Teacher – Scientist – Partnerships (TSP): a tool for professional development

A COMENIUS 2.1 Action (Training of School Education Staff)

Presently, traditional science teaching is ineffective to prepare students adequately for life´s complexity in a science and technology based society. Teachers´ professional knowledge and empowering contextual learning environments for students seem to be key factors for improvement.
We propose a systemic approach. We will start by building a partnership between teachers and scientists, and integrating both teachers and students in authentic research environments. For this purpose we have activated a well established network of research institutes all over Europe, working on carbon dioxide and climate change. Institutions of higher education in teacher development and local schools have agreed to establish local projects with research institutes. Target groups are science teachers and their students in secondary schools. Teaching and learning activities are agreed upon in a bottom-up approach, focused on improving teachers´ abilities to use external learning as a tool for development, student learning and scientist abilities to communicate with the public.
Outputs will be modules for in-service and pre-service teacher training that could be integrated into the various national education systems, based on best practice. Work is organised as an iterative ongoing process for 3 years. Learning processes and outcomes are analyzed by qualitative and quantitative means.

Rationale and background

In view of life's complexity in a science and technology-based society, it becomes more and more crucial that students as the future citizens are capable of understanding science, and be able to cope with a fast changing world. Factual knowledge is not sufficient. Understanding science requires complex cognitive abilities of individuals. These are being discussed in science education research as abilities for critical and reflective thinking, focussing on results-oriented, rational and logical thinking, which lead to a personal decision (e.g. Zoller 2000[1]). International comparative studies like PISA 2002 show, however, that such higher order cognitive competencies of students are average or below average in most European countries.
To prepare school graduates for an active role as responsible citizens, active learning tasks should be offered to students with a wide range of possibilities for decision making, action taking and valuing in true to life situations.

Traditional teacher preparation programs have not been very effective to prepare teaching staff for the corresponding change in teaching methodology. In order to enhance the quality of teaching and learning processes, the proposal is focused on teacher professional development. It aims at changing teaching activities into learning activities of students. It will be organized "on-the-job" in order to make it meaningful to both students and teachers in different European countries. We are going to involve teachers and students in a European network of scientists working on the problem of climate change. They will be involved in authentic learning outside the classroom, in a research environment, and have a chance to develop their understanding of science by getting involved in real research. At the same time, teachers will have to be prepared by supporting in-service courses for a new role-taking as moderators and facilitator of science education, since in the course of the project they will have to organise learning for their students in an external learning environment at a research institution.

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[1] Zoller, U. (2000). HOCS in the STES Context - An Imperative for the Disciplinarity-Transdisciplinarity Paradigm Shift. In: R.Häberli, R.W.Scholz, A.Bill, & M.Welti (Hrsg.), *Transdisciplinarity: Joint Problem-Solving among Science, Technology and Society. Workbook II: Mutual Learning Sessions.* (S.143-144). Zürich: Haffmans Sachbuch Verlag.

The problem of climate change in Europe and worldwide as influenced by emissions of carbon dioxide is chosen as the general topic for all participants. It is well established in most curricula of secondary schools in Europe, and project activities could easily be incorporated or adapted to meet local school conditions.

Overall aim and specific objectives

Overall aim is to identify the needs of science teachers to prepare them for teaching authentic science, according to national and local conditions. Specifically, we devise bottom-up approaches and identify evidence-based best practice for integrating teacher development, student learning and school development into innovative project work with research institutions. Improve student learning by involving them in practical tasks in authentic research environments. Improve teaching methodology of teachers and design innovative learning environments. Integrate external learning into schooling on a regular basis. Development and adaptation of appropriate teaching methodologies as well as teaching materials.

Innovation

The project is an innovative systemic approach to teaching and learning of science and teacher professional development. It is focused on improving teachers´ abilities to use authentic external learning as a tool for development, improving students´ individual learning, and improving scientists´ abilities to communicate with the public. It will be organised as a professional partnership between teacher education, science research and schools, starting bottom-up at teachers´ and students´ needs.

A particularly new and challenging asset of this proposal is the close connection with two large European research projects on climate change, **CarboEurope** and **CarboOcean**, in which more than 100 institutes from 17 countries are working together to investigate the carbon cycle on land and ocean respectively.
As part of their contractual obligations in the field of science & society, these two FP6 projects have together launched the "CarboSchools" initiative in 2005 (see www.carboeurope.org, www.carboocean.org, www.carboschools.org). Carboschools promote partnerships between global change scientists, secondary school teachers and their students in order to raise young people's awareness of the local and global consequences of climate change, to encourage them to discover the scientific research and to act locally to reduce emissions of greenhouse gases.
The FP6 budget of CarboSchools, limited to development of educational resources and training of climate change scientists, has no resources for teacher training activities : this Comenius project will provide highly complementary means to respond to the training needs arising on the field when teachers start partnership projects, and to fully exploit the great potential of two major European scientific networks on an issue of high societal and educational relevance, climate change.

By getting involved in a European network of schools and science institutions, teachers and students will be able to recognize the various ways of social perspective taking with respect to scientific research. Teachers and students participate actively with researchers in the process of personal decision making with respect to the question: What are we to do in order to deal with global climate change? Locally and globally? And communicate their results.

Pedagogical and didactical approaches

Teaching and learning will be organised along common guide lines for Lifelong Learning such as (Sterling 2000[2]),

- Contextual (in touch with the real world, particularly sustainability issues)
- Holistic (relating to the learning needs of whole persons and group)
- Multi- and transdisciplinary (emphasising on new territory between the disciplines)

[2] Sterling, S. (2000). Issues within and challenges beyond environmental education. In: European Commission - Directorate-General for Environment (Eds.), *Environmental education and training in Europe. Brussels, 3 and 4 May 1999 Conference proceedings.* (S.61-69). Luxembourg: Office for Official Publications of the European Communities.

- Empowering (an engaged and participatory process)
- Innovative (drawing inspiration from new thinking and practice in a variety of fields including the educational field).

Direct involvement in research laboratories will be the foundation of every project and cannot be substituted by just a visit of a researcher coming to school to talk about science.

Target groups and expected impact

Target groups are science teachers (in-service; pre-service), students, and scientists.
The benefits for **teachers** will be:

- Increase the relevance & quality of science teaching by integrating authentic learning at research institutionsLearn more about research processes and scientific methods, access original research data, update factual knowledge, put more evidence in the links between syllabus & society issues. Gain access to experiments and demonstrations that would not have been possible in the classroom. Bring "fresh air" in the classroom; for the students, scientists have a different status than the usual teacher; Increase the students' motivation in science classes and add life to the dry theory of textbooks.
- Fulfil new curriculum requirements (e.g. transdisciplinarity, project work) and gain experience in interdisciplinary group work with other teachers. Through European cooperation, learn from teachers from other countries and make pupils learn foreign languages in the frame of real communication situations.

Benefits for **students** will be:

- Discovering and better understanding scientific research, its methods and its results by doing concrete project work devoted to the problem of global climate change. Experience science learning at school meaningful by acting in the society and sharing the results of school project work with a wider public.

Benefits for **scientists** will be:

- Improve communication skills related to a specific target audience (here young people) with the help of teachers; Learn from the pupils' spontaneity to identify the key questions for normal people. Support a process in which young people will be not only beneficiaries of this exchange, but also *intermediaries* for a wider public to which they will pass on what they have learnt.

Duration

01.10.2006 – 30.09.2009

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Participating institution No 2

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Partner school: Geschwister-Scholl-Realschule Mannheim

This school is offering many extra curricular activities to students. The school is developing its own school programme, having three priorities: “Lebensraum Schule, Bewegte Schule und Fordern und Fördern”. Teachers at Geschwister-Scholl-Realschule are involved in developing their own school curriculum. In the course of such activities the school was involved in a Comenius Programme “Quality Development in Schools” with partner schools from Austria and Portugal during the past 3 years. It is one of 70 pilot schools of the State of Baden-Württemberg where the school staff is involved in the self-evaluation of their school development programmes in the years 2005/2006 and 2006/2007. There is a steering committee established which is responsible for documentation and evaluation of the developmental programme. There is experience with several instruments for evaluation and data analysis.

Explicitly the school promotes science teaching. There is a school programme for grades 5 to grades 10 emphasizing active learning through design and execution of science experiments, information acquisition and reflection competencies. Highly motivated students are specially supported.

The school has a great interest in finding co-operation partners for external learning and for improving science teachers´ professional competencies in science learning. The school is also partner in the pre-service education of students of the Universities of Education in the State of Baden-Württemberg, is co-operating with the state seminar for didactics and teacher education at Karlsruhe, while Hendrik Tzschaschel is lead teacher for science teaching and learning in the city of Mannheim. He is a regular teacher trainer for activities in-house as well as in the region.

Participating institution No 3

Full legal name of the institution in the national language	Fondazione per il Clima e la Sostenibilità
Full name of the institution in English (formal or informal translation)	Foundation for Climate and Sustainability
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Partner schools:

Istituto Comprensivo di Strigno
Via Roma 14
38059 Strigno (TN)
tel 0461 762046 Fax: 0461 763409
Direttore Renzo Gazzola
The Istituto comprensivo runs both primary and secondary school courses. The institute's policy is to attribute a high relevance to education to responsible citizenship, and to the education of pupils not only, generically, to the environment, but also specifically to the local environment.
Number of students: 400 in primary school, 240 in secondary school
Teachers involved. Agostino radel, Roberto Micheli, Paola Morizzo, Orietta Ingala.

ENAIP Borgo Valsugana
Via Gianmaolle - 38051 Borgo Valsugana (TN)
tel 0461/753037 - fax 0461/752070
direttore: Fausto Eccher
Created in 1951 ENAIP - Ente Nazionale ACLI Istruzione Professionale – works in the field of professional training running both state-funded courses and specific courses upon requests from companies, associations and state boards. ENAIP is present in all Italian regions, and is active in both the fields of scholastic education and further education. It aims to promoting technical innovation and economic development while enhancing human resources, in a perspective of "active citizenship"
Number of students: 213
Science teachers: Paolo Boccher, Ugo Gremes

Istituto Statale di Istruzione Secondaria Superiore "G. Galilei" ("ISIS – Galilei")
Piazza F. Bonilli, 1 - Poppi (Arezzo)
TEL. 0575-520268 0575-520269 L.C. 0575-529619 FAX 0575-52029
Direttore: Domenico Massaro
Number of students: 800
Teachers: Brunella Matarrese, Paolo Sisti

Participating institution No 4

Full legal name of the institution in the national language	Rijksuniversiteit Groningen
Full name of the institution in English (formal or informal translation)	University of Groningen
Type of institution code	EDU.4
Erasmus ID code, for Higher Education Institutions only	NL GRONING01
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Partner school: Platengymnasiet

Platengymnasiet is an Upper Secondary School in the city of Motala, Sweden. It has a staff of 110 teachers (including parttime employed teachers, teachers with parental leave etc.) and about 1000 pupils. Platengymnasiet has a variety of different programmes including anything from humanistic, social to science programmes.

Associated partners:

The CarboEurope and CarboOcean project offices (respectively Max-Planck Institute for BioGeoChemistry in Jena, Germany and Bjerknes Center for Climate Research in Bergen, Norway) will be in close connection with the Comenius project through the CarboSchools (www.carboschools.org) coordinator, Philippe Saugier (Email: saugier@netcourrier.com).