RESEARCH-EDUCATION-COOPERATION: EARLY EXPERIENCES WITH SCHOOLS AS PARTNERS IN TRANSDISCIPLINARY RESEARCH PROJECTS

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Summary

This paper relates first experiences of researchers cooperating with teachers to involve students from primary and secondary schools as partners in transdisciplinary research projects. A variety of ResearchEducationCooperation activities were implemented in seven research projects addressing risk and uncertainty in the framework of sustainable development. The paper focuses on the challenges and potential benefits of such a cooperation from the viewpoint of researchers and scientific projects. The experiences show that the cooperation between two worlds as different as school and academia requires substantial translation and communication efforts. Also, although the researchers found the cooperation highly rewarding, the activities did not necessarily yield a genuine scientific output. Given the prevailing 'publish-or-perish' culture in academic research, this might limit the researchers' commitment to cooperate with schools, despite the potential benefits. To overcome this dilemma, two strategies seem promising: increase the recognition for the skills researchers acquire through engaging with transdisciplinary research partners and identify innovative approaches to integrate the output from the ResearchEducationCooperation activities into the project results.

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Introduction

Transdisciplinary research uses an interdisciplinary approach and cooperation with partners from outside the scientific community to tackle problems in the lifeworld. All sides work together to examine both the underlying societal issues and the (assumed) societal consequences of any proposed solutions (Loibl 2005). Trandisciplinarity is therefore closely associated with the concept of participation: non-academic actors introduce their practical knowledge, value systems and interests to the research process. This ensures that the knowledge so gained is not only reliable from a scientific perspective, but also "socially robust" (Maasen and Lieven 2006). Transdisciplinary research thus bridges two significant challenges: production of scientific insight and intervention in the processes driving societal change.

ResearchEducationCooperation (REC) is a form of transdisciplinary research where educational institutions like schools and museums are active participants in the research process (BMBWK 2006). REC is not educational research, although it builds on its results (see, for example, Radits et al. 2005 or Kyburtz-Graber et al. 2006). Instead, it seeks to integrate research and educational objectives by tackling those issues related to the lifeworld of young people. REC activities therefore involve more than 'just' public relations on behalf of science or a set of talks designed to motivate children and young adults. The underlying vision is that children should gain more than just relevant specialist knowledge. They should also acquire or improve various autonomous skills and abilities, including critical self-reflection, judgement skills, the ability to proactively manage their own lives (and wider society), networking skills, planning skills and the ability to think holistically in terms of multiple disciplines. The formal initiative established to encourage cooperation between research and education seeks to support these skills and abilities and in doing so contribute to sustainable development and a robust society better prepared for the challenges of the future. (BMBWK 2006).

Although the educational objectives of the REC are explained in detail within the program's concept (see BMBWK 2006), the research objectives are less clearly formulated. However, the latter are at least as important to participating researchers. After all, the central task of the researcher is not the education of schoolchildren. If the REC is to play a permanent role in research practice, then it must fulfil two criteria. It must be an adequate tool for formulating and addressing research problems, and it must offer a comparative advantage when compared to alternative research approaches and activities. This paper addresses this second issue of added value and does not, therefore, cover the advantages that a REC might have for educational institutions, teachers and children (which is beyond the scope of this paper).

The paper begins with a brief overview of the REC activities undertaken in seven research projects. This is then followed by a discussion of the three core challenges that arise when implementing a REC within a scientific endeavour: (1) The management challenges involved when working at the interface between research and school environments; (2) The challenges associated with integrating results gained from the REC activities into

the overlying research project; and (3) The dilemma faced by the transdisciplinary researcher when trying to combine the demands of scientific excellence with the practicalities of working within a REC.

REC activities – An overview

The seven projects discussed here are all funded within the proVISION research program (see Stickler 2006). They all, therefore, focus on sustainability research and address the question of how to organise society to be better prepared for the challenges of the future. Since the REC is an integral part of the proVISION program, each research project includes a REC component. The REC activities are very diverse, as reflected in the ages of the children and young adults involved (between 9 and 20 years old), the type of school cooperating with the projects (primary schools, high schools, vocational schools, etc.) and the general conceptual approach taken. Table 1 gives examples of the REC activities involved, split into three categories: "Knowledge Transfer", "Skill Acquisition" and "Joint Research".

"Knowledge transfer" refers primarily to the communication of research project results to the children. This generally involves scientific talks, whereby the complexity of the issue under discussion is appropriately reduced, and the shorter attention spans of the children taken into account. A particular challenge is to find the common ground between the scientific perspective, and the children's own lifeworlds and experiential horizons. As an alternative to lectures or talks, scientific results can also be turned into teaching materials (such as CD-ROMs or role-plays). The children can work with these materials directly, or teachers can incorporate them within class activities.

"Skill acquisition" covers both the development of new skills and the strengthening of existing ones. Examples include reflective skills, planning skills, negotiation and organizational skills, information processing skills, and the ability to draw out relationships and interactions or to recognize objectives and values. Researchers provide a guiding hand during the process of skill acquisition and retention. The outcome of these REC-activities (posters, quizzes, playing cards, theatrical sketches) are well suited for school-parent communication and may contribute to build a school's public profile.

Those activities categorized as "joint research" refer to cases where children are integrated within the research team itself, for example where they help supervise laboratory experiments, conduct questionnaire surveys or develop new concepts through creative workshops. These kinds of projects mostly involve high school students. The topics covered within these REC activities are closely related to those of the overlying research project. The tasks and procedures followed reflect established scientific methods and the results are used directly (to a greater or lesser degree, as appropriate) in the project.

Table 1: Sample REC activities from seven proVISION research projects

Knowledge transfer The children are users of the product	**Skill acquisition** The children gain and strengthen skills	**Joint research** The children generate scientific data
ParlaVis In cooperation with teachers, a CD-ROM is developed offering a photorealistic rendering of the impacts of forest management practices. Students from a vocational school evaluate the product **Two Valleys** Researchers visit high schools to give talks on local and global aspects of climate change. High school students design posters based on this input and on information from regular classes. These posters are presented at a scientific conference. **LSTER Eisenwurzen** Researchers give talks at summer schools and KinderUnis (summer lectures for kids organized by universities) on the impacts of social change on landscapes. **NENA** Together with project partners, researchers create and adapt educational resources for a nature park. A development framework for such resources is also being produced. This will help teachers and other communicators design similar resources on the topic of sustainable lifestyles.	**Optima Lobau** High school students compile facts on the Lobau (a flood plain with a particular ecosystem) and design a computer-based quiz for their colleagues in lower classes. They present the quiz at their school's open day. **Two Valleys** Secondary school students tackle the subject of climate change in their German and music lessons. The results take the form of theatrical scenes and poetry accompanied by music. The poems and plays are then presented as part of the "Literary Days" festival held in Rauris. The students also write texts on climate change that are published on their school's website . **LSTER Eisenwurzen** Educators and researchers guide pupils as they design a questionnaire on changes in woodland management and then use it to survey forest warden. On field trips, the current landscape is compared with historical maps.	**Optima Lobau** High school students work with researchers in a university laboratory. Together they design and manage an experiment measuring the oxygen production by water plants under different conditions. **Two Valleys** After hearing a lecture on research methods in the social sciences, high school students work with a researcher to develop a questionnaire, conduct a survey of young people, and then analyse the collected data. The topics covered in the survey are: climate change and the media; gender roles; and local social and economic development. **NENA** Students present seminars and write bachelor theses on the topic of sustainable lifestyles. In a workshop, students from vocational schools tackle the topic of sustainable lifestyles and reflect on their own lifestyle habits.

Table 1 (continued): Sample REC activities from seven proVISION research projects*

Knowledge transfer The children are users of the product	**Skill acquisition** The children gain and strengthen skills	**Joint research** The children generate scientific data
STRATEGE Researchers build a role-play about a participatory approach to sustainable tourism management. The role-play allows students to simulate social processes involved in decision-making negotiations with tourist regions and businesses.	**future.scapes** Primary school children take photos on a walk around their town and compare their pictures with historical photos. In doing so, they reflect on the impacts of global change in their lifeworld. The children also draw pictures of the future and describe their drawing in writing. The photos and drawings form a "yesterday - today - dream future - nightmare future" series and are turned into playing cards by a professional graphic artist.	**STRATEGE** A creative workshop provides a forum for developing alternatives to winter sports tourism under different climate scenarios. **future.scapes** The photos, pictures and descriptive texts put together by primary school children are compared with the future scenarios built by adults during workshops in the same region. As the project is active in three regions, the children's pictures are also compared between the three regions.

* Note: The titles in bold refer to the actual titles of the projects involved. These are described in more detail online at: http://www.provision-research.at/

There is, of course, much overlap between the three categories. For example, being involved in a joint research activity, involves learning new skills. Children gain insight into the scientific method and are thus better able to critically evaluate scientific data. The process of acquiring new skills can itself produce results that researchers can use in their project. As such, the three categories of REC activities are not mutually-exclusive in nature, but simply reflect the main emphasis of a particular activity. Also, most research projects implemented a range of REC activities in the course of the project.

Method

To capture the experiences that researchers made with the REC activities, as well as the challenges and opportunities that REC would offer as a transdisciplinary research approach, individual in-depth interviews were held with the seven researchers – one from each project – who were mainly in charge of the REC activities. Based on this material, an inductive analysis yielded a first set of core challenges experienced by the researchers. The goal was to identify those challenges that were made in several projects, and therefore are not primarily a result of the specific setting within a project. Three core challenges were identified: the management of the interface between school and academia, the integration of the REC results with other project results, and the dilemma trying to comply both with the criteria for scientific excellence and successful transdisciplinary work. These three core challenges were submitted to an intersubjective control and a communicative validation process with the interviewed researchers as well as other researchers involved in the projects. Based on this feedback and in the process of co-authoring this paper, the analysis of the experiences was fine-tuned, illustrated with examples from the research practice, and discussed in light of relevant publications on transdisciplinary research.

This paper is thus the result of a systematic reflective practice of the transdisciplinary experiences by the authors, all of whom are closely involved in the REC activities in the seven projects. Neither these projects, nor the associated REC activities, have been completed, thus the conclusions reached are intermediate in nature and not a final judgment.

The challenge of working with schools: 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. Examples include the associated career objectives, success criteria, intrinsic and extrinsic motivation systems, the expectations placed on each system by society, work routines, working hours and conditions, administrative processes and requirements, the administrative system, and the physical working environment (see Labaree 2003 and Schwarzl 2005).

A REC therefore places considerable demands on "interface management" (Lieven and Maasen 2007). The key requirement is the ability to juggle the potentially conflicting demands of science and education. The work involved applies both to the actual activities themselves and their organization. For the former, the activities must be designed so that both partners (despite their divergent demands and expectations) benefit and perceive the

REC as a success. In terms of organization, interface management needs to ensure that the REC activities fit the working dynamics of both systems. All participants are responsible for forming and managing the continuing interaction and cooperation involved when working at the interface between such systems (Lieven and Maasen 2007). This process of give and take between science and education can be very time-intensive, but is also an excellent learning opportunity. As a tool for coupling science (sensitive to the needs of education) with (knowledge-based) education, a REC encourages all participants to be more willing to take on responsibility.

The ongoing projects have shown that successful interface management is a complex process and takes time. The main stumbling blocks at the organizational level are the complexity and momentum inherent in the two systems, as well as the constant time pressure faced by participants. At the participant level, there is the advantage that project partners can bring complementary skills to the initiative. Researchers offer specialist knowledge and skills related to their chosen field and the scientific method. Teachers offer broader general knowledge and better didactic skills, as well as their close relationship to the pupils. However, these skills cannot always be used immediately within a project; it is rare to find either partner with adequate experience of such cooperative initiatives. This means that each partner's reservations need to be addressed, expectations clarified, and respective roles defined in a step-by-step process. This process involves understanding and accounting for the different objectives, work habits and ways of thinking of the participants, and can often continue over the entire course of the project.

The projects have also demonstrated that most differences are latent in nature and only recognized with hindsight. For example, teachers might perceive themselves as being below researchers in some kind of status hierarchy. Such assumed differences in status can lead to communication barriers, where teachers and children hold back with the constructive criticism they might have to offer researchers. In a reverse example, researchers might try to solve a disciplinary or didactic problem on their own, instead of drawing on the teachers' skills and experience. This problem is usually traced back to a lack of clarity in role allocation, low levels of trust, or inadequate communication. Many subconscious barriers to successful cooperation only reveal themselves when an incident occurs. In one instance, a researcher asked cooperating teachers to review a text aimed at a general audience for clarity. However, it turned out that the teachers were too intimidated to critique a text written by a well-known researcher.

Accordingly, open communication between two equal partners can often only arise during the actual course of the project. In general, this means that the specialist didactic skills of the teachers are not fully available when planning REC activities at the start of such a project. Yet the didactic treatment of the research problem is of central importance when adapting the associated teaching materials, and vital to the success of the REC overall (see Kattmann 2005). The formulation of the research problem should establish relationships between that problem and each child's lifeworld, preconceptions, value system and way of thinking. Such relationships tend to be absent in day-to-day scientific practice (by necessity and through the demands of the scientific method) (Kattmann 2005). As a result, scien-

tific statements that seem reasonable to the researcher are not always clear to children. The research problem and associated REC activities need to be adjusted to account for the child's interests and pre-existing knowledge (Rauch and Steiner 2005), with a central emphasis on communication through experience rather than through passive receipt of information. This task is often a difficult one for researchers, since they have no direct access to the school curriculum or to the psychological world inhabited by children.

Many researchers do not have the time or ability to undertake the linguistic and didactic "translation" work required. The translation process is also a considerable burden for busy teachers (see Rauch und Steiner 2005). As a consequence, educational organizations were integrated within three of the projects discussed in this paper. In most cases, these were non-profit organizations who have specialized in turning results from environmental and sustainability research into material which educational institutions can use. They brought with them considerable didactic skills and long experience with working with schools, and thus acted as a 'translator' between the scientific and educational project partners. In all three projects, these organizations took on responsibility for both organizational coordination and the didactic adaptation of project topics. This took the pressure off the researchers, but also allowed them to gain insights into the methods used to develop teaching materials and techniques for communicating complex concepts and topics.

Most of the researchers involved in direct cooperation with teachers complained particularly about the time commitment demanded by the REC activities. Allowing educational organizations to act as the interface between schools and science can help solve that problem. However, these organizations can also introduce a new barrier, by preventing the direct and intensive exchange of views and experiences between researchers and teachers (or between researchers and children). Since a third party is now responsible for the 'translation' work, researchers no longer have the opportunity to interact quite so intensively with the school system and the child's lifeworld. However, it is this very translation work that underpins the reflective processes that the REC demands of the researcher, by obliging them to view factual material in terms of societal and individual relationships, to explain its importance and relevance for people's lives. An extension of this is the intensive language work required of all participants, since language influences the individual's world philosophy, problem construction and perception of reality (Grunwald and Schmidt 2005).

It would therefore seem sensible for the educational organization to play more of a mediator (rather than translator) role. They can then improve cooperation by facilitating joint discussions involving all project participants. Since these third-party educational organizations are aware of the problems that can arise in transdisciplinary work, they are in a strong position to work together with the other project participants in designing an optimal REC. Their presence means that the researchers and teachers are no longer liable to make elementary mistakes, nor are they obliged to search alone for the causes of (and solutions to) problems that arise during the course of the project.

Another way of reducing the required time commitment is to give schools the responsi-

bility for planning and organizing individual REC activities (such as excursions). Within agreed financial and thematic limits, the school can organize standalone activities that meet the objectives of the REC. The advantage of this approach is that although the researchers are spared from excess involvement in the administrative side of the REC, they still enjoy direct contact with the teachers and children.

Integrating results from REC activities

If the REC is to satisfy the demands of transdisciplinary research, then it needs to contribute to the production of new scientific insights. That sets the same methodological challenge faced by other forms of transdisciplinary research: the scientific knowledge base, research results and the knowledge and value judgements of the participants need to form a constellation that contributes to the solution of one or more problems and underpins some kind of practical action or response (Zierhofer and Burger 2007). Thus integration becomes the central issue of the discussion around scientific quality. According to the thesis put forward by Truffer (2007), the process of knowledge integration cannot be reduced to the level of a simple technical or organizational problem. Instead, it has to be seen as an active and social process of construction and negotiation.

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). Such limitations go against the requirement for participation built within the overlying project framework. Participation means to actively take part, to accept responsibility and exert influence. As such, a central challenge for participatory research is to create enough conceptual space to allow teachers and children to play a substantial and active role in designing and implementing the REC activity. Only through this participation (and by developing the associated skills) can children learn the principles and practice of democracy (Rauch and Steiner 2005). This results in a dilemma. On the one hand there is a (scientific) need to generate results through appropriate methods. On the other hand there is a didactic challenge, to give children as much creative and participatory space as possible.

Given this dilemma, most of the researchers have designed their REC activities in a way that focuses more on the participatory opportunities for the children rather than the (direct) potential usefulness of any research results so obtained. For example, in one survey the high school students were largely free to select the questions to be included in the questionnaire. This ensured that the students would get answers to those questions they found relevant and interesting. However, the questions selected by the students did not necessarily match the main research focus of the underlying project. Yet this development itself brought about a new input to the project: the nature of the selected questions was of scientific interest. In other words, the actual questionnaire – and not (just) the results of the survey – offered insights into the lifeworld, perceptions and priorities of the high

school students. There is thus a need for more flexibility and innovation in terms of research methods. The results from the REC may not be suited to be incorporated in a particular scenario or quantitative model, but they still contain valid information. The results are relevant, not least because the children's perceptions mirror (to some extent) those of their parents and of the school. The REC results can thus contribute to the discussion of models, provide additional and relevant local examples, and complement other project results.

Those REC activities where the researchers stayed closest to the REC principle of "participation in research" proved to be the most challenging from a teaching perspective. Although high school students found it "exciting" to learn about university research efforts, they also found data collection (i.e. taking several measurements each day for two weeks) repetitive (and to some extend boring). Nor was it possible to ensure that the data so produced met the required scientific quality standards, despite intensive supervision. The researchers are therefore left to question the extent to which the REC can truly satisfy the requirement that the children's participation contributes directly to the generation of new scientific insights.

Scientific excellence

Transdisciplinarity is both a research approach and a personal attitude (Thompson Klein 2004). However, the degree to which system constraints can limit a researcher's ability to incorporate this transdisciplinary attitude in their day-to-day research work should not be underestimated.

All researchers participating in the REC activities within the seven projects included in this paper describe their participation as enriching and motivating. The REC proved a valuable experience, encouraging the researchers to reflect on the importance of their work in the context of the wider society. Participation challenged them to reduce the complexity of their research issues to a level that can be easily communicated. This in itself helped them to develop their communication skills. Participation also allowed the researchers to become more closely acquainted with alternative non-scientific rationalities, with the school system and with the children's enthusiasm. Those researchers who worked directly with the children benefited particularly from the required reflection about their own role in society, and gained new experiences with interface management. These key skills and experiences do not, however, replace the traditional set of skills and abilities typically associated with scientific methods and disciplines. Instead, these new skills are gathered as "additional qualifications" (Truffer 2007) in a time-consuming manner. Problems in this context stem from uncertainty. Are these skills of any use to the researcher in their future scientific career? Will they be given appropriate academic recognition? Do they give the researcher a competitive advantage when it comes to the acquisition of research funds? One risk with REC – as with other forms of transdisciplinary research – is that the scientific insight that is expected to emerge, through the design of the research, is reduced in scope to the solution of some practical problem. This is due to the pressure of expectations from the transdisciplinary partners.

Institutional obligations impose a primary objective on researchers: the development of new knowledge and insights. In pursuit of this objective, researchers gather facts and opinions, analyse data, discuss results, draw out explanations and publish their conclusions. Publications are increasingly used as the main criterion to judge a researcher's performance. Other results and output is given little importance. This is particularly true in universities, where this written demonstration of disciplinary excellence is critical for success and the researcher's future scientific career. University researchers are forced to publish as much as possible in highly ranked scientific journals, and are thus obliged to take account of disciplinary boundaries, traditions and requirements (Wiek 2007).

The pressure to publish in leading scientific journals is lower in research institutions outside the university system. In such research facilities, publications in less academically prestigious media are also valued. These research institutions often have close contacts with industry partners, and communicate with these partners (at least in part) through periodicals with a more practical or outreach orientation. However, cost pressures mean that time-intensive REC activities are only pursued where actively supported by the funding agency and where the time requirement is budgeted accordingly.

The employment situation and working conditions of the individual researcher also play an important role. Established scientists, or those with permanent contracts, have more flexibility in terms of how they use their time than those whose continuing employment is closely linked to their scientific productivity. For these (often young) scientists, their scientific output is particularly important, especially if they work in a university. Collaboration with schoolchildren is unlikely to be recognized as 'real' research and correspondingly carries little prestige. The fact that in almost all the projects, REC activities were implemented by young women might also be linked to the low status accorded to the REC. Most of the researchers involved in the seven proVISION projects do not expect original scientific results to emerge from their REC activities. This implies that their cooperation with school is not likely to have a positive influence on their academic careers (see also Radits and Kattmann 2005).

The researchers' own intrinsic motivation is therefore curtailed by extrinsic constraints. As Daschkeit (2007:61, own translation) puts it: "the transdisciplinary researcher's heart beats in two directions. They wish to prove or improve their scientific credentials and know that to do so means complying with traditional criteria for success, i.e. disciplinary excellence … At the same time, they want to make some impact on society". Many research institutions are still characterized by a sceptical attitude towards the scientific potential of transdisciplinary research (see Burger and Zierhofer 2007). Thus, the official recognition now accorded to transdisciplinary research by funding institutions has not yet ended or even weakened the traditional mechanisms for evaluating scientific excellence. Researchers thus face a dilemma, caught between the traditional structures associated with disciplinary qualifications and recognition and the methods and requirements of transdisciplinary research. Even interdisciplinary research sees disciplinary objectives diminished in favour of interdisciplinary translation and synthesis. The insights thus generated may be important from the viewpoint of society and local participants, but offer little from the

perspective of the individual discipline.

Summary and conclusion

Public funding bodies are increasingly expected to finance research projects that have stronger ties with the non-scientific world, instead of underwriting the kind of scientific discourse that has little bearing on the needs and problems of the 'real' world (Loibl 2005). The REC approach allows to include educational institutions as partners within transdisciplinary research projects. Initial experiences suggest that a REC can act as a bridge between research projects and the lifeworld of children. A REC gives children the opportunity to get involved with researching, planning and forming a robust society prepared for future challenges. REC activities have encouraged valuable self-reflection and thus increased the ability of participants to enter into constructive dialogues with others. Researchers can improve their interface management skills and there is a motivating effect due to the clear 'social impact' in the regions where projects are implemented. As with other transdisciplinary approaches, though (see Pregernig 2007), the impacts of the REC are diverse, not easily grasped, and often only become clear in the long-term.

There are two primary factors limiting the further implementation and deeper conceptual integration of REC activities in the practice of transdisciplinary research. The first is the methodological challenge associated with integrating the results produced by a REC activity into the overarching research project. The second is the limited academic recognition accorded REC activities. To counter these constraints and better support the REC concept, following approaches may be helpful:

- The large time-investment demanded by a REC needs to be properly acknowledged and accounted for in project budgets and by funding bodies.
- Our understanding of scientific methods needs to be expanded and open to innovations to support the integration of results from REC activities into the broader results of the research project.
- The potential scientific output of a REC should not be overestimated. A REC may only be able to deliver the kind of results suited to publication in scientific journals in conjunction with other project activities.
- Research institutions need to consider the skills gained by researchers through participation in a REC as valuable qualifications, irrespective of the formal scientific output produced by that REC.

The seven projects discussed in this paper confirm that a REC is an innovative and valuable addition to the repertoire of a scientist engaged in transdisciplinary research. REC activities allow new segments of society to be integrated in the research process and opens up the research process to a wider audience. As with all new approaches, there is still plenty of room for innovation, but this potential can only then be realised if expressly

supported and demanded by those who fund research. Innovation implies risk and a commitment of time and energy. Given the current situation in research institutions, neither can be borne by the researchers alone.

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