



Making Science Visible – Information, Motivation and Participation in Formal and Non-Formal Educational Offers

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Abstract

In the eye of the general public, research on fundamental principles is mostly intangible as it is mainly presented in ways only experts can understand. This creates a gap between science and society, which in consequence raises the issue of the population's lack of awareness and participation in scientific and educational-political debates.

Since 2009 the interdisciplinary Collaborative Research Center (CRC) 803 at the Georg-August-University Göttingen has conducted research on the 'Functionality Controlled by Organization In and Between Membranes'. As proposed in the EU Framework Programme for Research and Innovation, Horizon 2020, and in accordance to the above mentioned problems, the CRC is placing great value on producing 'Science with and for Society', trying to engage the general public in its research activities.

In this context, a science outreach project aiming to foster the communication between science and society, by didactically processing the complex and increasingly diversified fundamental research conducted within the CRC 803, was developed. In order to design corresponding activities as well as materials and to make the developed measures, methods and contents sustainably available to the three targeted groups of students, teachers and the general public, a coordinated and close collaboration between the involved scientific and the chemistry education groups is pivotal. Additionally, the integration of the developed activities into already existing public outreach structures and their further development, including design, implementation, evaluation and optimization, is essential.

In this contribution we will therefore present the outline of this science outreach project, describing the planned activities for the respective target groups as well as highlighting several of the activities already in existence.

1. Introduction

Within the CRC 803, numerous researchers from scientific disciplines, such as chemistry, physics, biology and medicine, are conducting research regarding the "basic principles underlying the complex interplay between lipids and membrane proteins in order to understand membrane processes at the molecular level" [1]. This fundamental research on membranes, however, is so sophisticated that even trained scientists from other, similar disciplines are having a hard time when trying to understand the complex interrelations [2,3].

Guided by Horizon 2020's call for "Science with and for Society" [4] therefore, the main goal of the newly established CRC 803's science outreach group at the Georg-August-University Göttingen is to foster the communication between science and society by didactically processing the complex and increasingly diversified fundamental research conducted within the different research groups. Respective measures, methods, contents and materials will be made sustainably available to students and teachers as well as to the general public using a variety of educational platforms.

So far only few opportunities for these audiences exist to grasp and assess the importance of membrane research regarding personally and socially relevant issues such as public health, novel antibiotics, diseases and pathogenic agents [5]. However, highlighting the interdisciplinary nature of the CRC's research, we will not only shed a light on some of the above mentioned topics, but also contribute to the understanding of how modern science generates knowledge in general.

2. Objectives

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The topics of the CRC show a high prevalence and importance for everyday life. The potential for scientific literacy education and valid curricular connections in this context enable sustainable education and insights into current research activities. This opens up great perspectives for the formal and non-formal education sectors (Fig. 1), focusing on students and teachers, but also on the interested public, as the main target audience [6, 7].

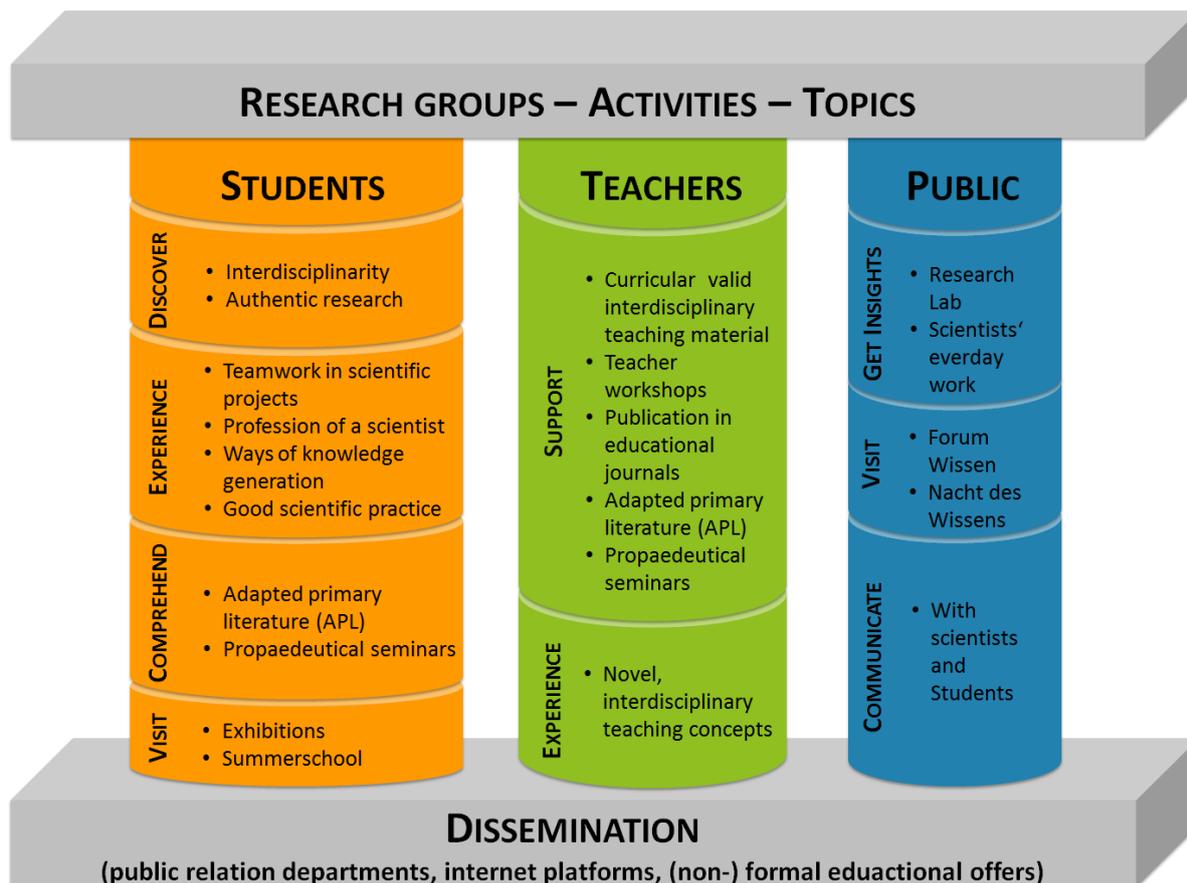


Figure 1: Perspectives for the formal and non-formal education sector, separated into the three target groups.

In order to generate suitable, didactically reduced, authentic, technically and scientifically accurate contents for public outreach projects, a cooperation of didactics and research scientists is fundamental. Hereby, the different perspectives of involved parties such as scientists, teachers, students, didactics and the general public will be considered in the public outreach activities. Following, we will describe some of the planned activities for the three above-mentioned target groups respectively.

2.1 Target group 1: Students

The objectives for students can be classified into three categories: science exhibitions, opportunities for professional orientation and summer schools. Student-oriented science exhibitions offer great opportunities to provide students with information about the activities of the CRC 803 in non-formal settings, engaging them actively in dialogues and fostering their interest for membrane research. The students furthermore have the opportunity to talk to scientists such as PhD students and PostDocs, ensuring authentic conveyance of information. Additionally, the support of the didactics department during the events guarantees the suitability of the disseminated information. More specifically, illustrative, well-structured and interactive informational materials such as EXPOneer shelves, posters, demo experiments and videos will be developed to foster the exchange between students and researchers.



Regarding the professional orientation of students, several projects offering vocational orientation have been developed by the Department of Chemistry Education in cooperation with scientific research groups since 2011. These projects provide opportunities to actively work in authentic scientific-oriented learning contexts in order to gain insights into the professional lives of scientists. Through the integration of newly developed offers, these projects will be expanded, shifting the focus towards the research activities of the CRC. Within these projects the students are, for instance, working alongside scientists on questions related to their mentors research, preparing their so-called scientific propaedeutical work, which they are required to work out in 10th grade.

In 2020, at the end of the current CRC funding period, a summer school for up to 30 students (grade 10 to 13) will take place. It will include a one-day introduction to methods and activities used within the CRC, conceived by CRC scientists in cooperation with the didactics department. Subsequently, the attending students can choose between a number of workshops, highlighting different research areas and activities. During those workshops the students will work on selected CRC related research questions and, among other things, will work alongside scientists in CRC laboratories. The summer school will end with a symposium, in which the students are going to present their work and experiences within the different workshops.

2.2 Target group 2: Teachers, In-Service Teachers and Student Teachers

Within the teaching and learning laboratory at the Faculty of Chemistry, innovative and curricular valid teaching units will be developed (e.g. as part of degree theses).

In order to sustainably and successfully embed such contents, several factors for the design and evaluation of teaching and learning materials have to be considered in terms of didactically-reconstructional work [8]:

- the reference to national education standards and competences
- the cross-linking with scientific basic concepts
- the consideration of teacher and student conceptions
- the integration of effective concepts such as problem- and context-oriented learning
- the inclusion of descriptive experiments
- the relevance, actuality and authenticity of the learning topics

Afterwards these units are taught and evaluated at contractual partner schools of the Faculty of Chemistry.

Aside from entire school units, materials for short digressions supplementing already existing contents in science class will be developed. Both the materials for the school units and science lesson digressions will be published in already existing and established online databases and will be available free of charge.

Sustainability is achieved by integrating the contents into the education of teacher trainees. For this purpose, several experiments as well as the work with adapted primary literature will be introduced into the class "Praktikum zur Durchführung von Schulexperimenten/Practical training for the execution of school experiments" of the teacher training master's program. Selected contents will also be embedded in the lecture "Introduction to Biomolecular Chemistry" and its corresponding practical training.

2.3 Target group 3: Interested Public

Scientific outreach regarding the interested public furthermore aims to enhance the transparency in terms of the structural organization of scientific facilities and to explain how interdisciplinary research among scientists works. For this purpose, selected contents in the form of exhibits, posters and other informational materials will be implemented into public institutions as well as established events at the University of Göttingen. In more concrete terms, thematic CRC contents will be descriptively implemented via references to everyday life such as diseases, toxins and (targeted) drug delivery. The information will be available at recurring events in form of exhibition pieces, informational materials, hands-on experiments and the direct exchange with scientists. During the generation of contents, already conceptualized materials for teachers and students will be revisited and adjusted as well as adapted to the respective target audience.



3. Existing Activities

During the last couple of years a number of initial science outreach activities were developed within the project CRC@School, focusing on the dissemination of selected topics of the CRC 803 into several areas of school education. The main focus lay on a project called “From Surfactants to Biomembranes”. Among other activities, a curricular valid, interdisciplinary teaching unit was developed and evaluated at partnering schools of the Faculty of Chemistry, as we previously presented [9, 10].

In addition, diverse educational offers were designed within this project including the development of an interactive exhibit (see Fig. 2) based on the EXPOneer [11] concept developed at the Leibniz Institute for Science and Mathematics Education in Kiel.



Figure 2: EXPOneer exhibition piece based on the project “From Surfactants to Biomembranes”.

The exhibition piece presents experiments, informational material and videos about the research within the CRC 803. The EXPOneer has so far been presented at two large German science fairs, where more than 60.000 and 350.000 students, teachers and other interested people respectively had the opportunity to learn about the CRC and conduct illustrative experiments on membrane properties under the guidance of teacher trainees and members of the project CRC@School. Furthermore, the exhibit is still frequently displayed at local events.

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