

Bertsch, Christian; Christanell, Anja; Leitner, Michaela (2012): **Bridging the Gap between Research and Science Education – Potentials and Challenges of authentic inquiry in Research-Education-Collaborations**. Proceedings der ESERA Conference 2011, 5.-9.09.2011, Lyon, Frankreich.

## **Abstract**

Reform efforts around the world stress the importance of developing images of science that are consistent with current scientific practices. However, many inquiry activities found in schools fail to capture important characteristics of authentic scientific inquiry and transport a naive vision of the activities that scientists engage in while conducting their research. One way to address the lack of authentic inquiry in the classrooms is Research-Education-Collaboration (REC). REC are transdisciplinary research projects involving schools as active partners in the research process. We accompanied two REC for two years and focused our research on the potential benefits and challenges of such cooperation. To identify a set of core challenges and potentials we used participative observation, informal talks and individual in-depth interviews with participating researchers and the teachers. All partners described the projects as very enriching. Teacher reported an increase of their own and their students understanding of the nature of scientific inquiry in social science. Challenges REC face are the time-consuming interface management when bringing together two different systems, the methodological challenge associated with the satisfying integration of the projects on both sides and the limited academic recognition accorded to REC on one hand and the still very inflexible structures in most schools to conduct project work on the other hand.

## **Background**

Reform efforts around the world stress the importance of developing images of science that are consistent with current scientific practices. Students should develop an understanding of what science is, what science is not, what science can and cannot do, and how science contributes to culture (Schwartz et al. 2004). However, many inquiry activities found in schools fail to capture important characteristics of authentic scientific inquiry and transport a naive vision of the activities that scientists engage in while conducting their research (Chinn and Malhotra 2002). Authentic inquiry bears little resemblance to the cookbook experiments found in many science classrooms or to the very simple forms of inquiry found in many textbooks. To address the lack of authentic inquiry in Austrian classrooms the Federal Ministry of Science and Research launched the program “Sparkling Science” to fund transdisciplinary research projects involving schools as active partners in the research process (Research-Education-Collaborations, REC). The program seeks to integrate research and educational objectives by tackling those issues related to the lifeworld of young people.

REC activities involve more than ‘just’ science communication, lab-visits of the participating school classes or a set of talks designed to motivate children and young adults. In REC students and their teachers assist the researchers in conducting research and the activities must yield a genuine scientific output in form of scientific publications or presentations.

From 2007-2010 the Austrian Institute for Sustainable Development (OIN) coordinated two Research-Education-Collaborations with a focus on sustainability research. With two high school classes (grade 10) they conducted the research project “My Life – My Style - My Future” on sustainable lifestyles and youth culture. With two other high school classes (grade 11) they conducted the project “Able Youth” on the impact of energy consulting on energy

related behavior. Both projects lasted two years and the participating classes were integrated in the research team from the very beginning to the final presentation of the project. The research methods used in the projects varied from questionnaire surveys to qualitative interviews with peers or parents.

## **Objectives**

Both projects were accompanied by a science education researcher (first author), who focused his research on i) the potential benefits of such cooperation for students, teachers and scientists and ii) challenges for the teachers and scientists working in REC.

## **Methods**

To capture the experiences that researchers and teachers made with the REC activities, as well as the challenges and opportunities that REC would offer, the projects were followed over the two years using participative observation, informal talks and individual in-depth interviews with the researchers and the teachers, who were mainly in charge of the REC activities. The transcribed interviews and the noted observations were analyzed following the grounded theory approach (Glaser and Strauss 1967) using the software *Atlas.ti*. The goal was to identify a set of core challenges and potentials experienced by all researchers and teachers in the two projects.

## **Results**

### **1. Potentials of REC**

All participating researchers and teachers described the projects as very enriching and motivating. The researchers were encouraged to reflect on the importance of their work in the context of the wider society and gained experience in the communication of their research – both the methods and the results – to a non-scientific audience. The chosen topics – especially the one on sustainable lifestyles and youth culture - wouldn't be easy to investigate without the participation of students. In both projects the students were not only active researchers but they were also the object of research. Their lifestyles or their behavior and knowledge about energy were the topics to be investigated. This approach facilitates the integration of the results of the REC activities in the work of the researchers and the production of new scientific insight.

The teachers described the projects as very enriching, because of the fact that the researchers provided knowledge and insights, which they themselves couldn't offer to the students.

*“In this project the students gained insights into the work of a social scientist. This is in normal lessons not possible or at least not planned. Especially the development of the questionnaire is something that we wouldn't be able to teach in this way. But not only the students gained new insights. For me the work they (the scientists) are doing is not completely new, but it is not daily grind. And it opened my mind for new things that I will pick up in other lessons as well.”*  
(participating teacher)

In her last sentence the participating teacher describes the expansion of her own understanding of the nature of scientific inquiry in social science. Some authors argue that teachers often lack sufficient knowledge about the nature of science (Abd-el-

Khalick and Lederman 2000). We think that authentic research experience in REC can improve teachers and students understanding of the nature of science – especially when it is combined with a reflection on the nature of scientific work. Richmond and Kurth (1999) investigated the influence of a research apprenticeship on high school students' understandings of the nature of scientists' work and reported gains in students' conceptions of scientific processes, the role of evidence, and the tentative nature of science. However, the empirical research does not generally support the claim that engaging in scientific inquiry alone enhances conceptions of the nature of science. But combining authentic inquiry with a reflection on the nature of science seems very promising (Schwarz et al. 2004).

## 2. Challenges of REC

Three main challenges were identified during the project: the time-consuming interface management, the integration of the project and its results on both sides and the limitations within the educational and the research system.

**Working at the interface:** a REC brings together two systems - the school education system and the academic research system. There are, of course, many important differences between the two. Work routines, working hours and conditions, administrative processes and requirements and the physical working environment are only a few of them. The educational system in Austria is still mainly organized in units of 50 minutes. This short-term system contrasts with the long-term system in scientific research. Developing questionnaires, analyzing data, writing reports is time-consuming. Fitting a long-term system in a short-term system is a lot of work and interface management needs to ensure that the REC activities fit the working dynamics of both systems. The large time-investment demanded by a REC needs to be properly acknowledged and accounted for in project budgets.

**Integration on both sides:** the REC needs to satisfy the demands of two systems. On one hand it should produce new scientific insight. On the other hand it should meet educational aims and the interest of the students. One plausible way to facilitate the integration of REC results into the wider research project would be to design the REC according to the needs of science. If the research process remains under the 'academic control' of the researcher, then it is much more likely to produce a result which complies with scientific quality standards. However, the more specific and complex the research problem, the less flexibility the school has in designing or developing activities (Schwarzl 2005). Given this dilemma, the teachers and the researchers have to find ways to satisfy both systems. Therefore it is necessary to start the cooperation as early as possible (when starting with the project proposal) to ensure that the research topic fits to the subject matter of the classes involved. Otherwise the project work has to be done additionally to the work planned in the school year, which leads to stressed teachers and frustrated students.

**Limitations within the educational and the research system:** packed curricula, 50 minutes units, angry colleagues (because you need their lesson again to conduct the project) and a general lack of flexibility to organize project work are the main challenge to overcome when organizing a REC for the teacher. The prevailing "publish or perish" culture, the narrow disciplinary boundaries, traditions and requirements (Wiek 2007) and the limited academic recognition accorded to REC might limit the researcher's commitment to cooperate with schools. More flexibility to conduct project work in schools and appreciation of the work done in REC by those who fund research is needed. Programs like Sparkling Science and

currently discussed educational reforms are positive signals, that the gap between research and science education can be partly bridged in the near future.

## **Conclusions**

Many inquiry activities found in schools fail to capture important characteristics of the authentic scientific inquiry process scientists conduct in their research. We believe that Research-Education-Collaborations are an innovative way to provide students with a better understanding of how science works and what scientists do. However, Research-Education-Collaborations face – like many transdisciplinary approaches - different challenges that might limit the broader implementation and deeper integration of such projects in the education and research system. The first is the time-consuming interface management when bringing together two different systems: the school education system and the academic research system. The second is the methodological challenge associated with the satisfying integration of the projects on both sides. And the third is the limited academic recognition accorded to Research-Education-Collaborations on one hand and the still very inflexible structures in most schools to conduct project work on the other hand. Science education research plays an important role in identifying these challenges and first recommendations how to face these challenges were presented in this paper. Further research on factors limiting or facilitating REC will assist in bridging the gap between research and school science.

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