IMAGINE... SHARING IDEAS IN THE LIFE SCIENCES

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ABSTRACT

Communicating about science with young people is a challenging activity. Young people do not necessarily have an interest in the subject at hand: one needs to draw their attention, make them curious, and address their concerns.

The school competition Imagine... offers secondary school students an interesting way to study concrete ideas in the life sciences for the benefit of developing countries. The project thereby creates awareness with high school students of the ways in which life sciences and technology can address the pressing needs of countries in the South.

The first two rounds of this annual competition have been evaluated very positively by students, teachers, scientists and policy makers. The aim is to use this successful Dutch initiative as the pilot and example for rolling the programme out in other countries.

INDEX TERMS

Science communication, Best Practice, Life Sciences, Secondary School Students, Developing Countries

INTRODUCTION

Young people are generally considered a main target group for science communication. The European Commission's Science & Society Action Plan for example has as one of it's main objectives: "to promote young people’s interest in science, and to encourage critical and creative ways of thinking; to improve science education and the uptake of scientific careers" (EC 2002). Young people are the opinion formers and decision makers of the future. Their scientific knowledge and creative thinking is crucial to understand and make informed choices in a society increasingly pervaded by the innovations of science and technology. At the same time the progress of science itself depends on the influx of new talent in scientific disciplines.

Stichting Weten, a Dutch Foundation on science communication, also emphasises the importance of communicating science to young people: “Presenting a proper image of scientific professions to secondary school students is a challenging necessity. That image may help increase the inflow to courses offering a preparatory step towards working in the scientific sector. However, an understanding of scientific developments is also important to people who do not go and work in that sector. After all, in order to achieve economic success, it is vital to have a labour force that can rapidly master new skills. The image created by scientific developments is also important on cultural (scientific insights as an item of cultural value) and democratic grounds (give direction to the social application of scientific developments).” (Boezeman & Roebroeck 2004)

The case is especially clear for biotechnology and the life sciences. Scientists are optimistic, and the technology seems to hold many promises for the future. The long term implications of the biotechnologies on our society are no doubt profound. There is an urgent need for skilled workforce for investigations. At the same time public knowledge is low, and many resist developments in this area. The Eurobarometer survey on Europeans and Biotechnology in 2002 states for example: '...it can be seen that a majority of people disagree that genetically modified foods are useful, agree that they are risky, find them morally unacceptable and are not prepared to support them' (Gaskell 2003). Biotechnology and the life sciences are in a realm of science where 'facts are uncertain, values in dispute; stakes are high and decisions urgent' (Funtowicz & Ravetz 1993).

The need for communication and education in the life sciences is therefore apparent. Now whereas an immense body of theoretical knowledge in science communication has become available (see for example the online STCSE bibliography on Science education, Anon), the challenge lies in putting these views into practice. Because young people spend most of their time at school, education is the most logical channel to reach them (Boezeman & Roebroeck 2004). According to a survey released to mark the National Biotechnology Week in Canada 'participation in a national student biotech competition helps determine study and career paths for a large majority of contestants' (Anon A).

To design a successful school project the following set of premises has to be incorporated (Jet-Net 2004 and Boezeman & Roebroeck 2004):

- It is crucial to *involve* the students. Not only passive listening, but active participation.
- There is a very strong *motivational dimension* for both scientists and students. Incentives are required.
- There is a need for *proximity.* The subject has to relate to the students' lifestyle.
- The scientific subject should be embedded into a *societal context*. It needs to be made clear why the subject would be interesting.
- The activities should be embedded into the *school curriculum*.
- There has to be *personal contact* between all parties.
- Activities have to start on a *small scale*.
- Activities have to be *centrally coordinated* by an *independent* body.
- A sustained effort is essential: no single performance, but a *continuous* project.

THE SCIENCE COMMUNICATION PROCESS

These aforementioned premises have been combined into a national Dutch school competition, named "Imagine…" (Anon B). This annual school competition challenges high school students (in the age of 16-18 years) to create business plans for project proposals describing useful and affordable applications of biotechnology in developing countries. The competition starts in September when a list of scientific projects (submitted by scientists) is being sent to schools throughout the Netherlands. Students join the competition in groups of 2-5, and have about 8 months to turn the general idea into a well-designed plan of action (each student spends at least 80 hours on the project).

There are strong incentives to participate. First of all, students in the Netherlands are required to do a special interdisciplinary project on a subject within their profile (*"profielwerkstuk"*).

Boezeman and Roebroeck (2003) classify the *“profielwerkstuk”* as an excellent means for direct interaction between students, teachers and scientists. The school competition Imagine offers the students the opportunity to execute this compulsory final examination subject, while adding more incentives: the winning students are offered a trip to the destination country as the competition's grand prize and the organisation commits itself to supporting the implementation of the winning project. These last two incentives also motivate the scientists to participate.

To get the list of projects, scientists throughout the Netherlands are invited to submit proposals. These proposals have to fulfil a number of criteria: they need to be feasible, original and ethically acceptable; they need to have a biotechnological underpinning, address real problems in a developing country and have a measurable impact; the implementation of the project should not take longer than 18 months. The scientists commit themselves to supporting the students with their research throughout the year. Examples of projects are: "Fighting malaria by producing Artemisinin locally", "Using genomics to improve Quinoa production in Bolivia", "Monitoring timber from Africa", "Agricultural production in the desert", "Solar Thermophilic Anaerobic Reactor", etc.

Students then receive a manual containing the selected scientific proposals along with specific instructions for the competition. The proposals are edited and presented in clear, understandable language. The students pick one proposal as the basis for their business plan. It is then up to them to decide how exactly this should be implemented. Questions they need to answer are such as: What technology is being used? How does this affect the people in the developing country? Where exactly will the project be implemented? Who are you planning to approach? What will it cost? What problems could your expect?

Apart from acquiring a thorough understanding of the science and technology that lie behind the idea, the students thus find themselves confronted with a range of other financial, political and social issues to solve. To help them with their questions and to support personal contact between all involved parties, three separate activities are made available in the course of the year:

- Hands-on experiments at the scientists' laboratories help the students to understand the scientific background of the project. After acquiring information through the internet and in the library and discussions with their science teachers, the students are offered a day in the participating scientists' laboratory. The students thereby perform relevant experiments, and can fire their burning questions to the scientist. Active participation is the key element here.
- During a special 'knowledge-day' students can fire their questions at development-aid experts to get an idea of what other issues are involved in the implementation of the project. These experts explain what it will be like working in developing countries and address problems to be expected. The students familiarise themselves with concepts such as cultural relativity, neo-imperialism, participation, capacity building, etc. This knowledge day is appreciated by students as it puts the science in a societal perspective.
- An instruction workshop brings the students up-to-date on presentation techniques and PowerPoint tips and tricks will prepare them for a high-quality and attractive presentation. This is important, since a selection of five groups of students (this selection is based on the written business proposals) is required to present their plans during a large conference. They are also offered a chance to produce a promotional video made in cooperation with an experienced movie producer to support their presentation.

During this conference a winner will be chosen on the basis of both a written report and the final presentation. Together with the scientist who submitted the project, the winning group will visit the country where the project will be implemented.
The above mentioned activities relate to the skills which have to be developed in the *"profielwerkstuk"*: information seeking skills, research skills and presentation skills (Utrecht Stedelijk Gymnasium, 2004).

EVALUATION
Various control and evaluation methods are required to continually adjust the activities based on feedback from the students. (Gouw *et al.*, 2003). To evaluate the school competition four evaluation moments have been built in:

- A representative of the Imagine organisation joins the lab experiment. Besides monitoring the quality of the laboratory visit itself, he or she acquires feedback from the students through informal discussion.
- During the 'knowledge day' 20 minutes are scheduled for each group to provide their views on the project.
- One of the items on the instruction workshop program is evaluation. At the end of the day the five participating groups join to evaluate the school competition up to then.
- After finishing the school competition every participant, both scientist and student, receives an evaluation form with questions about the communication tools (website, flyer), time schedule, information dissemination, guidance etc.

In the first round of this school competition a fifth evaluation moment was built in: the organization of Imagine visited the participating schools. This was possible because of the small amount of participating students. Because the number of participants is increasing it is no longer workable to visit every participant.

The evaluations during the first round of this competition in 2003-2004 indicated that students wanted to use this competition for their *"profielwerkstuk"*. This provided embedding of the project into the school curriculum, making it far more attractive for students to join. The communication to attract people for the second round of this competition was focused on this interdisciplinary final examination project.

It is hard to quantitatively measure the impact of the project, although various factors may serve as an indication of its success: the willingness of school students to join and the participating students' reactions. Similarly the quantity and quality of proposals submitted by scientist may serve as an indication of positive reception by the scientific community. Finally, there are personal reactions to the project. The Dutch Minister of Education, Culture and Science said: "I think it's very important for high school students to be introduced to science and technology. The Imagine...way appeals to me, the contact between students and scientists and the broad elaboration, from exact to economics and sociology, is nice."

DISCUSSION
The project finds its basis in a clear message: science is fun, it's important, and it's useful. Scientists are not used to justifying their research, but it's becoming more and more clear they will have to take this responsibility. A defensive tone is of no use. Scientists and the institutions in which they work should be encouraged to take the lead, to show what they are doing and why

they are doing it. The Imagine-project brings this idea out to students by putting the scientific projects into a societal perspective. Research is done for the sake of society. The fact that science can be applied to the benefit of developing countries is what convinced most students to join.

There are two limitations to this project. The first is that it very much targets a specific group of students, namely those already having a certain interest and knowledge. Secondly, In the Netherlands, expectations are very high, and school children spend a large proportion of their time either in school or doing home work. To ask of students to spend a lot of time on such a project, it will need to be firmly embedded into the curriculum, and respect the student's reality.

CONCLUSION

In order to promote young people's interest in science, to encourage critical and creative ways of thinking, and to improve science education and the uptake of scientific careers, a sustained effort required. The Imagine might serve as an example.

Science education needs to challenge the stereotypes: scientists *are* engaged, interested and motivated creative thinkers. The real challenge is putting the ideas into practice and following the criteria of involvement, motivation, proximity, relevance, and continuity.

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