ECTN - Links with schools

A position paper.

Introduction

Establishing links between higher education institutions and schools is not a new idea. A wide variety of activities takes place all over Europe for a range of purposes e. g., to improve students' interest in science or in careers in science and technology. Not every initiative realises its full potential. Top down approaches sometimes fail to meet the needs and interests of school education. The base for structuring the link is weak because there are few controlled experiments and evaluations available. Also, a well founded discourse on objectives, potentials, and strategies has not often been made explicit. People who engage in links with schools are often lone missionaries and do not get adequate acknowledgement for their work.

The "Links with Schools" working group within the *European Chemistry Thematic Network* wants to offer some help. The group has produced a guide on linking higher education institutions and schools. It is based on reflective discussion between participants from 10 different European countries, including representatives from the national chemical societies of the UK, France, and Germany and from CEFIC. This reflection tries to include both perspectives and is intended as a help in structuring and evaluating links with schools. It is not meant as a cook book recipe for a perfect link between a higher education institution and a school. It contains a discussion of different points that should be considered if a link is to be established.

A common goal: Scientific Literacy for All

The concept of Scientific Literacy for All is not a list of scientific knowledge. Scientific Literacy for All is a concept based on skills. To be scientifically literate means being able

- to understand what science is and the role science plays in our lives,

- to recognize phenomena based on aspect of science,
- to follow arguments about issues in which science or technology play an important role,
- to participate in discussions and democratic decisions on issues based on science and technology.

The term “for all” asks for scientific literacy for all citizens. This means school science education should not primarily focus on future scientists. It especially aims at helping students who will not choose a career in science or engineering to become scientifically literate. These future citizens need to be scientifically literate to follow and to be involved in discussions and decision making within society. It should also enable those students whose future jobs are not in, but related to science, make well founded decisions on science. This will be the case whether they work as lawyers, managers, or in a manufacturing business where environmentally relevant issues have to be taken into consideration.

So the concept of “Scientific Literacy for All” gives advice on issues for science instruction. The issues should deal with topics which are relevant to the everyday lives of the students, their future careers, or for developing society. Thus, science teaching should start from an everyday life issue or concern which is important and relevant for the students’ lives. And beyond learning subject matter knowledge, from the beginning it should include learning about the framework of science within society. This means discussions about science, the work of scientists, decision making about science and its impact on society and an education about ideas like sustainability, preservation of nature, or healthy living.

But, aiming for Scientific Literacy does not only require consideration of content or contextual approach, it is also about an appropriate learning organisation. Being scientifically literate does mean having basic subject matter knowledge from the field of science. But it is more about having skills in recognizing the relevance of science for understanding phenomena in our natural and technical environment and to be able to apply the acquired subject matter knowledge. This objective requires skills in addition to knowledge. It does require applicable basic knowledge requires learning environments which follow a constructive understanding of learning.

Designing learning environments and learning situations following constructivism puts the learner at the centre and asks the learner actively to (re)construct her or his knowledge. Thus learning situations are necessary which start from the learner's interests, pre-knowledge, and state of development. They have to be structured so that the learner is the active participant within the learning process. The environment has to offer her or him the possibility of finding her or his own way of becoming familiar with the topic and to step deeper and deeper into the field.

But, constructivism goes further. To achieve a sustained and applicable knowledge, constructivism suggests creating learning situations that are attractive and meaningful from the learner's perspective. This situated learning leads to knowledge which is framed in the situation in which it has been learned. The transfer to similar situations can then be handled more easily. Constructivism also asks for communication among the learners about scientific issues in a social field that is within their experience. Such discussions influence the sustainability and applicability of gained knowledge and competencies.

For Links with Schools both aspects require activities that are attuned to students' pre-knowledge and science learning in schools. Activities should aim at an understanding of phenomena from the everyday lives of the students. Topics must be interesting and relevant to the students, rather than for teachers or scientists. Activities within links with schools involving students should start from this perspective and should be selected for their potential contribution to scientific literacy. Both aspects overlap. Links with schools activities involving students have to be structured in a student-centred and student-active way. Lecturing to younger students in most cases will be quite ineffective. Co-operative working in small groups, with open learning situations oriented to the questions of young students, and a high level of interaction among the students and with the mentors from school and university promises to be a more effective framework for students to learn science.

Different backgrounds – different objectives

Linking higher education institutions and schools in the field of chemistry is accomplished in many different ways and countries. To give help in organizing such links it is essential to be aware of the differences in the involved groups: higher education institutions (e.g., chemistry departments in the universities) and their staff; teachers (of chemistry) and other staff of the school; and the pupils. These groups have different objectives and interests in being involved in such a link.

For the higher education institutions one of the probable motivations is to attract future students and to motivate pupils to choose a career in chemistry or science. But also an interest of the higher education institution can be to promote chemistry and science learning in schools to have better trained entrants in their future courses. This does not only focus on the cognitive side of learning. It also requires training teachers, who are then able to display the relevance of chemistry to their students. This is the base that the students can draw upon to make well-founded decisions on whether to choose a career in science or engineering. It prevents students entering universities with completely wrong expectations. Last, but not least, the promotion of the image of chemistry (within a particular region, university, or in general) can be an objective of the higher education institutions: to show the benefits of chemistry, to have a better image and thus a better chance to enhance the status of chemistry. This last aim is perhaps the most meaningful if industry is to be involved in such a link.

The interests of university staff go beyond and are more pragmatic. A co-operative and interactive link may allow university staff to learn about the chemistry taught in schools and about the learners in schools. This may help them to understand better the students entering university. It may help to attune introductory university courses by having a better insight into the curriculum and practice of science teaching at schools. Here it may be helpful for university staff members to visit schools and to participate in classes to learn about the practice of school science education. This also may offer the opportunity for insights into new trends and concepts in education which may influence the quality of university science education. In many cases schools are nearer to new teaching methods and developed concepts, e.g., how to

deal with mixed ability courses. This is a current problem in many schools and may become more of an issue for introductory science education at the university level.
The interests of schools and teachers are often more immediate. In most cases teachers are looking for help in everyday practice. This can be achieved through material support (e.g. in experimentation), the dissemination of teaching materials or information, or help in the school's waste management. It can be training how to, e.g., implement experiments into the classroom without danger, fear, or from a weak knowledge base. Also helping teachers who are not trained to do so to teach chemistry can be an important field where schools can gain help from a link with universities. But teachers are also looking for help in displaying aspects of chemistry which cannot be shown authentically in schools. Here site visits, visits of experts to schools, or laboratory courses in universities are welcome. Another benefit for schools can be help meeting the needs of gifted students. A link may challenge them in exciting ways.

And, last but not least, the students: Their interest is in learning chemistry in a more attractive manner. They expect to get a broader view and they are, hopefully, looking for interesting variations in their learning. At a later stage they may also expect information on career opportunities. It is essential to make clear that studying chemistry does not necessarily mean becoming an employee in industry or an academic. A degree in chemistry provides opportunities for employment in many other areas. This is not always obvious and links to university and/or industry may help to provide insights. In this field it may be helpful to bring pupils from schools together with students from the university or young researchers.

For all these objectives a link between schools and university can be an answer. But linking schools and universities is not easy. Not only do the objectives of the three groups differ, but also their thinking, levels of understanding, and view of chemistry within the society. Thus, such a link requires good planning, cooperation, and support.

Recommendations for good practice in Links with Schools

Make the link personal, reliable, and cooperative

An anonymous link is no link. Both sides need a single person responsible for the link. The link has to be reliable for both sides. It is helpful to outline explicitly the opportunities for both sides, and also their duties to each other.

The contact persons should be responsible for all aspects of the link. But, two people cannot do everything. It is recommended to involve more persons in the link from the beginning. It is helpful to have a forum of university staff and school teachers to discuss objectives, issues, and agree activities. This should be done as a real cooperation from the beginning. It should be done in an atmosphere of equality - but with the partners having different roles. It is important to accept teachers with their particular kind of professionalism as equals and to avoid an atmosphere in which materials, arguments, or persons from university for institutional reasons are considered by the teachers as of higher value or relevance than those coming from schools. To avoid or overcome this kind of hierarchical view, one idea may be to hold the meetings of the project group alternately in the school and the university. The leader of the project or chair of the meeting may also come alternately from the school or the university.

Make the link acknowledged, networked, and supported

A link between a school and a higher education institution should be acknowledged by the head of the department and the university as well as the principal of the school. This gives the activity an official status. It may also help in getting further support and give recognition to the engaged people. It should be ensured that time and money given to the link is valued by the school and the university as part of normal working time and financial resourcing (or extra funds are explicitly granted).

It is recommended to network the link with other activities and groups. In some universities there are committees for links to external partners. Sometimes it may be helpful to involve the expertise of university staff from the departments of general education or science education. It is helpful to get them involved and not to build up parallel systems. Support can go beyond the partners. It may be possible to involve

regional centres, school system administrations, subject associations (e.g., chemical societies or science teachers associations) or industry (regional plants or associations).

Make the link visible

A great help for ensuring sustainability is support and recognition. Interest in the link is promoted if the link is visible to the public. Try to make the link visible within the school, within the higher education institution, and beyond. Especially important is to make the link and the activities visible to parents and local authorities. Encourage regional newspapers or electronic media to report on the link. Try to exhibit reports and/or outcomes within the school and the university, or on the internet.

Make the link attractive and helpful for the students

The objectives of school activities have to focus on the students' interests and learning. From this perspective, a link is valuable if it meets the students' needs. Learning within the link should not be an isolated activity. All activities and materials should be related to everyday learning within the classroom. Topics have to be chosen from this point of view. Patterns of explanation have to be structured in a way that they fit the students' pre-knowledge, learning capabilities, and actual state of the school curriculum.

In an ideal case, activities from the link should be part of the school curriculum. It should be borne in mind that relevant issues for students in most cases are those related to topics from their personal environment. The link should include specific regional and local aspects of chemistry and should start from the everyday life of the students – not from the theoretical side of chemistry.

The focus should not exclusively be on upper secondary specialists or potential university chemistry students. Extra-curricular activities should promote scientific literacy and interest broadly and among younger students.

Make the link feasible to and helpful for teachers' everyday practice

Being a teacher in a school means having a lot of different things to do. Participation in links with a higher education institution is an extra activity. Teachers and schools

will only engage their time and effort if they are benefiting from the link without increasing their workload disproportionately.

Help for the teachers can be completely different. In many cases it does not require too much time or resource. A great help can be a link which provides schools with reliable access to information, equipment, or small amounts chemicals which are not available in schools.

Also help for teaching will be welcome. This includes teaching materials, in-service training, or media. But, this help is only useful if the offered materials are really suited to school practice, fitting the curriculum, and are well attuned to school relevant learning processes.

Well attuned materials, training, and activities will be especially helpful for those teachers who are teaching science but who have not been educated in science teaching. Another benefit for schools will be help in dealing with highly motivated and gifted students. Schools often are not able to make special arrangements for these students. Teachers are sometimes not trained to deal with gifted students. Additional programs with appropriately high demands may challenge these students and help to keep their motivation and interest in science.

Make the link of benefit to university staff members

Links with schools-activities in a lot of cases are done by university staff in addition to their normal duties. Being involved in a link means additional workload. But being engaged in the link can be highly motivating if members of university staff also benefit from the link. Many objectives are very indirect, e.g., motivating future students. But, sometimes it is possible for university staff to benefit directly from the link.

University staff may improve their ability to communicate chemistry. They may learn about today's backgrounds and school learning of their future students. They may get actual information about trends in school science education which may be of interest and applicable to university education. It is recommended that university staff members seek to learn from the educational expertise of schools and teachers. This may be especially important for newly appointed teaching staff.

Make the link structured and implement feedback and evaluation

Links with Schools needs the working time of teachers and university staff. They require learning time of the students and in most cases financial resources. Time and resources need to be used effectively. Systematic analysis of feedback and evaluation is recommended as a basis for enhancement.

Evaluation of the link requires clarity of objectives and expectations. It is helpful to make objectives and expectations explicit in the preparation phase. It is recommended negotiating the duties and expectations of both sides at the beginning and recording them. Each has to be clear about what is expected from the other side.

The objectives should regularly be reviewed and the effects should be evaluated. This evaluation should include the students' perspective. It should cover - beside the cognitive aspect of learning – the effects on motivation and affective outcomes.

Examples of good practice

The Link with Schools-group within the European Chemistry Thematic Network seeks to evaluate examples of good practice. This is done to promote and disseminate good ideas and experiences. In the next issues of the newsletter you will find examples out of this collection.

Prepared for the European Chemistry Thematic Network by

Anthony Ashmore (The Royal Society of Chemistry, United Kingdom)
Gustavo Avitabile (Naples, Italy)
David Barr (The Royal Society of Chemistry, United Kingdom)
Kurt Begitt (Gesellschaft Deutscher Chemiker, Germany)
Peter E. Childs (Limerick, Ireland)
Marc Devisscher (European Chemical Industries Council CEFIC, Brussels, Belgium)
Ingo Eilks (Bremen, Germany, speaker of the group)
Michele A. Floriano (Palermo, Italy)
Johannes Froehlich (Vienna, Austria)
Alan M. Jones (Newcastle, United Kingdom)
Małgorzata Krzeczkowska (Krakow, Poland)
John Leach (Manchester, United Kingdom)
Kalina Mutafchieva (Sofia, Bulgaria)
Anda Priksane (Riga, Latvia)
Josep M. Ricart (Taragona, Spain)
Jean-Louis Rivail (Societe Francaise de Chimie, Nancy, France)
Doris Soevegjarto-Wigbers (Bremen, Germany)
Alexander Zahariev (Sofia, Bulgaria)