conceptual change evidently did not occur in many cases. Presumably, this is linked to the fact that overall, during the course of the lesson, the rules which were definitely recognised by the learners, were not sufficiently backed up. Both during the simulated pre-test and during the selection decisions, the rules were only formulated and applied once. Furthermore, during the presentation, there was not enough time to present the determined rules to the assembled class once more. It therefore seems imperative to secure the insights gained more intensively or, respectively, to apply them repeatedly. On a positive note, the learners were obviously able to recognise and apply several research rules intuitively or based on prior knowledge. These include the typical sequence of the research process, the purpose of conducting an interview, and sensitivity regarding questions that are too personal and lack comprehensibility. What needs to be reinforced during lessons is the sensitivity regarding lack of clarity, double questions, the rules governing the choice of signatures, and – above all – the purpose of mapping.

When it came to the evaluation of the tests, the two teaching concepts used did not show any obvious, non-coincidental differences in terms of an accrual of competencies. The observations allow the conclusion that the identification of errors in a simulated pre-test based on an interview experienced passively evidently passes by too quickly and harbours too many distractions. Meanwhile, the selection principle with a parallel discussion are much more likely to lead to success in the distinction between good and poor variations, and consequently to derive rules. Independently of the procedure, what must certainly be reinforced, is the backing up and the transfer of rules once they have been recognised. Future studies on guided inquiry in human geography should test the

teaching concepts in higher grades, in order to determine whether the methodological sensitivity of the older pupils is greater and leads to better competency accruals.

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### **Biographical Statements**

**Günther WEISS** is a senior lecturer at the University of Cologne in Germany. His research is focused on problem-based and inquiry-based learning, argumentation in geography and more.

**Elisabeth GOHRBANDT** is a senior lecturer at the University of Cologne in Germany. Her research is focused on teaching human geography methods.