

## **Scientific research in a public environment: benefits for science and communication**

### **Recherche en sciences physiques et naturelles dans un lieu public: Avantages pour la recherche et la communication des sciences**

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#### **Mots-clés:**

méthodes d'études scientifiques, nature des sciences naturelles, compréhension publique du chercheur, musée, laboratoire ouvert

#### **Résumé**

Nous décrivons un nouveau projet de communication des sciences dans lequel nous exploitons un laboratoire de recherches universitaires de façon permanente dans un lieu public du musée. Le but du projet est d'éveiller chez les visiteurs du musée une compréhension du fonctionnement des sciences par le contact direct avec les chercheurs. Nous présentons différents points de départ qui permettent au public en général ainsi qu'aux élèves en particulier, d'acquérir un aperçu authentique de quelques méthodes du travail scientifique. Nous montrons également comment le travail dans un laboratoire scientifique ouvert permet aux chercheurs participant au projet de mieux se faire comprendre par un public non-spécialisé.

#### **Keywords:**

scientific inquiry, nature of science, scientist understanding of public, museum, open research laboratory

## **Summary**

We describe a novel concept of science communication which is based on the idea of running an university research laboratory permanently within the public area of a museum. The aim is to raise interest about the nature of science and to communicate aspects of scientific inquiry. Based on this concept, we present various approaches to allow the general public and especially pupils to get an authentic insight into the toolbox of scientific methods and to enable the involved scientists to achieve a better understanding of the public.

## **1. Introduction**

Due to the development from industrial society to knowledge society several skills such as knowledge management, information gathering and information evaluation as well as a basic understanding of the process of innovation has become more and more important for individuals. Educational institutions (schools, universities, museums) are faced with the challenge to adapt to this development [1]. One important aspect within this context is the systematic extension of their educational mandate from teaching the results of research towards communicating the process of research and the nature of science [2,3].

The concept of the Open Research Laboratory addresses the question to what extent the key to understand natural science – comprehending its processes and methods and not only its results – can be communicated to the general public within the context of a museum. The goal is to convey the process of real scientific research as authentically as possible to the interested public by bringing the day-to-day life of researchers right into a museum. For this purpose, the concept is based on a fully equipped scientific laboratory, permanently installed within the exhibition area of a scientific-technical museum. The laboratory is being used by a research group of a local university for conducting their scientific experiments [1,4]. Due to this character its concept can clearly be differentiated from the concept of school science laboratories [5].

Here we discuss the conditions of running such an open lab by a research group, based on our experiences with the Open Research Laboratory installed within the public area of the Deutsches Museum. We present various approaches which we developed to allow both the public to get insight into the toolbox of scientific methods and the involved scientists to achieve a better understanding of the public and line-up our discussion by three main questions.

## **2. How can museum visitors be encouraged to tap the rare opportunity of discussing directly with scientists and to gain an idea about the process of scientific inquiry?**

To ensure the authentic character of the laboratory the research activities must be given a high priority. This can be done due to the fact that most of the visitors are cautious, so that the researchers can decide for themselves at what point they want to get in contact. To give the visitors the possibility to inform themselves in a first step, an introduction into the characteristics of the Open Research Laboratory is given via text panels, animations and a touch screen. The reactions of the visitors in front of the introductions help the researchers to assess if it makes sense to get in contact with the visitor. If they don't have any interest in the introductions, experience has shown they find it obtruding to be addressed. The further steps depend on the certain interests and the background of the visitors. They can be subdivided into four main groups: scientists or engineers from the university, technical professionals from the industry, pupils and people without a scientific or technical background.

Especially for the last two groups it is important not only to describe the motivation behind the scientific work, but to let them experience the fascination with hands-on experiments, which have a reference to everyday life, e.g. superhydrophobic surfaces or ferrofluid. Instead of presenting an explanation of these phenomena, the researchers are working it out together with the visitors, using a scientific approach. This is the starting point to portray the everyday work in a scientific working group, focusing on their own personal experiences to remain authentic. Dependent on the interests of the visitors and the course of conversation the following topics are addressed: protagonists involved in the scientific process (e.g. students, group leaders, donors, scientific community, society), lines of communication, targets/performance criteria (e.g. publications, graduation), ethical questions, funding, technical requirements, division of work, daily routine, current challenges, failings and successes in this working group.

### **3. What are the conditions and benefits for a scientist working in an open research lab?**

New researchers in the Open Research Lab have to get used to work under permanent observation. The available time for scientific work in the laboratory is limited due to the opening times of the museum while on the other side one to two hours in total are spent on science communication. However, there are also important benefits: in contact to the public, scientists have the possibility to gain awareness on which assumptions and expectations the public understanding of science is based. This raised the “scientists understanding of the public” [6] – a highly valuable aspect which enables the scientists and students to improve their communication skills on an interactive and daily basis. Such skills are an essential part of all scientific activity (e.g. scientific conferences, lectures, press). Another important aspect is the fact that the scientists are forced to reflect on their own work, either by anticipated or actual questions of the visitors.

### **4. How can pupils realize that scientific thinking is not elitist but can rather be learned systematically even by them?**

For pupils the laboratory offers two ways to get an insight into scientific work, either as part of the research group or as part of an one-day workshop.

The pupils of the first group are leading the workshops. They are working two days per month in the laboratory and getting paid for it. One day per month they lead a workshop, the other day they prepare or follow up on the courses, or help the scientists in the laboratory conducting experiments. The official topic of the workshop is an introduction into nanotechnology and the operation of an atomic force microscope (AFM), but the focus is on letting the pupils experience the possibilities of scientific methods. Instead of giving lectures the course instructors are trying to create situations where the participants find the solutions by themselves, by applying scientific methods such as “1. observe, 2. describe, 3. interpret”, classification, “*ceteris paribus*” and “*Occam’s razor*”.

Acting as teachers can be very important for pupils with respect to the development of their personality. Since they prepare the course mostly independent they take responsibility and improve discipline. They also practice rhetoric skills, learn how to interact with the participants and how to cooperate with their colleagues and supervisors. In addition to their teaching tasks the pupils are working as members of the research group. They become familiar with scientific inquiry via own research projects. By actively collaborating they can develop an early understanding for daily routine of science. All of these aspects generate a feeling of relevance, competence, autonomy and social integration – aspects which has to be proven to promote motivation significantly [7].

The second group of pupils are those who attend the course. Because the course is designed to be very interactive and not a teacher-centred learning environment, they also learn soft skills such as teamwork. In addition they realize that scientific thinking is not elitist but can rather be learned and applied systematically also by them.

To control and improve the success of these concepts and to ensure the scientific standards an evaluation of the course is performed. The qualitative analysis, which is supported by the chair of Prof. Dr. Lewalter at the TUM School of Education, Technische Universität München, examines the two different ways in which the pupils can act. Therefore different instruments are used.

For evaluating the impact of the course on the workshop instructors a study diary is used as a promoting instrument. With several questions the pupils are asked about their mood, what they have done during the course, what they are proud of and what they want to improve. With answering these questions the pupils are forced to face up with their work and also with their goals. At the beginning of their work at the laboratory the pupils are asked to complete a form in which they can indicate what they already know, what goals they want to achieve and which skills they already have. At the end of their work they are asked to do the same so they can see their own changes and what they achieved during their working time at the laboratory. With the statements from the forms it is possible for the supervisors to react to their needs and to support the pupils through different workshops, e.g. how to give and take feedback or a role play workshop to show how difficult situations can be handled. Over the time of evaluation an incremental of confidence, motivation and professionalism of the pupils can be observed so far.

To evaluate the impact of the course on the participants we use instruments such as a written quiz and interviews. The quiz target the learning success with respect of the subject matter. The term “quiz” is used in communication with the pupils in order to avoid that the pupils feel like being at school or being judged. In addition to the quiz, an interview at the end of the course is held in order to check if the course changed their attitude or influenced their career choice. The final results of the evaluation study will be published in 2013.

## **5. Conclusion and Outlook**

The described benefits of scientific research in a public environment are supported by the combination of the permanent character of the Open Research Lab and the flexibility of the concept.

The permanent character creates a systematic possibility of a direct contact between scientists, pupils and the general public. This enables the accumulation of science communication experience and a significant improvement of a scientists understanding of the public. Combining the long-term installation of the lab with the flexibility of the concept allows an Open Research Lab team to systematically improve existing communication approaches and to develop and test new approaches, all based on results of scientific evaluation studies.

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