STELLA Science Teaching in a Lifelong Learning Approach

SCIENCE EDUCATION IN EUROPEAN SCHOOLS

Selected Practices from the STELLA Catalogue

Education and Culture DG
Lifelong Learning Programme

Education and Training

eBook

Education and Culture DG
Lifelong Learning Programme

This project has been funded with support from the European Commission.
This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

EDITORS
Francesca Magrefi & Sibylle Möbius

CONTRIBUTORS
Christina Crawley, Snejanka Georgieva, Dr. Àgueda Gras-Velázquez, Sónia Hetzner, Alexa Joyce, Caroline Kearney, Philippe Leclère, Yoana Minkova, Daniela Minkovska, Rossella Palomba, Sandra Proença, Cyrille Raymond, Sabine Rohleder, Rafael Santos, Evelyn Schlenk

ACKNOWLEDGEMENTS
Dr. Derek Freeman – Revision & Proofreading
We would like to thank all teachers, educators and researchers in charge of the selected practices included in this eBook for their contributions and support.

DESIGN
Filippo Stecconi - landau

PHOTOS
Stockxpert.com, HAAP Media Ltd.
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FOREWORD

For some years now, many developed countries - particularly those in Europe - have recorded a significant decline in the uptake of university degrees, particularly for the disciplines of mathematics, physics and chemistry, and in general a disaffection for scientific subjects amongst the youth. Available statistics indicate that 10% of children who leave primary school would like to become scientists when they grow up, but where do these vocations end up? It must be highlighted that the decline in the uptake of university courses for so called "hard core" science degrees is often observed in societies that have achieved a high level of development and this pattern is common to science subjects with very different work and career perspectives as well as amongst countries with very different cultural traditions. These facts would suggest that the problem is related to the profound nature of social change occurring within highly developed societies, and should provide appropriate stimulus for the introduction of modifications to science teaching techniques currently applied in schools and in vocational education. Students often consider the study of science subjects complicated (53%) and many also express a negative opinion with regard to the manuals used at school, which they consider to lack clarity (48%) and fail to provide appropriate examples that demonstrate a concrete application of science and technology (43%) (IRPPS, 2008). In short, current methods for teaching science subjects at school tend to stifle students' passion for science, rather than illuminating the subject and kindling their interest in it.

In addition, the lack of passion for or interest in science subjects is very much felt amongst young females, and influences their subsequent choices in relation to university studies and future career paths. They are particularly influenced by deeply-rooted gender stereotypes that exist in relation to the perceived roles and competences of women in the field of science and technology, a perception which progressively drives them away from these studies. It is not uncommon for young women to be actively discouraged by their families (and also at school) from undertaking science studies. Their potential talents are thus suffocated, penalised and rarely if ever rewarded, recognised or encouraged during their time spent at school and their informative years.

A critical objective for European society as a whole, is that of promoting, stimulating and developing the idea of "the scientist" which exists in all of us, so as to allow the emergence and take advantage of the precocious scientific talent which often exists but is rarely tapped. To do so, it is necessary to compare and share the experience and progress being made through initiatives developed in different European countries, choose the most interesting ones and propose them as models that can be applied in other situations or contexts, amongst other countries and that also involve both boys and girls on an equal footing. The eBook presented here represents an important instrument for achieving this aim and provides a useful way of teaching and communicating a passion for science through the dissemination of new learning models. Achieving such an objective will constitute a considerable but necessary challenge, that will have to be met over the coming years.

Rossella Palomba

Director of Research at the National Research Council (CNR), Italy
Former EU Ambassador for Equal Opportunities in Science

INTRODUCTION

This eBook **"Science Education in European Schools - Selected Practices from the STELLA Catalogue"** provides a sample of selected practices, collected as part of the predefined scope of the European Lifelong Learning Programme Project "STELLA" (Science Teaching in a Lifelong Learning Approach), in order to support educational authorities, school heads and science teachers in fostering and adopting innovative practices within the field of science education at Pre-Primary, Primary, Lower Secondary and Higher Secondary school levels.

The STELLA project aims at contributing to the improvement of science teaching in European schools, with particular emphasis being placed on the stimulation of young people, especially female students, to undertake science studies and ultimately follow further careers within the science field.

In terms of reaching its targets the STELLA project focuses on promoting the exchange of contents related to science education amongst teachers from all over Europe.

The main instrument used to promote this objective is the STELLA Catalogue of Science Education Initiatives. Teachers can submit their own initiatives to the STELLA Catalogue, thus providing their colleagues from all over the world a readily accessible portal where they can read and study the various different initiatives and if appropriate adopt/adapt them for use within their own classes.

To describe their initiatives teachers can take advantage of a set of Multimedia Tools. These tools have been developed within the STELLA project with the purpose of facilitating the publication and dissemination of useful and interesting content to a large number of science educators, including both pupils and students involved in the documentation process associated with different educational initiatives.

Based on the STELLA Catalogue of Science Education Initiatives, a Pool of Good Practices for Science Education Projects has been developed. These Practices are documented in the STELLA eBook **"Science Education in European Schools - Selected Practices from the STELLA Catalogue"**.

The STELLA eBook **"Science Education in European Schools - Selected Practices from the STELLA Catalogue"** illustrates selected practices identified from the STELLA Catalogue of Science Education Initiatives. The countries participating in the STELLA project, i.e. Bulgaria, France, Germany, Italy and Portugal, have each contributed a single chapter that describes in detail the selected practices chosen for inclusion by the respective country. Moreover, a particular eTwinning section is dedicated to selected practices from the eTwinning programme, included in the STELLA Catalogue.

The main factors that foster innovation in science teaching at school are discussed and summarized in the "Conclusions" section of the STELLA eBook.

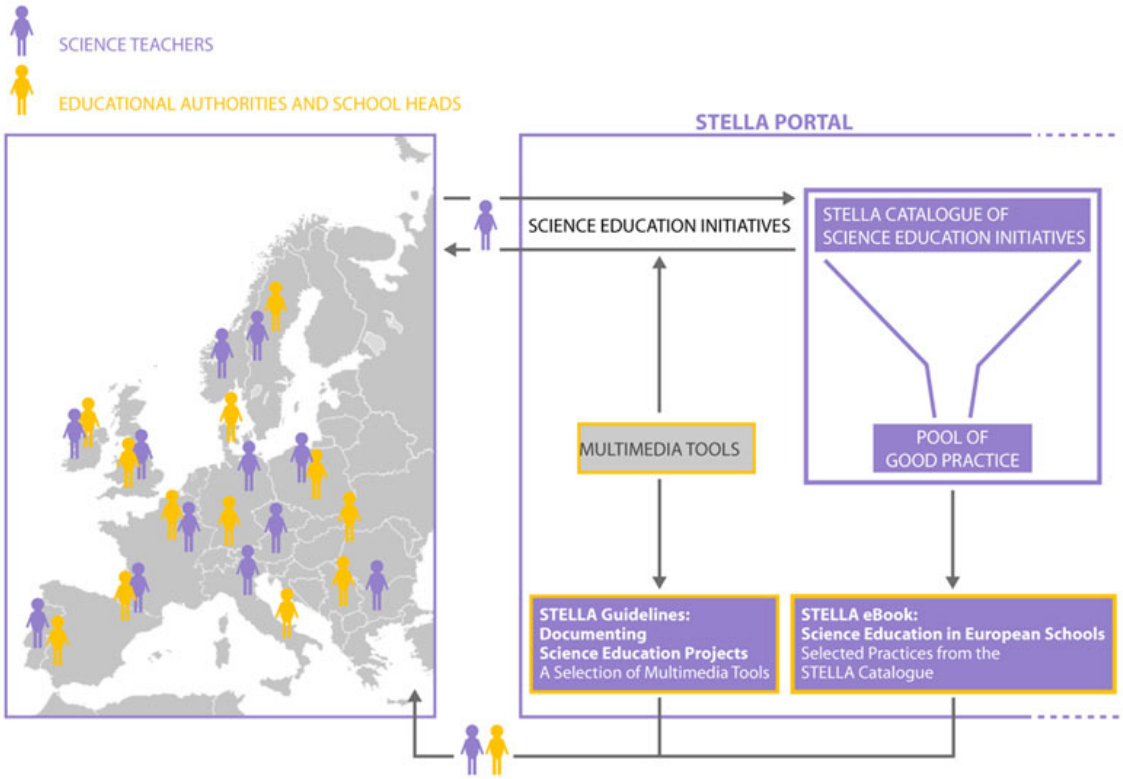


Fig. 1
Correlation between the STELLA outcomes

IDENTIFICATION OF GOOD PRACTICES

The exemplars selected for the Pool of Good Practices - documented in the STELLA eBook **"Science Education in European Schools - Selected Practices from the STELLA Catalogue"** - have been selected from the STELLA Catalogue of Science Education Initiatives by the STELLA consortium.

A "good practice" project in the context of the STELLA project can be defined as a project that is well and effectively presented though the use of multimedia tools, and that supports student involvement at all project stages, as a way of promoting maths, science and technology (MST) education at school. In addition, reflecting its European nature, "good practice" in the STELLA context also means that a given project approach or selected project elements can be transferred to other settings, e.g. countries, schools, subjects, etc.

The identification and selection process followed a two step approach. The first step was the analysis of selected practices according to a set of previously defined criteria (see below). A short summary of the proposed initiatives at national level was created. The second step was a detailed description of the initiatives which was evaluated and endorsed by the coordinating partners. For this purpose, three types of data collection process were carried out:

- analysis of the STELLA questionnaire (primary data);
- analysis of secondary data, such as additional multimedia resources including PPT presentations, video, blog etc.;
- interviews with teachers.

The following **four criteria** have been used by the STELLA consortium for the identification and analysis of the selected practices:

1. Is the project well presented?

- Is the outline of the project sufficiently comprehensible to get an effective overview of the project aims, approaches and results?
- Is the detailed information provided in the questionnaire, and in additional multimedia resources like PPT presentations, video, blog etc. sufficient to understand the realisation and results of the project?

2. Is there a good level of interactivity on the part of the students?

- Did students participate in the development of project activities?
- Did students participate actively in the realisation of the project?
- Were students involved in the reporting and presentation process?

3. What is the degree of transferability?

- How easy is it to implement and use the initiative?
- How flexible is the initiative for the purpose of being adapted to different settings and contexts?
- Is there any inherent reason why the project cannot be transferred to other settings?

4. Is it correct as far as the subject is concerned?

- Is the information provided correct (i.e. accurate and reflective of current thinking and convention) from a subject point of view?

According to these criteria, the selected practices have been described by analysing and integrating data from the STELLA catalogue and the associated webpage.

The resulting detailed descriptions of the selected initiatives have been gathered together and are presented in the STELLA eBook **"Science Education in European Schools - Selected Practices from the STELLA Catalogue"**.

PUPIL'S RESEARCH SCHOOL ON IT

УЧЕНИЧЕСКА ИЗСЛЕДОВАТЕЛСКА ШКОЛА ПО ИТ

This initiative is promoted by the **SECONDARY SCHOOL "HRISTO SMIRNENSKI"** and is intended for **Higher Secondary School** students from 15 to 19 years of age.

More information is available here.

Organisation in charge: Secondary School "Hristo Smirnenski", Brezovo
Email: sou_brezovo@abv.bg
Website: http://sou-brezovo.org
Contact person:
Todorka Atanassova Glushkova - Email: todorka.glushkova@gmail.com

INITIATIVE

This initiative involves a single class of about 20 students between 15-19 years old, coordinated by Prof. Glushkova at the Secondary School "Hristo Smirnenski" of Brezovo. The aim of the initiative is the effective application of the knowledge and skills gained by students attending specialised ICT classes to real-world ICT projects and their participation at national and international conferences, competitions and Olympiads. The specialised training is extra-curricular taking place outside of normal school hours and is structured in several phases:

Phase 1. Training: Students attend lectures given by qualified teachers and PhD students, organised by the Students' Institute of Mathematics and Informatics in collaboration with Plovdiv University.

Phase 2. Role or Game Playing: Involves establishing a proxy "Software Company". Work teams, of 2-3 pupils each, are created with each of them given a specific role and project assignment. Road maps and work plans are defined for each project.

Phase 3. Independent Project Work: Teams work to develop the product assigned, according to the "road map" and the work plan provided.

Phase 4. Test Phase: As soon as the product is ready, modular and integrated tests are carried out by each team.

Phase 5. Presentation: The developed products are presented by each work team in front of the other "Software Company" teams, as well as a commission of ICT specialists.

Phase 6. Discussion and Revision: The preliminary version of the software product is discussed and potential errors that are identified or detected are corrected.

Phase 7. Installation: The final version of the products is prepared for installation, including the documentation and relevant user's guide and the software system is downloaded on to the computers of the intended users.

Phase 8. Final Preparation: Final testing and preparation for participation in national ICT competitions and Olympiads takes place.

Phase 9. Competition: Participation in the competitions and improvement of the systems and products developed.

SUBJECT/S

The initiative focuses on the subjects of ICT and Informatics, by applying a group and team work methodology. The idea is to make students learn from working in real life circumstances. When defining the assignments, the teachers choose topics that are of genuine importance, necessary and practically applicable to the school, or to different companies and institutions. The teacher gives students assignments, i.e. the development of a software product which the students must elaborate by themselves over a period of several months, outside and independent of their regular school classes. Eventually they must document, present and "defend" their products in front of their classmates. Each team develops a product with an allocated structure, and the project must cover all phases of the software development process - analysis, design, development, testing and implementation.

METHODOLOGY

Initially in the "Software company" role game every student receives a defined "position" or "role": i.e. manager,

Целта на тази инициатива е прилагането на получените от учениците знания и умения в профилираната паралелка по ИТ при разработка на реални ИТ проекти, с които да участват на национални и международни конференции и състезания. В ролевата игра "Софтуерна фирма" всеки ученик приема определена „роля" като мениджър, анализатор, дизайнер, програмист и др. Всеки екип разработва софтуерен продукт, преминавайки през всички необходими стъпки - анализ, проектиране, разработване, тестване и внедряване.

analyst, designer, programmer, specialist in testing and implementation of the software product. It is important that the initial assignment is "realistic" and "necessary" and that it is assigned by a real rather than theoretical "client", e.g. the librarian of the School Library. In this way, students learn how to work in a real situation, having to deal with a real client or user who sets and negotiates the requirements of the final product. As a consequence, students can put into practice what they have learned about the software development model, which in practice is not quite as linear and consistent as it would appear in theory.

The teams of 2-3 students work on the development of the software product by seeking additional information, conducting investigations, making decisions regarding numerous technological problems and putting into practice their accumulated theoretical knowledge.

They work in teams, share their tasks, rely on each other and importantly, they feel themselves responsible for a significant part of the overall process.

DIMENSION

The initiative is developed at a local level but it is also supported by the Bulgarian Ministry of Education and Science. It is realised with the collaborative support of teachers from Plovdiv University "Paisiy Hilendarski" and through cooperation with the laboratory of e-commerce at Plovdiv University "Paisiy Hilendarski", the University of Limerick - Ireland, Humbolt University - Berlin and the Institute of Mathematics and Informatics of the Bulgarian Academy of Science.

MULTIMEDIA TOOLS

The initiative is documented on the school website. On this website are also available the products realised by the participants. The site contains courses for class work (e.g. "Solar System" lessons in astronomy for the 11th grade level; Bulgarian language at 7th grade level; Tales Theorem in 9th grade, etc.), courses for extra-curricular activities (e.g. "Folklore of Bulgarian areas"), courses and materials for autonomous work (e.g. electronic encyclopaedia "Bulgarian natural landmarks", etc.), electronic services (e.g. virtual excursions, test generation applications, virtual competitions, a virtual school library).

During the development process, each team writes a diary where the main steps and activities are recorded. Before the implementation stage, all relevant documentation together with the user's guide is prepared. Afterwards training for the users is held and the system is experimentally implemented.

The best elaborations are published and implemented by the school administration or by the school library as well as by companies or other organisations. These projects have earned the right to represent the school at relevant national competitions and Olympiads.

INVOLVEMENT OF PUPILS

The students actively participate in the whole process of documenting and creating the final software product. They divide and allot the tasks amongst themselves and develop the different modules in a continuous process of cooperation and assistance. Examples of products, created by the pupils, are available at the website. Some example of products, created by the students, are e-learning lessons integrated on to the school web portal, e.g. on folk thematics and geography, an e-book on the use of the Internet, etc.

The course "Bulgarian geography" for example is addressed to all pupils who want to receive information about Bulgarian natural landmarks. There are lessons about different geographical landmarks in Bulgaria, natural resources and different geographical regions. There are preliminary tests, tests following each individual lesson and final tests. All terms are explained in a dictionary provided. The user is able to take a virtual walk around different geographical landmarks - rivers, lakes, mountains, parks, natural reserves etc. Users can arrange quizzes or give their opinions in a specially created chat room.

TIPS FOR TRANSFERABILITY

The initiative can be implemented and used in every school where ICT is studied. What is important is that the teacher has sufficient knowledge of the process of software development used by software companies and has sufficient contact with them, in order to have the possibility to take students there to observe the actual processes of software product development and project management. The school must have a computer laboratory where developed products can be tested.

LOCAL BIRDLIFE – A SCHOOL STUDY

ПТИЦИТЕ В УЧИЛИЩНИЯ ЖИВОТ

This initiave is promoted by **PRIMARY SCHOOL "HRISTO BOTEV"** and is intended for **Primary School** pupils from 6-12 years of age.

More information is available here.

Organisation in charge:
Primary School "Hristo Botev", Baykal village, Pleven Region
Contact person: Ivo Stefanov Jokin - Email: ivo_jokin@abv.bg

INITIATIVE

The aim of the initiative is that of raising young people's interest in learning about the nature of local birdlife including waterfowl as well as those of the surrounding fields and city parks and understanding the needs and methods for its preservation. An important element of the initiative is the monitoring of the biological diversity that exists in areas in close proximity to the schoolyard, the surrounding village of Baikal and the nearby coastal strip of the Danube. The initiative includes the preparation of feeding racks from materials at hand, observations using binoculars and telescopes, counting the types and numbers of different waterfowl present during midwinter, as well as preparing presentations and films. The project involves about 50 children and 3 teachers and takes place through extra-curricular classes conducted on a voluntary basis. The activities focus on the following priorities:

- Improving access to quality education for pupils of different ages, sex, ethnicity, social and health status.
- Creating conditions to develop the potential of pupils with different educational needs and interests, providing them with equal opportunities for intellectual and personal development and full social integration through diversification and expansion of extra-curricular activities.

As a result of the initiative's implementation, the pupils acquire various skills in relation to the monitoring of biological diversity. This is achieved through the study of natural birdlife habitats, their feeding and migration habits as well as carrying out a census of the various species in the surrounding environment. The practical ICT, sport, communicative and observational skills acquired by pupils can be used, developed and applied to a variety of activities in science, not only those related to biology.

The initiative has involved cooperation with experts from the Bulgarian Association for Bird Protection, the Department of Ecology at the "K. Preslavski High School", the "Demokrit Forum" and the National Museum of Natural Sciences. The on-going support of the initiative's activities by NGOs in the area of environmental protection guarantees the creation of conditions suitable to ensure the sustainability of project-associated activities.

SUBJECT/S

The subject of the initiative is in the field of science - specifically biological and environmental science, and involves an interdisciplinary approach to the study of environmental science and ecology. The study and conservation of species diversity amongst the avian world and especially that of waterfowl, represents an important element in the activities of the «Dunav» Eco Club (a club for young conservationists). Monitoring, while often considered as an elementary skill, can be a challenging and stimulating activity for students. As a result, the pupils - with the help of teachers - prepare manuals for monitoring species, develop simulations and experiments, and display the actual results of initiative-associated activities. The children prepare feeding racks from plastic bottles and trays (collected in one of the many ongoing eco campaigns), as well as making models of different types of birds and animals. Through this initiative, the pupils have had their achievements recognised and rewarded at various levels including, regional, national and European.

Проектът цели да повиши интереса на младите хора към изучаване живота и опазването на водолюбивите и водоплаващите птици. Важен елемент е наблюдението на биологичното разнообразие, намиращо се в непосредствена близост - в училищния двор, околностите на с. Байкал и крайбрежната ивица на река Дунав. Инициативата включва изработването на хранилки от подръчни материали,наблюдения с бинокли и далекогледни тръби, среднозимно преброяване на водоплаващи и водолюбиви птици и подготвянето на презентации и филми.

METHODOLOGY

As part of the project activity, the behaviour of the birds is both monitored and studied. The working methods employed include talks, lectures, presentations, meetings, round table discussions, excursions, workshops and fieldwork, i.e. outdoor studies and bird watching as well as eco campaigns. Pupils are encouraged to seek ways to solve problems. Through the exchange of their experiences, ideas and conceptions, they share their attitudes and interests with both the local and regional communities. The communication between pupils is based on the principle of friendship and mutual trust. They help with the organisation of the different events and activities - they copy and fold information leaflets, and even prepare and clean the classrooms and meeting areas. Thus, they feel they have an important role in the project's success and their personal motivation and expression of interest is consequently enhanced. The use of role games enables the children to act in different roles - e.g. that of science communicators, leaders, journalists, cameramen, writers and especially that of researchers.

DIMENSION

The initiative is carried out at a regional level but involves the assistance of university teachers, research institutes, foundations and a science museum, which are all involved in collaboration in various national projects. Thus the initiative has a national dimension. The initiative is mainly self-supported but receives some regional financial support - especially from donors of materials, food, etc.

MULTIMEDIA TOOLS

During the initiative, the behaviour of birds was observed, monitored and studied and the results were written in a diary in the form of a handbook, explaining the basic steps and processes. Photo comments and presentations were made to present the initiative at various local, national and international seminars, competitions and festivals. These have included the Regional Biology Day, where the initiative won the regional competition, the "European Bird Day", where it was recognised as best European biology laboratory in its class, as well as the "WONDERS" European festival.

INVOLVEMENT OF PUPILS

Pupils actively participate in the whole process of documenting the initiative - taking photos, writing the diary and preparing presentations. In the multimedia laboratory pupils arrange the video shots with the help of software programmes for film processing and create short documentary films and video clips.

The documentary "Kids and Birds" has been created by the pupils, who worked together in various roles such as script-writers, actors and operators and were directed in this activity by the responsible for the initiative, Prof. Joikin.

The documentary was presented at the international film festival "Ecofilms" in Rhodes, Greece. Another example of involvement of pupils in the documentation process is the book "Song of Water" that won the first prize at the national competition "Water for Life" and included poetry and illustrations realised by pupils themselves.

TIPS FOR TRANSFERABILITY

The initiative can be implemented in every school and every country where biology and ecology are studied. It is necessary that the teachers and the pupils have competence and knowledge in the areas of biology and ecology and have access to an appropriate environment including e.g. wetlands or water basins where interesting birdlife may be found. The latter requirement is not compulsory and it could be interesting to discover, monitor and care for birdlife present in city parks etc. The main prerequisites for the transferability of the initiative are: computer and internet resources and access, suitable monitoring equipment such as binoculars - which do not need to be too expensive or complicated, even the zoom function of a simple digital camera can be used. If necessary, documentation of the initiative can be simply carried out using a mobile phone. It is also extremely beneficial to involve local or regional wildlife / birdlife protection or conservation agencies, as well as Natural Science Museums. By participating in this initiative, pupils can develop and discover new skills and identify future career possibilities. Teachers may acquire new competences and work methods applicable to future projects. During project-related activities, new contacts and friendships are readily established between the participants, both between young people of different age groups - and also between the adults involved, including the parents of the pupils.

ONLINE COURSES IN INFORMATION TECHNOLOGY FOR THE 5TH, 9TH AND 10TH GRADES

ЕЛЕКТРОННИ УЧЕБНИ КУРСОВЕ ПО ИНФОРМАЦИОННИ ТЕХНОЛОГИИ ЗА 5, 9 И 10 КЛАС

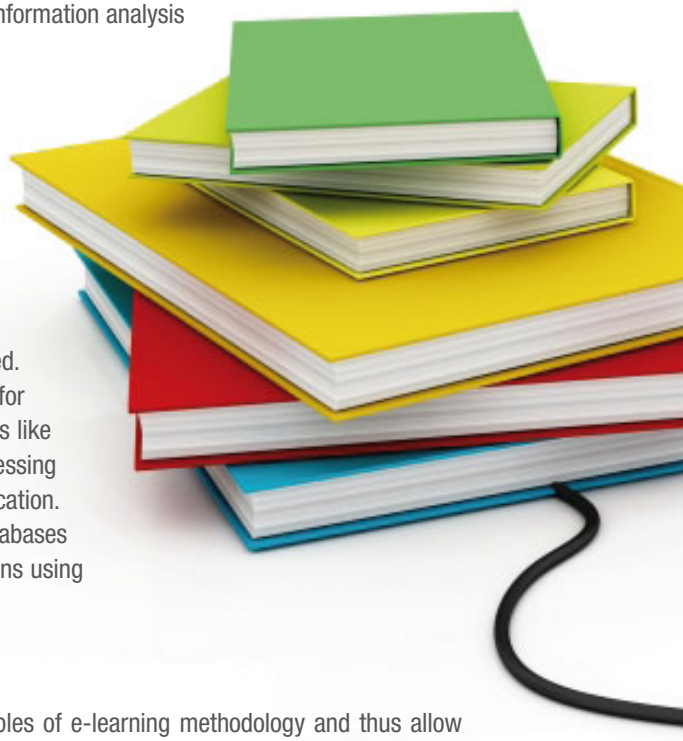
This initiave is promoted by **the MATHEMATICAL MODEL SCHOOL "ACAD. KIRIL POPOV"** and is intended for **General Secondary School** students from 11-19 years of age.

More information is available here.

Organisation in charge:
Mathematical Model School "Acad. Kiril Popov", Plovdiv
Email: omg_plovdiv@abv.bg
Website: http://omg.atspace.com
Contact person: Violeta Hubenova Taseva - Email: vili_taseva@abv.bg

INITIATIVE

The aim of the initiative is to support the training of ICT in General Secondary Schools, by means of e-learning courses that provide free access to educational software for different kinds of users, such as teachers and students. The e-learning courses include basic concepts and activities in the area of Information Technology. They are developed according to the current compulsory curriculum in Bulgaria for Information Technology studies and intended for the 5th, 9th and 10th grades (i.e. for students of 12, 16 and 17 years of age respectively), but they can also be used for autonomous learning and include tests for self-evaluation as well as practice exercises. The e-learning courses have been mandated by the Bulgarian Ministry of Education and Science and are now used in many Bulgarian schools, either during school lessons or for homework purposes. The expected effects of this initiative are the acquisition of ICT skills, as well as mathematical abilities and basic competences in science and technology. The initiative also fosters the acquisition of skills for information analysis and synthesis as well as those associated with problem solving.



SUBJECT/S

The e-learning courses focus on the subject of „Information Technology" and their content complies with the current educational curriculum and corresponds to the educational requirements approved by the Bulgarian Ministry of Education and Science. As a consequence of the curricular requirements, a range of e-learning instruments on CD-ROM together with a website providing online versions of the courses have been developed. Thus, every teacher and student can freely use the courses, both for training or autonomous learning. The courses in ICT include topics like operating systems such as MS DOS and Windows, the word-processing application MS Word and spreadsheets using the MS Excel application. The IT course for 10th grade students introduces the topic of databases using MS Access and also involves the preparation of presentations using MS PowerPoint.

METHODOLOGY

These ICT courses are developed in accordance with the principles of e-learning methodology and thus allow access to different parts of the lesson structure at any time. They provide an interesting and attractive way of teaching, which enhances the students' interest. The e-learning courses have good design features and an intuitive interface allowing easy navigation. Contents are presented in an understandable style and illustrated by images and video clips. Every lesson starts with a summary of the most important information and contains graphical images for visualization

Целта на тази инициатива е да подпомогне обучението по ИКТ в средните училища чрез електронни курсове, осигуряващи свободен достъп до образователен софтуер за различни типове потребители като учители и ученици. Курсовете включват основни понятия и дейности в областта на ИКТ. Те са разработени според задължителната програма по информационни технологии за 5-ти, 9-ти и 10-ти клас (т.е. за ученици на 12,16 и 17 години),а могат също да се използват и за самообучение.

of the contents. Every course contains a glossary for the commonly used terms and additional practical tasks for every section or topic included in the course. The courses help students to improve concentration and mental agility together with other different skills such as creative thinking, logical thinking and problem solving, etc.

DIMENSION

The initiative is a national one and is accomplished with the assistance and the financial support of the Bulgarian Ministry of Education and Science (MES) and the software company ORAK Engineering - Plovdiv. In 2006, the Ministry of Education and Science announced a competition for the development of e-learning courses for various subjects that were to be included as new compulsory elements of the educational curriculum in secondary schools. The specialised mathematical secondary school "Acad. Kiril Popov" won the competition and developed seven courses, three of which are focused on Information Technology and targeted at 5th, 9th and 10th grade students. It can not be indicated exactly how many teachers use the e-learning courses as the Ministry strongly advertised and recommended the National Educational web portal but did not make it compulsory to use its courses. However, it is well known that a lot of schools and teachers in Bulgaria use these courses.

MULTIMEDIA TOOLS

The e-learning courses are web-based and accessible from the national educational web portal. The portal consists of different sections dedicated to different subjects such as News, Educational Resources, School Listings and links to their associated websites and forums, etc. The users (teachers or students) can search the portal content by subject, grade, school name, city name (in order to find all schools in a particular city), etc.

The courses in ICT for 5th and 10th grades are developed in Adobe Flash while the course for the 9th grade is based on HTML technology. The courses include video and demonstration clips with graphic animation. For the 5th grade the course is realised in two versions - text and video, so that the users can choose at the beginning of the course which version they prefer. Demonstration clips for every lesson are prepared using teachers and students as the main actors, thus allowing students to visualise the separate topics and help them obtain a complete and accurate understanding of the course. An example is available at the website.

Access to the e-learning courses is available through the national educational web portal: IT for 5th grade; IT for 9th grade; IT for 10th grade.

INVOLVEMENT OF PUPILS

The students from the mathematical secondary school "Acad. Kiril Popov" participated actively in the development of the e-learning courses and were responsible for developing the design and some of the technical aspects of the e-learning courses. This work was conducted under the supervision of Violeta Taseva, a teacher in Computing and Information Technologies at this specialised mathematical secondary school. Violeta Taseva herself was the author of the contents and of the conceptual project. The courses for 5th and 9th grade students were realised by Stefan Stajnov, now an ex-student of the school, and the course for 10th grade students is the work of Martin Margaritov and Nikolaj Petkov, both also ex-students of the school.

TIPS FOR TRANSFERABILITY

The initiative can be easily implemented and used in any school where IT is studied - although one must of course take into account that the language of these particular courses is Bulgarian. Schools hoping to make use of the courses should have a computer laboratory where pupils can work with e-learning technologies. The pupils need a web browser, Flash Player 8 (for the 5th and 10th grade courses) and Media Player (for the 9th and 10th grade courses). These courses also facilitate the development of good levels of computer literacy amongst those with computer and internet access.

APPLYING ICT IN CHEMISTRY EDUCATION

ПРИЛАГАНЕ НА ИКТ В ОБУЧЕНИЕТО ПО ХИМИЯ И ОПАЗВАНЕ НА ОКОЛНАТА СРЕДА

This initiative is promoted by the **PRIVATE VOCATIONAL GYMNASIUM IN MULTIMEDIA, COMPUTER GRAPHICAL DESIGN AND ANIMATION** and is intended for **Higher Secondary School** students from 14 to 18 years of age.

More information is available here.

Organisation in charge: Private Vocational Gymnasium in Multimedia, Computer Graphical Design and Animation, Sofia
Email: info@codam.net
Website: http://www.codam.net
Contact person: Vilia Atanasova Nejkova - Email: vilian06@mail.bg

INITIATIVE

The aim of the initiative is that of learning and acquiring knowledge and skills using information and communication technologies in the field of Chemistry and Ecology training. The students develop multimedia products containing information on many processes and phenomena in the field of chemistry and ecology and the multimedia products include high quality photographs and relevant support information. The products are created for students by students. In this way they actively participate in the learning process and enrich their knowledge of chemistry and ecology. Thus, students achieve greater awareness of their subjects and in addition both creativity and communication are encouraged. This is also facilitated through the use of the e-learning system "Moodle" and its associated forums.

The expected effects on the students from this initiative are raised awareness of science and research and the acquisition of competencies relevant to the knowledge society. They acquire skills relevant to different areas: e.g. the gathering, processing, analysis and synthesis of information, as well as both presentation and ICT skills.

SUBJECT/S

The subjects in which the initiative is applied are Chemistry and Environmental Protection (Ecology). The students examine the information on the assigned topic, investigate selected themes and attributes and try to find a way to test and explain the results obtained in a clear and orderly manner in order to give their classmates the opportunity to understand their experiment and to learn something new from the material presented. Examples of research carried out by students include: chemical reaction kinetics, properties of chemical solutions, calorific effects occurring in chemical processes, methods of purification developed and applied during various production and treatment processes, including those associated with the production of gas, liquid and solid waste materials, etc.

The prepared PowerPoint presentation together with photos and videos or other multimedia materials, is loaded on the website. In this way instruments for e-learning are created and published on the website - the "Moodle" e-learning system - as teaching materials.

METHODOLOGY

The methodology adopted in this initiative is principally that of "e-learning" and involves using the e-learning system "Moodle". Every

Този проект е фокусиран върху усвояването и придобиването на знания и умения чрез използване на ИКТ в обучението по химия и екология. Учениците разработват мултимедийни продукти, които съдържат сведения за редица процеси и явления,придружени с качествен снимков материал и интересни факти. Продуктите, т.е. PPT презентациите със снимковия и видео материал,са създадени от ученици за ученици. Освен това учениците активно използват системата за електронно обучение moodle и форума, който тя предлага.

week during school term, the teacher uploads the topics which are to be studied. She also uploads additional learning resources in order to support and add to the materials available from the course textbook. She also suggests to the students different topics, related to the curriculum, and they choose among themselves which topics they want to investigate. Before the designated deadline for completion, students upload their presentations on "Moodle", so that they can be seen by all their classmates. Subsequently, the teacher starts a discussion on the "Moodle" forum and encourages students to give their opinions about the content and quality of the presentations created by their classmates. In addition to uploaded e-learning materials, different types of chemistry experiment are conducted during the lessons and students have the possibility to record the outcomes of the experiments and their observations, using their cell phones. In this way they are able to include relevant video clips in their subsequent presentations.

DIMENSION

The initiative is local but it is realised with the cooperation of university lecturers. The initiative commenced in 2008, when three university lecturers and two PhD students introduced "Moodle" to the school and the system was installed on the school server. The teacher Vilia Nejkova organized and encouraged her class of about twenty students to actively use different features of "Moodle": e.g. for research, home work and completion of assignments and assessment materials.

MULTIMEDIA TOOLS

The pupils themselves develop the multimedia products on a voluntary basis. A selection is made and the approved products are published on the school's Moodle website, where they are visible to registered users only. Two examples of PPT presentations created by students as part of this initiative are available in the documentation section of the STELLA questionnaire namely:

- One called "Chemical kinetics" that explains the speed of a chemical reaction, the factors on which it depends, and describes the formulas for calculating the speed of reaction, based on substance / chemical concentration and the kinetic equations for chemical reaction time;
- And another called "Chemical Fibres" that depicts the gross structure and composition of both artificial and synthetic fibres by presenting their chemical structures. Special attention is given to the structures of silk, nylon, polyester and cellulose acetate.

Tests and logical tasks appropriate to each presentation are uploaded on the system and they create opportunities for conducting tests and carrying out self-evaluation.

Video clips with experimental procedures that illustrate the reactions between chemical substances: e.g. the reaction between Silver Nitrate ($AgNO_3$) and Sodium Chloride (NaCl) or that between Zinc (Z) and Sulphuric Acid (H_2SO_4) are available to registered users on the Moodle platform.

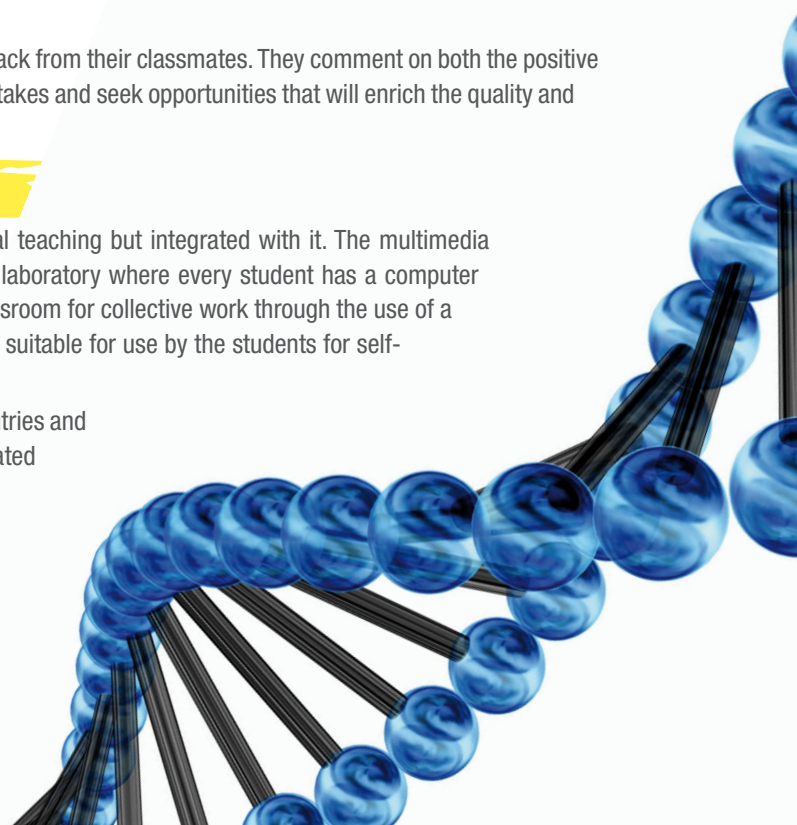
INVOLVEMENT OF PUPILS

The students make the presentations themselves and receive feedback from their classmates. They comment on both the positive and the negative aspects of the presentations, correct observed mistakes and seek opportunities that will enrich the quality and increase the number of PowerPoint presentations available.

TIPS FOR TRANSFERABILITY

The lessons developed are not used as an alternative to traditional teaching but integrated with it. The multimedia teaching products are readily suited for use in both the computer laboratory where every student has a computer and can develop his own experiments, as well as in the regular classroom for collective work through the use of a single computer and a multimedia projector. The products are even suitable for use by the students for self-training at home.

The core idea of this initiative can be easily transferred to other countries and contexts: in fact Moodle is an open source tool that is highly appreciated by students in secondary schools, as it facilitates interaction and communication among students and teachers, both in relation to class work and home work assignments. Furthermore, making students work on PPT presentations that are to be used as learning materials by other students, is a challenging task that encourages students' creativity, inventiveness and feelings of self worth.



INTEGRATED SCIENCE AND TECHNOLOGY TEACHING

ENSEIGNEMENT INTEGRE DES SCIENCES AU COLLEGE

This initiative is promoted by the **ENSEMBLE SCOLAIRE PRIVÉ JEAN XXIII** and intended for **Lower Secondary School** students from 11 to 12 years of age.

More information is available here.

Organisation in charge: Ensemble Scolaire Privé Jean XXIII, Montigny lès Metz
Email: secretariat@jean23.org
Website: http://www.jean23.org
Contact person: Michel Larrory

INITIATIVE

Usually at Lower Secondary school level students encounter an academic discipline-oriented teaching approach (mathematics, biology, technology, physics, etc.). However, the New Curriculum for Lower Secondary Schools clearly highlights the need to strongly link all scientific disciplines together with technology. With this in mind and to ensure continuity with regard to the renewal of science education established since 2000 in French primary schools, along with the appropriate integration of a "hands on" approach to the teaching of science, the Jean XXIII Lower Secondary school of Metz has volunteered to experiment with an "integrated teaching" approach to science in two classes of students aged between 11 and 12 years old. Three teachers (one each from biology, physics and technology) share the pupils from the two classes. The two classes are divided into 3 groups of 15 students each to enable cross-curricular teaching of science (integrated science) that does not distinguish between each discipline. Each group is managed and supervised by the same teacher throughout the year and all groups work in parallel twice a week for a total of three and a half hours.
The objectives are: to streamline the transition between primary and lower secondary school, to develop students' curiosity and give them a taste for experimental science and technology, to build an integrated science curriculum based on three disciplines (physics, biology and technology) and to strengthen the development of inquiry-based learning.

SUBJECT/S

The subject addressed is that of "matter" (in physics, everything that has a mass is matter). This broad topic covers many areas of science (chemistry, life sciences, earth sciences and physics) as well as technology and also mathematics. Integrated science and technology teaching enables students (11 to 12 year olds) to discover the profound links between science and technology, while at the same time developing a well thought out vision of their familiar environment. Matter and materials by nature disclose much of the beauties of the world, contribute to our learning of reasoning and thinking, while also contributing to the improvement of our living conditions.

METHODOLOGY

To find accessible examples of the natural or technological world that are likely to stimulate students' curiosity and interest, the chosen topic is addressed in general, without focusing on any single disciplinary approach (biology, physics or technology). Teachers prepare and design each of the activities together. During their journey of learning, students reason, argue, share their ideas, carry out experiments, compare their results, engage in debate and employ their critical thinking. They gradually build on their knowledge, which they formalise in conjunction with the teacher for purposes of intellectual rigour. Teaching situations are organised with sequences that follow the progression of learning as established in the official curriculum of technology, physics, chemistry and biology. During these sequences, students often work autonomously. There is no a priori preconceived hierarchy between addressed subjects. A minimum of 3.5 hours per week for all students is devoted to the same theme for several weeks. The continuity of the activities and methods is guaranteed

Ce projet porte sur l'expérimentation de l'enseignement intégré des sciences au collège. Trois enseignants se partagent les élèves de deux classes de 6ème pour faire un enseignement transdisciplinaire des sciences (sciences intégrées). L'objectif est de développer la curiosité des élèves, de leur donner le goût pour les sciences expérimentales et la technologie, de construire un curriculum en sciences intégrées regroupant les trois disciplines (physique-chimie, biologie et technologie) et de renforcer la découverte de l'apprentissage basé sur l'investigation.

from Primary School up to and including the first two years of Lower Secondary school and as a consequence the unity of science and technology is gradually becoming apparent though the diversity of disciplines and approaches used during the students' investigations. Students regularly write and document information in their notebooks during their investigations (or experiments), always using their own words. They use traditional and modern techniques of communication, for example computers and the Internet. The objective is the gradual appropriation or consolidation by the students of science concepts and operative techniques and at the same time, the improvement of literacy and language skills (both written and oral). Adapted assessments allow both students and adults (teachers, parents, family members) to measure the "distance travelled", i.e. the learning progress and results obtained. Scientific partners, like technicians and engineers, make their skills available to both the teachers and the students.

DIMENSION

The Lower Secondary School "Jean XXIII" of Metz which is involved in this initiative is part of a group of 13 different academies or institutions that test an experimental approach to science teaching called Integrated Science and Technology Teaching (EIST). In total, 38 schools have been participating in this initiative during the current academic year 2008-2009. The number of teams involved in this testing has doubled since the first year of experimentation (the academic year 2006-2007). The Academy of Sciences is coordinating this project and is supported by the French Ministry of National Education (MNE) and in particular by its associated pedagogical institutions. The additional resources are provided either by the MNE or its regional institutions.

MULTIMEDIA TOOLS

The website is mainly dedicated to educational professionals (teachers, managers, trainers, etc.). It includes a lot of information on the initiative and presents many relevant documents including:

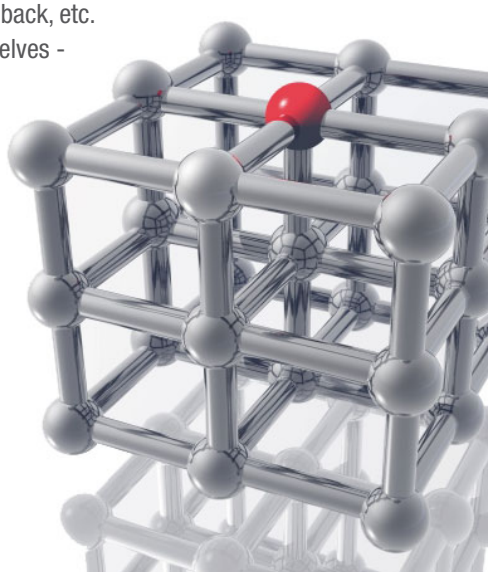
- **A General Presentation of the Initiative** together with the list of coaching persons by region, frequently asked questions, a picture gallery, the implemented pedagogical principles, documentation for school heads wishing to participate in the experimentation, a listing of the partners involved (public and private) and initial assessments of the initiative.
- **Guides for the Classroom** with proposals for pedagogical sequences that cover the whole curriculum.
- **General Documentation** including reviews of both papers, seminars, together with official texts etc.
- **A Suggestion Box** that offers opportunities for links with other disciplines (French, English, Mathematics etc.), pedagogical sequences, student assessments, etc.
- **A Discussion Forum** for teachers to discuss and debate on-going issues and developments.
- **Work Spaces** for teachers, coordinators, contributors etc.
- **Projects** focusing on job and professional development opportunities.

INVOLVEMENT OF PUPILS

This website is not intended for students. For this initiative, given the youth of the project, documents are primarily designed for teachers to help them build learning sequences within the framework of integrated science and technology teaching. However, students participate in their school projects and communicate internally. The experience or investigative notebook in which they document their activities and results can be used to keep track of their work. It is possible to include students' work on the school website or that of the MNE. In order to better understand how the experiment has worked during the past year, the teachers of Jean XXIII school have written a report, illustrated with a lot of comments, opinions, interviews, pupil feedback, etc.
The report is also accompanied by a film - an audiovisual product produced by the teachers themselves - available on the MNE's Regional website.

TIPS FOR TRANSFERABILITY

The degree of transferability is not easy to assess. While the availability of resources on the national website (see above) facilitates transferability, it is however, necessary to set up a support process with the contribution of peers already participating in the programme and this needs to be put in place principally during the first months of initiative implementation. The notion of integrated science teaching is not easy for a discipline orientated teacher, trained in a particular scientific discipline and teaching approach. The concept of teamwork is a prerequisite for the success of these projects. The biggest problem to date seems to be at this latter level.



BRIDGE FOR THE FUTURE
UN PONT POUR L'AVENIR

This initiave is promoted by the **CDEFI (CONFERENCE OF DIRECTORS OF THE FRENCH ENGINEERING SCHOOLS)** and is intended for **Lower Secondary School** students from 14 to 15 years of age.

More information is available here.

Organisation in charge:
CDEFI (Conference of Directors of the French Engineering Schools), Paris
Email: cdefi@cdefi.fr
Website: http://www.unpontpourlavenir.org/index.php
Contact person: Alexandre Rigal - Email: alexandre.rigal@cdefi.fr

INITIATIVE

This initiative aims to contribute to the struggle against youth disaffection for scientific studies and to promote equal opportunities regarding access to Higher Education and Engineering Schools. This problem has been confirmed by numerous studies by the OECD (Organisation for Economic Co-operation and Development), the Senate or the Ministry of Education and it is particularly true in France, especially for young people from disadvantaged social backgrounds, who are convinced that they have little opportunity of access to and chance of success in higher education studies in science.
The CDEFI (Conference of Directors of the French Engineering Schools) decided to organise a national competition open to classes with students of 14-15 years of age, located in priority education and rural areas. This competition proposed to make available engineering students to collaborate with secondary school students in the building of pasta models of bridges, and thus permit them to discover the basic principles and fields of application for physics, chemistry and material science (strength of materials), etc. Furthermore, it was seen as an enjoyable way for students to get their first taste of an introduction to engineering studies and the engineering profession as a whole.

Initially in 2006, two regional education authorities participated on an experimental basis in this initiative. By the following year, the competition had been expanded to 10 regional education authorities.
The anticipated results are many and include: making students more receptive to this approach of investigation and experimentation, but also that of improving the view that students have of science studies and science in general. Finally, a longer term objective is to analyse the impact of this initiative on students' decisions with regard to the uptake of higher education studies.

SUBJECT/S

As a first step, students are invited to visit the laboratories of an engineering school and meet engineering students. The construction of pasta bridge models (i.e. model bridges made of pasta) requires the acquisition of specific scientific knowledge. Two guidance teachers are involved: one from a lower secondary school and one from the engineering school itself. The representative from the secondary school is often a teacher in physics or sometimes technology. In a few cases, there are two secondary school teachers involved in the project: one specialising in physics and technology and the other specialising in physics and French language (for the purpose of supporting writing and communication skills amongst the students).
To assist students in this process, two engineering students intervene five times in class. For the preparatory work, the secondary school students have at their disposal methodology sheets in which a course that they are free to follow is proposed. The elements of the course framework include:

1. Documentary Research - the study of famous bridges in the world (state of the art)
2. Material Science - materials used in the construction of bridges
3. Bridge Structure - physics, strength of materials, chemistry, etc.

Durant cette compétition nationale destinée aux classes de 3ème situées en zone prioritaire ou rurale, des étudiants collaborent avec les élèves pour construire des modèles de pont en pâtes, et découvrir ainsi les principes de base et les champs d'application de la physique, la chimie, la résistance des matériaux, etc. Il s'agit d'un moyen ludique leur permettant d'avoir une première découverte des études et du métier d'ingénieur, de présenter leur travaux durant les compétitions interrégionales et nationale.

4. Computer Assisted Bridge Design - using the software application KATIA
5. Mechanics - choice of materials (e.g. why choose one type of wood glue over another etc.) and practical experimentation.

School Competition, Inter-Regional Finals and a National Final, are held in an assigned engineering school. Students must first present their work before testing their bridge. Three prizes are awarded: one for the strongest bridge, one for the most aesthetic bridge and one for the best project blog.

METHODOLOGY

Using the methodology sheets, the engineering students prepare their activities in the classroom. The guidance teacher from the engineering school validates their work, advises them and at the same time allows them to discover and get an idea of how the role of the teacher-researcher is best applied. There is then a prior exchange between engineering students and the secondary school teacher for an initial adjustment of course and project content. In class, it is the engineering students who manage the activities. The teacher remains in the background and intervenes only when necessary. Two class based sessions for project work are organised. In the intervening period between the first and second (final) class based project sessions, students work on their bridge model and this activity takes place outside of normal school hours, i.e. during hours usually reserved for extracurricular activities. These activities are supervised by their guidance teacher. Students continue to maintain direct contact with the engineering students during this phase, thus fostering communication and exchange of information.

DIMENSION

The competition takes place at national level. In 2007-2008, 10 academies, 24 classes from Lower Secondary Schools and 15 Engineering schools participated. For the overall management of the project, it was necessary to engage a full-time employee to coordinate all the various activities.

At the start of the initiative in 2006, funding was obtained under the call of the national project "Equal Opportunities at the University". This budget allowed the project to run for 3 years, and the creation of the necessary pedagogical tools, kits, communication tools, website, etc. The project also paid the travel expenses of classes to visit the engineering school and to participate at the Inter-Regional Finals and again at the National Final when appropriate. Finally, a small part of the budget was allocated to the purchase of prizes and awards. It is currently estimated that it will require more than € 80,000 per year to maintain the organisation at the same level as that of 2007-2008. Now that the national funding has come to an end, the objective is to develop private partnerships.

MULTIMEDIA TOOLS

The website of the initiative contains information regarding the project, the engineering profession itself and some photos of famous bridges, etc. A special blog-like tool is available on the competition website for participating classes. The aim is to enable students to describe the evolution of their project by writing regular articles, throughout the year. It is possible to insert photos or sketches of their bridge on the blog. This activity is mandatory and a prize is awarded at the end of the year to the best designed blog. All blogs are hosted on the same website and accessible to all students from participating classes.

INVOLVEMENT OF PUPILS

Students write a proposal for an article in a Word document and submit it to their teacher who is the only one who can upload it on the blog. The national project officer (who coordinates the competition at national level) performs a final validation before publication of material on the blog. In general, teachers facilitate the openness and transparency of this process by refraining from editing or changing any material submitted by their students.

TIPS FOR TRANSFERABILITY

The initiative is transferable to different levels, from one country to another (the disaffection of young people for science concerns all European countries), but it could also be expanded to other institutions of higher education with for example, visits to and from a research laboratory. Similar competitions exist in the United States. The major problem linked to the deployment of such a national initiative concerns the search for funding to cover not only the human resources for project management at the national level, but also the various travel expenses of students.

CONFERENCE OF YOUNG RESEARCHERS

CONGRES DES JEUNES CHERCHEURS

This initiative is promoted by the **DDEC 54 ET 55 (DIRECTORATE OF DIOCESAN CATHOLIC EDUCATION)** and is intended for **Primary School** pupils from 6 to 12 years of age.

More information is available here.

Organisation in charge: DDEC 54 et 55 (Directorate of Diocesan Catholic Education), Meurthe-et-Moselle and Meuse
Email: ddec54@scolalor.tm.fr
Website: http://www.enseignementcatholiquedelorraine.com/articles/congrn_s_des_jeunes_chercheurs.htm
Contact person: Vincent Idatte - Email: vincent.idatte@free.fr

INITIATIVE

Every two years, Directorate of Diocesan Catholic Education holds a conference that brings together about 350 young "researchers" from fifteen classes in the Meurthe-et-Moselle region. The third edition of this meeting took place on the 27th and 28th of March 2008. This symposium follows the traditional format of a research symposium. The children work all year round on scientific topics, employing an inquiry-based learning approach, as recommended by the "Hands On Science" initiative. Science in class is subject to autonomous learning through observation and analysis. Pupils prepare presentations / communications that they will present to their peers at the conference. This event is the culmination of a year of work and experimentation. The main objective is to organise a meeting between schools that enables the young researchers to communicate the results of their research, their conclusions and present the outcome of the challenges they have met in relation to the theme of sustainable development. This is also an opportunity for individual young researchers to organise and engage in discussion and debate regarding these issues and compare their views with those of other "real life" adult researchers in the same field of study.

SUBJECT/S

During the last conference, emphasis was put on the topic of "Sustainable Development". In particular, the following issue has been addressed: "Is progress harmful to the environment?" Many secondary themes have been developed around this issue. This conference is also an opportunity to meet researchers and obtain answers to the following general questions: How does one become a scientist?, What are the principle areas of research currently being undertaken?, Why do researchers meet each other during conferences?, How best can researchers benefit from these discussions in order to refine one's decisions and open new research paths?, How to present research results?, When is it possible to consider a particular research as having been successful? and Is there any certainty for success?

These meetings aim to show pupils that the research carried out in class is soundly based on methodologies recognised by professional scientists. This gives their work a real dimension, with more importance and greater emphasis being placed on how they learn (the learning process) than to the actual outcomes (the results).

METHODOLOGY

Each of the 15 classes involved in the initiative presented their experimental work relating to the theme of "sustainable development" to all the other participants at the conference. Since January, each class has undertaken a "scientific challenge" and reflects on a question, under the general theme of "sustainable development". Individual pupils

Cette initiative porte sur l'organisation d'un congrès de jeunes chercheurs, dans la forme traditionnelle d'une conférence de chercheurs. Les élèves travaillent toute l'année sur des sujets scientifiques, suivant une approche d'investigation recommandée par La main à la pâte. Ils préparent des exposés qu'ils présentent à leurs pairs lors du congrès. Cet événement est l'aboutissement d'une année de travail et d'expérimentations, avec la possibilité de comparer le point de vue des élèves avec celui des «vrais» chercheurs.

propose their ideas and concepts. After an initial evaluation and comparison of these proposals, the most appropriate hypotheses are selected. They must then be validated by experimentation. While teachers help and support the pupils, they have no active contribution or participation in the development of the proposals, or in the conclusions reached. Of course, the teacher is required to verify compliance of the project with the chosen protocol and can contribute to the successful completion of any experimentation undertaken. More than the result, it is the way of approaching the problem, through observation, the drawing conclusions and raising new hypotheses, which is advanced and encouraged.

An audiovisual product e.g. a film on "sustainable development" is presented to each group. It is followed by a debate that allows the pupils to raise questions and contribute ideas for activities and/or commitments that will safeguard our planet. The comparison of reactions after the movie leads to the identification of common issues concerning the protection of our environment. This comparison involves both listening to and respecting the opinions of others, conducting analysis, developing the ability to synthesise cogent arguments and personal opinions, as well as the ability to articulate, communicate and defend such opinions.

Verifying that young scientists have developed appropriate methodology and incorporated sound reasoning - not subject to randomness - into their approach is an essential element of the process. A summary of the proposed commitments is made and communicated to all participants after the conference.

DIMENSION

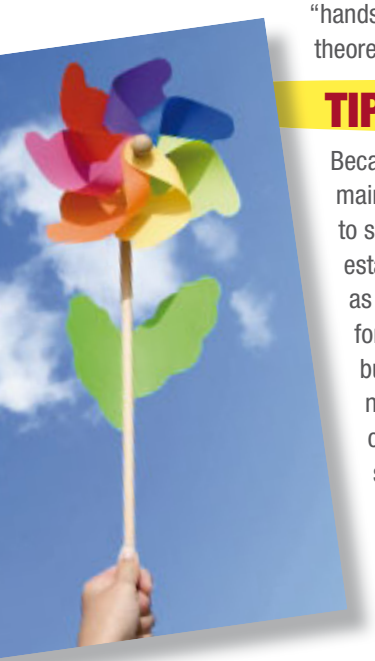
The conference involves fifteen classes (350 pupils) from private Catholic schools throughout the region. Research institutes are associated with this event. These include in particular the CNRS (National Centre for Scientific Research) or CRAN (Automatic Control Research Centre, Nancy University). Attendance at the conference is open to all, though the majority of the audience is from the Meurthe-et-Moselle, Moselle and Meuse departments.

MULTIMEDIA TOOLS

Reports, photos and articles by teachers, researchers, parents and pupils involved in the last edition of the conference are published on the web portal of the promoting organisation. The financial means of the organising institution do not allow the publication of writings or video presentations, but the web based articles give a good overview of the content of the discussions and the spirit of these meetings.

INVOLVEMENT OF PUPILS

During the conference, pupils present the methodology they have adopted and the conclusions they have drawn. They make an oral presentation illustrated with posters and models that enable others to access and review the results. The pedagogical added value seems evident. Science is experienced through a "hands-on" approach, through the confrontation and integration of theoretical knowledge with practical experimentation.



TIPS FOR TRANSFERABILITY

Because of its importance, this event takes place every two years. The smooth running of this initiative rests mainly on human aspects: identifying a few motivated persons in the institutions involved and researchers willing to share their knowledge and experience with the pupils. The network notion is a supporting factor: gradually establishing a partnership with research institutes which facilitates the organisation of the conference as well as the development of themes and project subject content. Skills are also required on the management side for the organizers: elaboration of the "terms of reference", the call for projects, developing the agenda and budget, finding partners, material logistics, etc., all require considerable management resources. It is also necessary to ensure and coordinate the smooth running of the various projects within the schools involved over the year and ensure the effective application of the terms of reference for the projects. In this regard, start up may be facilitated, by limiting the number of classes during the first year, after which they can become more numerous year by year, all the time strengthening the growing network of researchers.

SUPPORTING TEACHERS THROUGH THE INVOLVEMENT OF SCIENTISTS IN PRIMARY EDUCATION (ASTEP)

ACCOMPAGNEMENT EN SCIENCES ET TECHNOLOGIE A L'ECOLE PRIMAIRE (ASTEP)

This initiave is promoted by **LA MAIN À LA PÂTE** and is intended for **Pre-Primary** and **Primary School** pupils from 3 to 12 years of age.

More information is available here.

Organisation in charge: La main à la pâte, Montrouge
Website: http://www.astep.fr
Contact person: Aline Chaillou - Email: Aline.Chaillou@inrp.fr

INITIATIVE

Since 1996, The programme ASTEP ("Supporting teachers through the involvement of scientists in primary education") has encouraged researchers, science students, engineers and technicians from companies to assist (in the role of scientific tutor) Primary School teachers in the implementation of an investigative approach to science, as defined in the current Primary School curriculum. This implementation of this process, for which the teacher is primarily responsible, aims to enable pupils to acquire and build scientific knowledge by themselves through self-discovery. All the actors (teachers, pupils, external contributors) benefit from a mutual enrichment. The teacher, not necessarily from a scientific background, discovers what is involved in the investigative process. Thanks to the presence of the scientific tutor, the teacher approaches the science curriculum with less apprehension, becomes more self-assured in the conduct of scientific or technological processes and consolidates his/her mastery with regard to scientific content.

Pupils have a more lively and exciting interaction with and appreciation of science as a subject and also of the scientist, who is often portrayed as a tousled-haired savant. In addition, their curiosity, critical thinking and autonomy are developed, key competencies for tomorrow's citizens. The tutor develops his/her skills to make their scientific knowledge more understandable and accessible. Both the unexpected and original nature of the questions raised by pupils strengthens the scientist's self-evaluation of his/her practice and knowledge.

SUBJECT/S

The approach is a cross-disciplinary one. Any scientific topic can be addressed if it meets two requirements: i.e. that it is part of the curriculum and that it is authentic (connected to realistic and real world scenarios). Unlike other forms of collaborative activity, class-based support is the only one that establishes a direct and lasting contact between scientists and pupils during the learning process. The situation is particularly innovative and effective when it involves the presence of a third party element in the class, a "teaching co-contributor". The third party is most often a student of higher education specialising in science, an intermediate generation between the teacher and pupils, as they themselves are still learners.

The scientific tutor represents a type of scientific guarantee, the teacher remains in charge of the pedagogical organisation of the activities in the classroom. Through the investigation process, the activity is centred on pupils (social constructivism) who acquire their own knowledge by venturing hypotheses that must then be validated by experimentation.

Cette initiative encourage des chercheurs, des étudiants de formation scientifique, des ingénieurs et techniciens à seconder, en tant qu'accompagnateurs scientifiques, les enseignants du primaire dans la mise en œuvre et le déroulement d'une démarche d'investigation conforme aux programmes de l'école primaire. Cette démarche, conduite sous la responsabilité de l'enseignant, vise essentiellement à permettre aux élèves de s'approprier les connaissances scientifiques en les construisant eux-mêmes en partie.

METHODOLOGY

In essence, the collaboration between the teacher and the scientific tutor consists firstly in agreeing on the subjects, taken from the official curriculum, with which they will choose to engage the pupils. They identify the challenges and objectives and agree on the conduct of the activities. They then cooperate through joint and complementary management of the class sessions using their respective competences in science and pedagogy. The charter of the scientific tutor specifies this sharing: the teacher remains the learning specialist in the classroom and retains the control of the pedagogical course of the activities, while the tutor supports the scientific approach through dialogue and interaction between the teacher and his/her pupils. The activities are "hands-on" in order to allow pupils investigate and verify by means of experimentation, their assumptions.

DIMENSION

The ASTEP initiative has been promoted by the Academy of Sciences and was introduced in 1996. Having started with a few pilot sites, there are today 60 centres in the partnership with twenty classes each, and it currently involves approximately 1000 to 1500 students-tutors with between 25 to 30,000 pupils currently benefiting from this collaborative teaching approach. The initiative is estimated to represent at least 15 hours worth of class time every academic year for those pupils involved. This number is modest but not negligible. To assess and develop the ASTEP approach, several symposia have been organised since 2003. Today, a research team working on this form of collaborative teaching is in the process of being established. The project endorsed by the French Academy of Science, the Ministry of Education, the Ministry of Higher Education and Research, is coordinated at national level by La Main a La Pâte and at regional level by various universities and engineering schools. At national level, the necessary manpower for effective implementation requires more than 50% of a full-time position, for management and coordination purposes.

MULTIMEDIA TOOLS

To support the various actors (teachers and tutors), a website in French and English was created in 2008. It is comprised of three sections: Comprendre (About ASTEP), Participer (Getting Involved) and Echanger (The Discussion Board). The part "Comprendre" provides educational resources to assist teachers and tutors in the process, such as a general presentation of the project itself and of the different forms of cooperation that take place between teachers and tutors, an introductory guide, a tutoring charter, a short video that shows real in-class situations, a brochure, testimonials and a guide (both in short and full version), etc. The section "Participer" provides the contacts and information necessary to participate in the project, as well as available information regarding training resources. The third website section is devoted to information exchange and communication among participants and it allows them to ask the experts any questions they may have, to make contact with persons directly responsible for the project and to take advantage of examples and other support tools available etc.

INVOLVEMENT OF PUPILS

ICT is rarely used for in-class experimental activity. This is because the initiative is based on fostering an environment in which the maximum amount of time possible can be devoted to a process that allows the pupils, themselves, enjoy the greatest possible level of interaction, investigation and experimentation. Each local initiative (i.e. at school level) is free to choose which outputs will be requested from the pupils. In Nancy, for example, pupils are asked to elaborate a poster that will allow them to present their project at an event held at the end of the year.

However, on the national level, enhanced interaction takes place to support the various local actors whether through regional correspondence for personalised support or through forums where questions may be asked of the experts and where there is the opportunity to share the experience of other actors, etc.

TIPS FOR TRANSFERABILITY

From a local point of view, the success of the implementation of collaboration between students, scientific tutors, and a primary school class is based mainly on the motivation and the availability of the different actors. It must be recognised that a critical condition for success is the recognition of the importance of participation in the project of university or third level students. This can be done through the creation of learning units dedicated to scientific students during their Primary and Master degree courses: e.g. about 60 hours (30 hours of course work and 30 hours of practical work in the classes) validated through the award of 3 or 4 ECTS. It is a win-win situation, both for the primary school classes and the higher level students. Experience shows the need for training of both the scientist and the teacher, including training in the practice of "co-elaboration", "co-guidance" and "co-mediation" in teaching and on how to promote an effective investigative process in the classroom.

WHAT YOU CAN DISCOVER ABOUT PAPER

WAS MAN ALLES ÜBER PAPIER ENTDECKEN KANN

This initiave is promoted by the **PRE-PRIMARY SCHOOL "Die Pfifferlinge e.V."** and is intended for **Pre-Primary School** pupils from 3 to 6 years of age.

More information is available here.

Organisation in charge: Pre-Primary School "Die Pfifferlinge e.V.", Erlangen
Website: http://www.wakiga-pfifferlinge.de
Contact person: Ute Wening - Email: die.wenings@gmx.de

INITIATIVE

The initiative concerns the manufacture of paper (including not only the production process, but also related information and discovery regarding the overall context of the paper manufacturing life cycle i.e. from the starting point, the raw material, to the finished end product). This initiative has been conducted in the outdoor pre-primary school "Die Pfifferlinge" in the city of Erlangen, Germany. The outdoor pre-primary school is a day-care centre for children from 3-6 years old that is held exclusively outdoors, in a forest environment to be precise. Thus on the one hand, this initiative is directly related to the adjacent environment in which the children find themselves ("Paper being made from trees"), while on the other hand, the project addresses the basic needs of children to learn through play, such as painting, playing with water (splashing around), being creative with different materials and learning new things through discovery. Furthermore, the initiative is aimed at creating an awareness about the need to approach the use and manufacture of paper in a thoughtful manner and recognise that the trees from which it is derived are a valuable and sustainable resource and represent a complex ecosystem. Learning partners such as the local library, a local printing office and the city museum have also been closely involved during the course of the initiative.

SUBJECT/S

The initiative supports the self-directed learning processes of the children. Therefore the teachers and the pupils not only follow the primary learning path defined, i.e. how to manufacture paper, but also delve into various other related subjects such as biology, chemistry, physics, material science, music, and history. In addition, the children are stimulated to develop various self-competences, such as the creation of value systems as well as the development of team work and communication skills, creativity, concentration, patience, persistence, tolerance, reduced frustration and increased self-

Bei dieser Initiative widmete sich ein Waldkindergarten dem Thema Papier. Einerseits wies das Projekt einen Bezug zur unmittelbaren Umgebung der Kinder auf ("Papier wird aus Bäumen gemacht"). Andererseits adressierte es elementare kindliche Bedürfnisse, wie das Malen und Panschen mit Wasser und den kreativen Umgang mit verschiedenen Materialien. Spielerisch wurde das sinnliche Erfahren und eigenständige Schöpfen von Papier durch entdeckendes Lernen auf zahlreichen Haupt- und Nebenwegen durchgeführt. Auch lokale Bildungspartner (z.B. Stadtbücherei) wurden einbezogen.

METHODOLOGY

The methodology adopted is one of a "hands-on" approach, embedded within the framework of an open and constructivist learning approach. While the teacher provides the idea for the "principle learning objective and associated learning path" (i.e. how to manufacture paper), she is also sensitive to the children's needs and allows for other related topics to emerge as a result of engagement with the principal learning path. For example: When the role of caterpillars in relation to paper manufacturing was explained, the pupils got very excited about collecting different caterpillars in the forest, observing them in glass containers, providing them with adequate food, studying their development and transformation from the caterpillar stage to butterflies and documenting their discoveries on a daily basis. This was just one of several learning paths that emerged during the overall learning process. One of the teacher's tasks is to follow these paths, to gain knowledge about the different subjects and to answer the children's questions. Another task for the teacher is to document and summarize the interim results in order to show the relationship of the different learning outcomes to the main learning objective and from time to time to redirect the process back towards the principle learning path to ensure the coherence of the learning activities with the primary learning objective. Finally, after all the preparation activities, the process of manufacturing paper is carried out by the children on their own - while this is a process that follows a particular procedure, it also allows for a degree of individual freedom and expression, i.e. allows children to experiment in different ways to colour and decorate manufactured paper.

DIMENSION

The initiative was funded by the pre-primary school itself and had a local impact and dimension. The kindergarten cares for over 20 children. Parents were partly involved in carrying out the initiative - one mother was experienced in the process of paper manufacture and therefore instructed both the teachers and the pupils as regards the process requirements as well as providing the primary documentation. Local partners such as the city museum, the city library and a printer were also involved: Teachers and kids visited them, asked questions and learnt about different aspects in relation to the topic of "paper", its source and manufacture.

MULTIMEDIA TOOLS

The initiative is documented on the school website. A PowerPoint Presentation has been created to summarize the main elements of the initiative and includes some photos. As a result of the documentation process, a book has been created complete with text and photos that detail all the steps of the whole learning process, including the main activities and results. Furthermore, it contains many very beautiful pieces of paper manufactured by the kids together with their drawings. Relevant outputs such as text and photos are also available on a CD-ROM. To allow a greater number of people access to the documentation, further forms of documentation are currently under development, such as the book that will be subsequently published.

INVOLVEMENT OF PUPILS

The main role of the pre-primary children is that of being co-creators of their own learning paths. During the learning process, the children are interviewed by the teachers about their learning experiences. On the one hand, the interviews serve to give feedback to the teachers about the experiences and emotions of the kids. On the other hand, the interviews help the children to reflect on what they have learned and to deepen their overall knowledge. However, the main documentation work was completed by the teachers and the parents involved. Teachers commented on their experiences with the different learning paths and were responsible for recording activities and observations by taking photos. Some of the parents developed the photos, collected the material from both the teachers and the children (comments, interview results, drawings, pieces of paper etc.), and designed the paper book. Other parents were responsible for the development of a related PowerPoint Presentation and for publishing the documentation on the kindergarten's website.

TIPS FOR TRANSFERABILITY

The initiative could be easily carried out in different countries and settings, i.e. in more traditional pre-primary or primary schools: A primary learning path is offered by the teacher, individual learning paths are co-created by the pupils. Teachers should be open to the individual development of the learning process and be both capable and willing to gain new knowledge, even if the discoveries touch areas they are not familiar with and where it is necessary to seek the involvement of suitable external expertise.

PHYSICSCLUB SCIENCE RESEARCH CENTRE FOR YOUNG STUDENTS

PHYSIKCLUB - SCHÜLERFORSCHUNGSZENTRUM NORDHESSEN

This initiative is promoted by the **GENERAL SECONDARY SCHOOL "ALBERT-SCHWEITZER-SCHULE"** and is intended for **General Secondary School** students from 11 to 18 years of age.

More information is available here.

Organisation in charge: Albert-Schweitzer-Schule, Kassel
Website: http://www.physikclub.de
Contact person: StD Klaus-Peter Haupt - Email: kphaupt@aol.com

INITIATIVE

The PhysicsClub initiative promotes innovation both in the way science is taught and learnt at school. Interested students from the ages of 11 to 16 years and older are enabled to pursue academic work independently. The pedagogical framework is based on a constructivist learning theory. While working on real research projects in astrophysics and geophysics, students are stimulated to develop their competences in many ways (self-competences, professional qualification, social competences, and methodological competences). The student research teams work on a particular issue or topic for one or two years. Following this, some of them will go on to take part in the German Youth Research competition "Jugend Forscht", usually with great success. Every year students from the club win state awards, including in 2006 "the National Award in Physics". The concept of the PhysicsClub is unique in Germany and has won a number of important prestigious awards at national level.

The PhysicsClub/Youth Research Centre is part of the "Youth Academy" which provides special opportunities for interested and gifted students. Currently, one hundred and eighty (180) students work on 50 different research projects and are coached by six (6) teachers and fifteen (15) alumni (former university students). The topics of the actual projects change every year, depending on the interests of the participants. They find their own issues or can choose from a catalogue of ideas, prepared by teachers, students and other participants.

The meetings are held at the Albert-Schweitzer-Schule in Kassel, Germany, and starting in 2010 activities will take place in a dedicated, purpose-built building near the school. Membership is open to any student from any secondary school in Kassel or the surrounding. In addition, teachers can visit and view the on-going activities or work as coaches depending on the nature of the agreement established with the PhysicsClub leader (Klaus-Peter Haupt, see above).

SUBJECT/S

The main subjects addressed by the PhysicsClub are Physics, Technology, Astrophysics and Geophysics. However, as students are working on real projects, knowledge of several other subjects and disciplines is also involved by necessity. These subjects include: Chemistry, Mathematics and Biology. A number of pedagogical tools are provided to students, such as pedagogical manuals and information resources provided on the website. School teachers can also attend further training or work as coaches for the projects. Some of the topics of research projects undertaken to date have included: the "mpemba effect" (i.e. in certain specific circumstances, warmer water freezes faster than colder water), time resolved fluorescence spectroscopy, construction of a micro-lens, quantum cryptography, nano-gold structures and construction of a solar car, etc.

Im PhysikClub bearbeiten Schüler/innen der Klassen 5 bis 13 echte Forschungsprojekte u.a. in Physik, Astrophysik, Geophysik, Chemie und Technik über einen Zeitraum von 1 bis 2 Jahren. Nach der konstruktivistischen Lehr-Lerntheorie eignen sie sich das erforderliche Fachwissen selbst an. Lehrer und Studenten unterstützen den Prozess nur als Berater. Seit 2004 nehmen die Schülerteams sehr erfolgreich an Wettbewerben wie „Jugend forscht" teil. Der PhysikClub wird getragen von der Kinder- und Jugendakademie zur Förderung besonders interessierter und begabter Schüler/innen.

METHODOLOGY

The students (the majority of which are aged 14 - 19) work in small teams on interesting and up-to-date subjects. They acquire the necessary knowledge on their own. After choosing their research topics during the first months of their studies, they begin to solve their problems and answer their questions by themselves through the means of open-ended experimentation during the course of which they use real and validated scientific methods.

The younger students (aged 10-13) work on interesting projects, proposed by the teachers or the students themselves (examples include: building of electronic devices such as lie detectors, radios or the construction of a steam engine) and in doing so learn the necessary expertise and knowledge without direct instruction from the teachers. In particular students are encouraged to practice their social skills. Teachers and student-teachers act only as advisors, not as instructors, they train the students in soft skills and self-organisational skills relating to their work.

The PhysicsClub arranges contacts between experts at universities and enterprises, which very often sponsor the equipment for the experiments.

DIMENSION

The initiative has been developed at regional level, but has had a national impact thanks to the awards obtained and the consequent dissemination of results on the project's website and in relevant scientific magazines.

MULTIMEDIA TOOLS

The input required for documentation purposes constitutes about 1-2 hours weekly for the website, publications, articles and reporting aspects related to the further education of teachers. The multimedia tools developed are presented on the website. The website contains brochures relating to on-going initiatives, articles published both in science magazines and on Wikipedia together with photos and video materials relating to experiments conducted. The development of contents on the homepage is partly supported by teacher colleagues and students. The benefits of the documentation work itself for the PhysicsClub are many and principally include: Increased Transferability of the concept to other initiatives, the High Level of Popularity amongst the users for this format type for the purpose of accessing information and the advantages of the enhanced Level of Exposure and Accessibility for the purpose of attracting sponsorship.

INVOLVEMENT OF PUPILS

Students are partly involved in the on-going development of the PhysicsClub website. They are responsible for compiling reports on their work for youth research competitions or writing articles for youth research magazines. They also take pictures and sometimes create videos, but in this case these are not used for publication purposes.

TIPS FOR TRANSFERABILITY

The initiative can be easily carried out in schools from different countries. Numerous documents are provided concerning the methodology. An obstacle might be the fact that the documents are currently only provided in the German language, so that they would have to be translated into English or the relevant national language of those wishing to use them. The initiative requires teachers with a high level of expertise in their subjects as well as sufficient cross-curricular knowledge. Teachers should be willing to promote an open and constructivist learning approach amongst their students, with the students primarily acting as self-directed learners who are "merely" supported by the teacher who acts in the role of tutor. The infrastructure required includes a permanently available room, appropriate laboratory facilities and basic multimedia supports. Depending on the number of participants and also the number of projects involved, additional financial support and voluntary staff (trainee teachers, university students etc.) may be needed.

PROJECT LUFTIKUS
PROJEKT LUFTIKUS

This initiave is promoted by the **UNIVERSITY OF BIELEFELD, FACULTY FOR CHEMISTRY** and is intended for **Pre-Primary School** pupils from 3 to 6 years of age.

More information is available here.

Organisation in charge: University of Bielefeld, Faculty for Chemistry, Bielefeld
Website: http://www.uni-bielefeld.de/luftikus/
Contact person:
Dr. Hans-Georg Stammler - Email: georg.stammler@uni-bielefeld.de

INITIATIVE

The main goal of the "Luftikus" project is the promotion of the scientific curiosity of pre-primary school kids concerning physical and chemical phenomena. "Luftikus" was initiated by the chemist Georg Stammler from the Department of Chemistry of the University of Bielefeld and developed together with a professional puppeteer and a number of pre-primary school teachers. The initiative was financially supported with an award for Public Understanding of Science funded by the "Stifterverband für die Deutsche Wissenschaft", the business community's innovation agency for the German science system. The emphasis is on that of children experimenting for themselves. Initially, the initiative offers a one day training programme for kindergarten teachers, enabling them to conduct experiments with the children. In the following phase, the stage play "Luftikus" is performed as a kick-off event for the children. It is a mixture of puppet theatre (involving the puppet "Helius") and a science show. The third part of the project involves the children carrying out various experiments for themselves. Their experiments often relate to experiments previously observed in the stage play "Luftikus". While conducting these experiments and having their questions clarified, science phenomena become tangible and understandable to the children.

SUBJECT/S

The subjects addressed are physics and chemistry. After attending an exciting stage play, pre-primary school kids conduct experiments dealing with "air" and "fire" under the guidance of their teachers. For example, the inflation of a big chocolate marshmallow in an enclosed glass drying chamber apparatus, is shown during the stage play, but can also be done by the children themselves with a small chocolate marshmallow in a syringe, or a candle light can be extinguished using an inverted glass, similar to the "little fire" on stage that was extinguished using a large glass jar. Support material for the teachers includes the Seminar Handout which provides general information about physics and chemistry and the Experimental Handbook. Usually the experiments seen in the science show are the starting point for further ideas and questions from the children. For example: "If the microwave makes water vapour out of water, does it also then make oil out of soil?".

Ziel des Projekts ist die Förderung des Forscherdrangs von Kindergartenkindern hinsichtlich physischer und chemischer Phänomene. Das Projekt beginnt mit einem Fortbildungstag für Erzieher/innen, an dem sie die Freude am Experimentieren wieder entdecken können. Als nächstes wird ein Bühnenstück für die Kinder aufgeführt, eine Mischung aus Puppentheater und Wissenschaftsshow. Es dient als Initialzündung für die eigenen Versuche der Kinder. Die stehen oft in Verbindung mit den Versuchen des Bühnenstücks und lassen naturwissenschaftliche Phänomene „begreifbar" werden.

METHODOLOGY

The methodology involves a hands-on approach. On the one hand, the experiment is presented following the procedures detailed in the Experimental Handbook; on the other hand, children have the possibility to use it as a starting point for further experiments. After the stage play, many of the children's questions can be solved by the teachers, because they have learned during their training programme how to answer these types of questions. The answers themselves are not provided in the form of a verbal explanation, but by providing instruction for common experiments, which can be carried out by the children themselves. This also allows the teachers overcome their often commonplace discomfort regarding physics and chemistry. In this way, further ideas, questions and discussions are stimulated, because all senses are involved - including the pleasure of learning new things, experienced by both the pupils and teachers while carrying out the experiments. For example, one experiment to start off with could be to prove that air is everywhere by immersing an inverted glass into a bowl of water. If the children feel that they are allowed to carry out experiments, it is very likely that they will soon conduct further experiments related to "floating" and "sinking", which are often very creative and spontaneous. In this way they are working like "real researchers".

DIMENSION

The start-up was initially funded with an award from the "Stifterverband für die Deutsche Wissenschaft", but now the University of Bielefeld supports the initiative with its own resources. It has a national impact and dimension: To date the project has been performed in about 40 pre-primary schools, involving about 600 teachers and many thousands of children.

MULTIMEDIA TOOLS

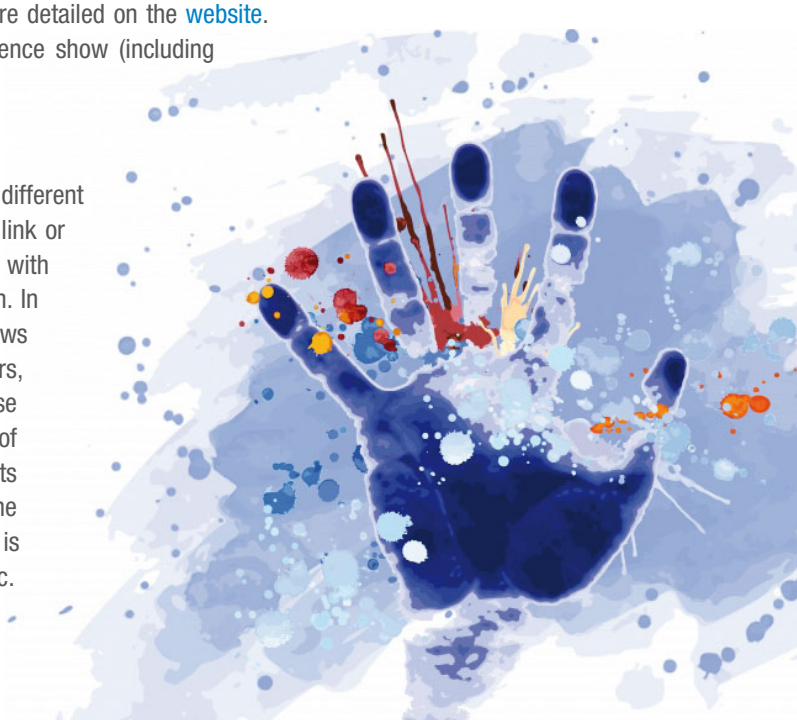
The initiative is presented on the website. The website contains detailed documentation regarding the project and a free handbook for pre-primary school teachers, including guidelines for carrying out the experiments. Numerous photos, some of them with comments together with an informative video serve to illustrate the science show performed by Luftikus and his puppet Helius. On request, the provider can supply a DVD that documents the whole play and gives further background information as well. The support and project documentation was compiled in co-operation with teachers, pedagogues and chemists.

INVOLVEMENT OF PUPILS

Feedback from children about the science show and the experiments conducted in conjunction with their teachers have been collected and documented. The interaction and activities of the children participating were observed and recorded by camera during the Luftikus stage play and the results were shown in a DVD, which is available on request (see details on the website).
During the two months subsequent to the show, the kindergarten teachers provided reports about the experiments being conducted by the children, and both the children and teachers are interviewed by a PhD student in educational science. The resulting reports are available at the website, and examples and results of the hands-on experiments that follow or have been developed from those demonstrated during the stage play are detailed on the website.
The screenplay together with a list of experiments from the science show (including appropriate safety guidelines) is available on request.

TIPS FOR TRANSFERABILITY

The initiative can be easily carried out in pre-primary schools of different countries. A necessary prerequisite is that there exists a suitable link or connection with an appropriate university department together with appropriate experts in the relevant fields of science and education. In many countries there exist associations that perform science shows for schools. The experts should also offer further training to teachers, who often feel apprehensive with regard to scientific subjects. These fears could be addressed in this training and replaced by the joy of experimentation. The teachers could then conduct the experiments independently, based on an Experimental Handbook provided by the experts. The equipment necessary for the teachers' experiments is easily available, such as drinking straws, glasses, gummy bears, etc.



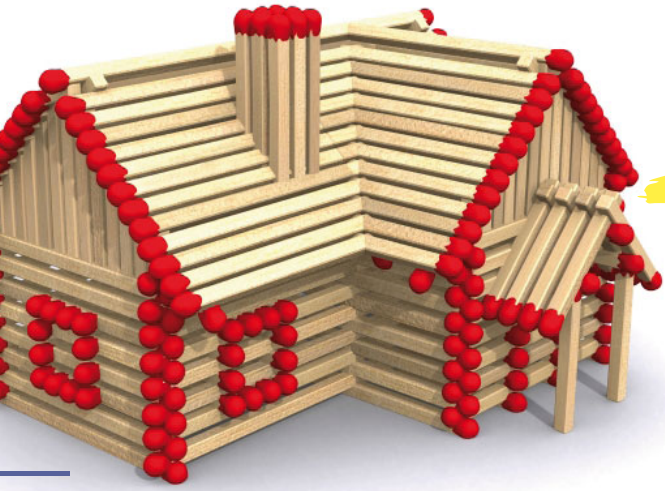
MATHS WITH LEGO AND MATCHES

MATHEMATIK MIT LEGOSTEINEN UND STREICHHÖLZERN

This initiative is promoted by the **GENERAL SECONDARY SCHOOL "STÄDTISCHES LABENWOLF-GYMNASIUM NÜRNBERG"** and is intended for **General Secondary School** students from 11 to 18 years of age.

More information is available here.

Organisation in charge:
Städtisches Labenwolf-Gymnasium Nürnberg, Nürnberg
Email: labenwolf-gymnasium@stadt.nuernberg.de
Website: http://www.labenwolf.de
Contact person: Dr. Christian Cura - Email: ccura@t-online.de

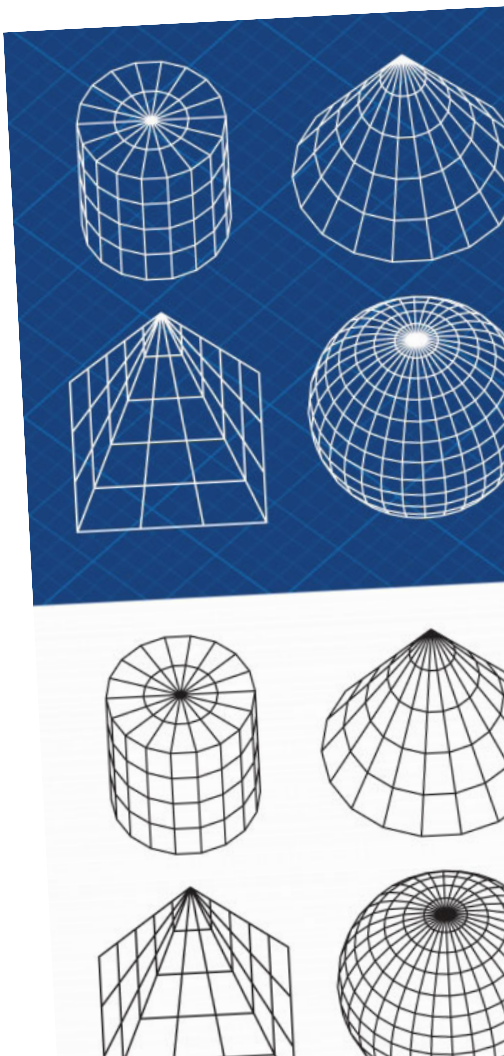


INITIATIVE

The main aim of the initiative "Maths with Lego and Matches" is to provide students with simple and familiar 'tools' (matches, building blocks, etc.) with which they can visualize and playfully explore abstract mathematical issues in a self-directed way. Activities with these tools can be carried out individually or in group work at school and at home.

Application of these tools in Maths classes starts during the first year of secondary school and may continue until the school leaving examination. For example: In grade 5 (when students are 10-11 years old), Roman numbers can be explained by using matches or tree diagrams can be visualized by using building blocks. The tools can still be applied for later grades. For instance, matches can be used to explain vectors, for 2D and 3D figures in geometry, and also for stochastics. Building blocks may serve to visualize terms, but also for visualizing tasks in combinatorics. The tools offer a wide range of applications. Their continuous use over all grades generates recognition of their value and permits a high degree of coherence with respect to the programme contents.

At the moment, seven classes from grades 5 to 9 are engaged in this project and each class has performed learning activities using Lego and matches on about ten separate occasions during the school year. Furthermore, the range of application of these tools is continuously increasing, as the initiative stimulates new ideas.



SUBJECT/S

The initiative addresses mathematical issues throughout all secondary school classes. Teacher and students use simple and familiar tools to visualize abstract problems. Products and outcomes include pedagogical manuals (already partly available on the school's website) with suggestions for the application of these tools in different mathematical tasks and settings. Examples include: Three matches create a triangle. If one adds two further matches, one gets a second triangle and so on. Students can derive a mathematical term or equation which describes this special sequence (chain) built from matches. In this particular case the corresponding equation or term for the match series is $T(x) = 2x + 1$.

Beim Einsatz von Legosteinen oder Streichhölzern im Mathematik-Unterricht steht der handlungsorientierte Aspekt im Vordergrund. Die Schüler lernen dabei, mit einfachen und vertrauten Hilfsmitteln spielerisch abstrakte mathematische Probleme zu visualisieren und leichter zu begreifen. Der Einsatz der Legosteine und Streichhölzer eignet sich sowohl für Einzel- als auch für Gruppenarbeit in der Schule wie zu Hause.

METHODOLOGY

The initiative applies a "hands-on" approach to the related activities. Students can explore mathematical issues in a self-directed way either individually or in group work. According to experience, the visualization of a mathematical problem by matches or blocks is stimulating to the majority of students, leading to lively class room discussions. Also students with allegedly less ability can more easily overcome their mathematical inhibition and contribute with good ideas to the resolution of math related problems.

DIMENSION

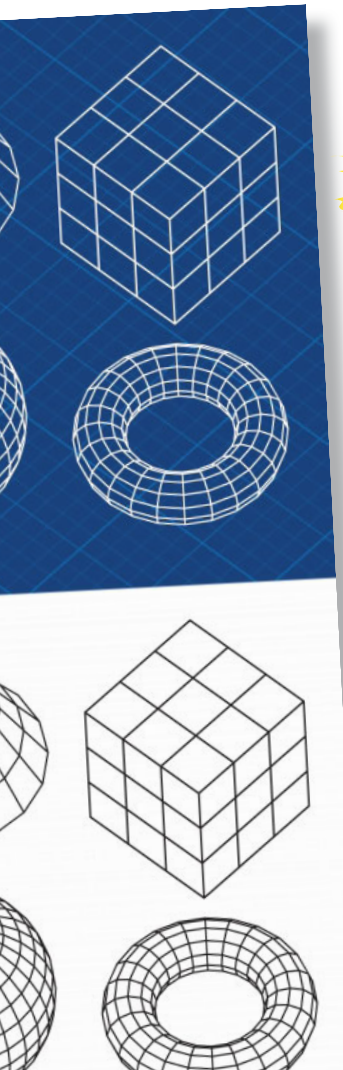
The initiative is self-supported and has a local impact and dimension. While a number of projects concerning the use of matches or blocks in Maths lessons were previously tried out on a limited basis, since 2009 these tools have been used more systematically and more frequently and in a far wider range of applications. Even so, the initiative continues to grow in relation to the number of classes involved, the variety of applications and the increased integration of multimedia tools for the enrichment of learning scenarios and documentation.

MULTIMEDIA TOOLS

The initiative is documented using a PowerPoint Presentation that provides information about the main elements of the initiative and contains some photos for illustration purposes. Currently, there is also a section on the school's website being implemented that refers to the initiative in its many forms. The section "Mathematics" will soon provide presentations of the results of several aspects of the initiative such as "Modelling Terms with Matches" (including pedagogical manuals) or "Mathematical Fantasy Stories" written by students themselves. The main benefit of this documentation work is that the ideas can easily be accessed by other teachers who would like to make use of them.

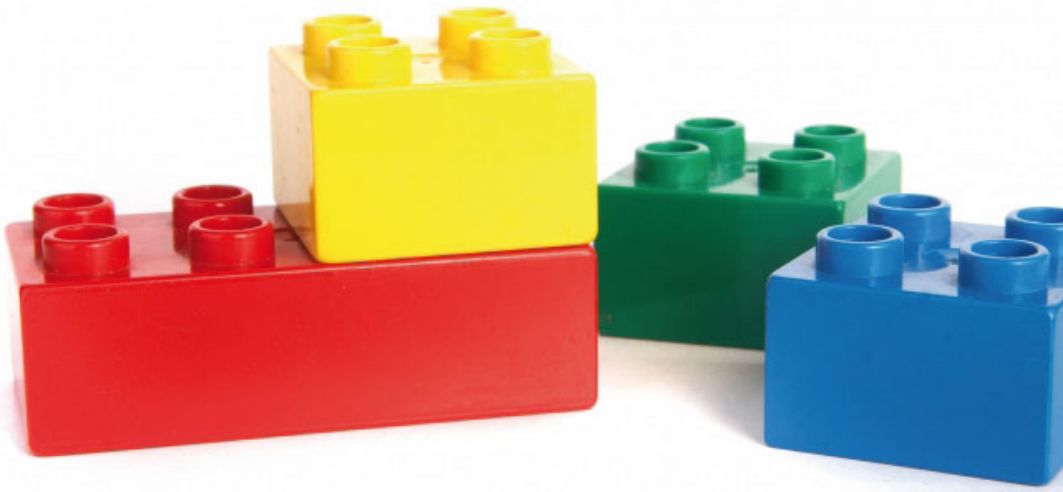
INVOLVEMENT OF PUPILS

In class, the students create terms using Lego and matches and present the results individually or as a group in front of the whole class. At home, they create terms and take photos of their work. Some of these photos have been used for the PowerPoint presentation to document the initiative. Furthermore, it is planned that students can upload their photos on a dedicated area of the school's website and add comments on their work.



TIPS FOR TRANSFERABILITY

The initiative could be easily carried out in schools from different countries. The tools (matches, building blocks) are simple and easy to obtain. The conduction of the initiative requires teachers with a high level of expertise in their subject. They should be motivated to translate pure, abstract mathematical thinking into concrete tasks and familiar or playful contexts. They should allow their students to explore mathematical issues in an open, self-directed way and support their individual learning processes.



PHYSICS OF KARATE
FISICA DEL KARATE

This initiave is promoted by the **HIGHER SECONDARY SCHOOL "Q. CATAUDELLA"** and is intended for **Higher Secondary School** students of 16 to19 years of age.

More information is available here.

Organisation in charge: Higher Secondary School "Q. Cataudella", Scicli
Email: fisicadelkarate@altervista.org
Website: http://fisicadelkarate.altervista.org
Contact person: Concetto Gianino - Email: concetto.gianino@istruzione.it

INITIATIVE

This initiative promotes innovation in science teaching and learning through the study of the Laws of Physics applicable to karate techniques. The aim of the project is to develop in students of a Higher Secondary school level a critical attitude by identifying and checking experimentally the laws and principles of Physics involved in the actions of human body and to present Physics not simply as a school subject that "has to be learnt", but as a powerful research tool that allows us to know and understand the laws that regulate nature. The activities involve 30 students of the Higher Secondary School "Q. Cataudella" of Scicli in the province of Ragusa, which meet once a week in the evening in the school gymnasium to learn and practice karate and to try to rationally understand what is happening to their bodies, both from the point of view of physics as well as from the point of view of kinesics. The school gymnasium has thus become a working Physics Laboratory, where students carry out experiments with quantitative measures, using both simple equipment (balances, dynamometers, tapes measure, etc.) and more sophisticated systems, such as receptors, a digital camera connected to a PC that allows the analysis of videos, force sensors and the use of the Microcomputer-Based Laboratories (MBL) system for data analysis and monitoring purposes. The initiative originated in 2007/08 from an idea proposed by the Physics teacher Prof. Gianino and is currently carried out in cooperation with the Dojo Karate-do Shotokan karate club of Scicli (Province of Ragusa, Sicily) and in particular with the cooperation and involvement of the Karate Instructor A. Gianni. At the end of the school year a public event with a practical demonstration is organised for parents and other students. As of 2008/09 the project has also been extended to other schools in the province of Ragusa, in cooperation with the Physics and Astronomy Department of the University of Catania and the Provincial Scholastic Office of Ragusa. A number of "travelling workshops", each of a three hour duration, are organised for students (up to those of the 3rd grade). The workshops include Physics lessons, Karate activities as well as experimental measurements to support the theory. These workshops give both students and teachers an overview of the main content of the project.

SUBJECT/S

The initiative deals not only with the subject of Physics but also with the subject of Natural Sciences and other cross-curricular topics. The specific topic is "Karate-do", a martial art fighting discipline which originated on the Japanese island of Okinawa. During the current academic school year 2008/09, 19 lessons, both theoretical and practical, have been held on many topics, starting from the origins and history of "Karate-do" and continue with the study of some specific karate actions with the aid of a combination of cinematic testing and standard Experimental Physics methodologies, i.e. measurement of the speed, acceleration, trajectory and average push force, etc. Analysis also includes experimental graphs of motion diagrams realised in the laboratory. The activities have also included the study of Newton's Third Law of Motion, which is tested using force sensors, together with other important topics relevant to Physics. Concerning the external workshops, they are focused on the measurement of the human body's "barycentric" position and include practical activities and exercises relating to Karate and self-defence techniques.

Questo progetto promuove lo studio delle leggi della fisica applicate alle tecniche di karate. Lo scopo è quello di sviluppare negli studenti di scuola secondaria superiore il senso critico, individuando e verificando sperimentalmente le leggi e i principi fisici coinvolti in azioni del corpo umano e quindi aiutarli a sviluppare una visione della fisica non come materia scolastica che 'deve' essere imparata, ma come potente mezzo di indagine per conoscere e comprendere le leggi che regolano la natura

METHODOLOGY

The methodology applied is a "hands-on" one and involves learning by doing. Theoretical lessons alternate between practical activities in the gymnasium on Karate techniques and laboratory activities for the analysis and measurement of the relevant physics and kinesics laws and the actual discernable phenomena that these laws imply. Two meetings were organised, one in December 2008 with Shaolin Monks and one in February 2009 with the Japanese Master, Shihan Masaru Miura, a 9° dan black belt, who is the technical director for Europe and head instructor for Italy of the Shotokan Karate-Do International Federation. The students spoke with the Monks and with Shihan Miura and had the occasion to ask questions about monastery lifestyle, Kung Fu techniques and the philosophy and history of karate. The teacher periodically organises an internal evaluation of the project through anonymous assessment questionnaires which are filled in by the students.

DIMENSION

The initiative was carried out for the first time in 2007/08 and was funded by the Ministry of Education within the framework of the "Scuole Aperte" (Open Schools) Programme. Since 2008/09 it has been included in the National Programme "Lauree Scientifiche" (Scientific Diplomas) and extended to other schools as a result of the implementation of a programme of travelling workshops. It has also been presented at the 4th meeting organised within the "Lauree Scientifiche" Programme framework at the Physics and Astronomy Dept. of the University of Catania. The "Physics of Karate" initiative has been also presented to thousands of visitors as part of the European "Night of Researchers" organised and held in Catania on the 26th and 27th of September 2008.

MULTIMEDIA TOOLS

The website provides information both in Italian and English and provides a detailed archive of materials that document the activities carried out during the school years 2007/08 and 2008/09. The list of topics included in the school activities is published and available at the website. The website documents the events organised during two years of activity and numerous pictures of students at work, can be viewed as a Slideshow or using Piclens. Also available on the website are YouTube videos used by the teacher in order to expand some topics and the site also includes the annual reports on the students' evaluation and information relating to student feedback and their degree of satisfaction.

INVOLVEMENT OF PUPILS

Students have taken part in the development of the website, as well as the translation of the website into English. They have been really active in the project activities, as the accompanying pictures show. The best students were selected to take part in the 3rd and 4th meetings of the "Lauree Scientifiche" Programme where they presented the project activities in greater detail.

TIPS FOR TRANSFERABILITY

The initiative can be transferred to other higher secondary schools where physics is taught. Most of the costs refer to the equipment needed to carry out the measurements and observations. What is most important is effective cooperation with the associated sport club and suitable support and backup from the school itself. Six persons from the school have been involved in this particular initiative: apart from the two teachers (those of Physics and Karate), a tutor (Prof. V. Carbone), a school laboratory assistant (Mr. Budello) and a gymnasium caretaker (Mr. Savà). During 2007/08 a kinesiology teacher (Prof. Cottone), was also involved in the initiative. The success of the initiative among students shows that the idea to study physics laws related to a sport activity is extremely appealing to students and it is readily applicable to other sports, i.e. football.

THE SPECIAL LANGUAGE OF RESEARCH

IL LINGUAGGIO DELLA RICERCA

This initiative is promoted by the **BOLOGNA RESEARCH AREA - CNR (NATIONAL CENTRE OF RESEARCH) AND INAF (NATIONAL ASTROPHYSICS INSTITUTE)** and is intended for **Higher Secondary School** students from 14 to19 years of age.

More information is available here.

Organisation in charge: Bologna Research Area - CNR (National Centre of Research) and INAF (National Astrophysics Institute), Bologna
Email: linguaggiodellaricerca@isof.cnr.it
Website: http://www.bo.cnr.it/linguaggiodellaricerca
Contact person: Mila D'Angelantonio - Email: mda@isof.cnr.it

INITIATIVE

The **Special Language of Research** is a project whose aim is that of improving the relationship between science and society by activating a new channel of communication between the school system and that of scientific research carried out by the Bologna Research Area - CNR (National Centre of Research) and INAF (National Astrophysics Institute). With this purpose it addresses students of higher secondary schools of all kinds, particularly those who are about to make crucial decisions about their future, including choices regarding uptake of university studies or entry into the work environment and aims to stimulate their interest in the popularisation of current scientific research activities amongst a non expert public (society in general). The original idea was proposed and developed by Carla Ferreri and the project involves all the institutes of the Bologna Research Area, many higher secondary schools (from 2004 to date, 17 schools in total) and a group of scientific popularisers and journalists who this year are members of the International Rotary Club - Felsineo Group.

The project foresees two phases. In phase 1 researchers meet the students in a cycle of presentations and guided visits to the laboratories of the CNR and it also includes exercises on subjects (agreed beforehand with the teachers) considered capable of providing suitable enrichment of the school curriculum. Phase 2 comprises lectures by journalists and popularisers with regard to how science can be communicated, and includes presentations, articles or other multimedia products (video, website, PPT presentations etc.) elaborated by students themselves and relevant to certain subjects dealt with in phase 1. The "best" products developed and received during the year are presented on the project website and on occasions at workshop events. At the end of the project, a workshop is organised that involves students, teachers, school directors and other regional contributors to the project. During the workshop there is an exhibition of all works received and prizes are awarded to the best works.

A very important element of the project is its bilingual character (use of Italian and English) both during the lecture presentations by the researchers and in the materials produced by students. English accompanies the Italian mother tongue because it is the main language for the communication of scientific news and because the technical-scientific knowledge generated is relevant to a generation of European citizens who have high levels of mobility within a Pan-European work environment.

SUBJECT/S

The topics dealt with involve various research areas relevant to the Bologna Research Area group, like geology, chemistry, biochemistry, physics, astrophysics and biometrology. A wide range of presentations are made available to interested schools, from which they can choose those they consider most suitable or relevant to their particular school curriculum. The presentations and guided visits available to date, include up-to-date topics like: food and the damage caused by free radicals, air quality, climate change, the global challenge on energy conservation, radioactive pollution, new methods to fight malaria, the connections between art and science, new novel materials and their production, nanotecnologies, microelectronics and the most up to date topics in the area of astrophysics research. The lectures which focus on science communication techniques deal with the art of science popularisation and the experiences of professional journalists. Particular attention is paid to the use of vocabulary and terminology in both English and Italian.

Questo progetto si propone di attivare un nuovo canale di comunicazione tra il mondo della scuola e quello della ricerca scientifica. Gli studenti incontrano i ricercatori in un ciclo di presentazioni, visite guidate ed esercitazioni su argomenti concordati con gli insegnanti. Quindi, dopo aver seguito le lezioni di giornalisti e divulgatori su come si racconta la scienza, si cimentano nella produzione di articoli o altri elaborati multimediali di divulgazione scientifica, sia in italiano che in inglese.

METHODOLOGY

The initiative combines different methodologies: learning objects, e-learning, practical exercises in the laboratory and at the computer. The presentations and guided visits are proposed in an interesting way to catch the attention of the students. All science related topics are dealt with in a popular way in order to transform students, through the experience they have gained in contact with the world of research, into promoters and messengers of the importance and relevance of science to today's society. The work with students focuses not only on scientific content but also on aspects of communication with the aim of enabling students to initiate direct and appropriate communication with a non specialised public. This should occur in both an original and creative way, which at the same time is also accurate and complete from a scientific point of view.

DIMENSION

This initiative is funded by the CNR Bologna and has a regional impact and dimension. The programme is completely free for those schools involved.

MULTIMEDIA TOOLS

The project website widely documents the project from a methodological and organisational point of view. It also provides access to the products developed by prize-winning students from over the past three years together with photos from final conferences, etc. There is also a special section where all presentations given by researchers about various topics are made available.

INVOLVEMENT OF PUPILS

The students are asked to communicate the scientific topic selected (after having assisted with presentations, lectures and exercises) in a popular way, choosing from among the various possible tools of communication available such as articles, brochures, commercial spots, videos, websites, PPT presentations, and other multimedia tools. Some examples of the products which have won prizes in 2008 include: website of "Chemistry on the Web", developed by students of the higher secondary school "L. Galvani" at Bologna (members of the project since 2004 and well respected for the quality of their on-going project work), which presents the research developed by various groups of students related to the lecture topic "Radioactive pollution from Hiroshima to nowadays passing by Chernobyl". The materials developed include videos, PPT presentations, articles, cartoons, and are all available on this website. Another class of the higher secondary school "L. Galvani" at Bologna has worked on the lecture topic "Climates at Present and in the Past" and has produced a PPT presentation on this topic.

Excellent articles in the style of newspaper articles or specialised reviews have been written by other students from the higher secondary schools "L. Galvani" and "N. Copernico" at Bologna, as well as from the Technical Institute for Agriculture "G. Garibaldi" at Cesena. Particularly worthy of mention is a study done on "Malaria" completed by the "N. Copernico" High School, which also involved an educational trip to Mozambique. The video shows children from Mozambique acting in a theatre performance based on a tale written by the Italian pupils on the curative property of the plant Artemisia (a variety of Wormwood) and in the play the character of the witch "Malaria" dies when she smells this plant.

TIPS FOR TRANSFERABILITY

The initiative is very complex and well-constructed, but lends itself to be transferred to other contexts. It is more suitable for secondary schools because it asks students to tackle complex topics and languages, but it is transversal to many scientific topics. In a reduced version, it could be realised by schools in relation to specific topics with the appropriate collaboration of a research institute and local newspaper.

EXPERIMENTATION WITH A BLOG FOR TEACHING AND LEARNING SCIENCE

SPERIMENTAZIONE DEL BLOG NELL'INSEGNAMENTO/APPRENDIMENTO DELLE SCIENZE

This initiave is promoted by the **LOWER SECONDARY SCHOOL "G. UNGARETTI"** and is intended for **Lower Secondary School** students from 11 to 14 years of age.

More information is available here.

Organisation in charge: Lower Secondary School "G. Ungaretti", Solarolo (RA)
Website: http://scientificando.splinder.com
Contact person: Annarita Ruberto - Email: annaritar5@gmail.com

INITIATIVE

The blog Scientificando ("Going for Science") has been conceived and developed by the teacher Annarita Ruberto with the primary aim of making science subjects more appealing and interesting to her students (those of a Lower Secondary school age). blog activities include animating the daily activities in class and enriching them with references, hints, various types of multimedia material and related tools. On the blog are published daily posts from the teacher, including materials developed by the students as part of their normal class activities, i.e. homework, research work, in depth study projects and investigations. This content type is complemented with other contents linked to the world of research and science in general, such as the results of international research, awards, news from research institutes and laboratories around the world, as well as advice, suggestions, proposed learning units and resources for other teachers and colleagues in Italy. In this way the blog Scientificando has become a fertile and productive interface between the worlds of school and research. The network of users includes both the class students of the teacher in charge as well as pupils and colleagues from other schools throughout Italy.

SUBJECT/S

The posts published on the blog cover various arguments relative to science education and are made available and archived, not only in chronological order but also with respect to the particular argument being dealt with: e.g. Food and Health, Astronomy, Biology, Chemistry, Physics, Geology & Palaeontology, Ecology and Ethology, History of Science, etc. The blog also includes sections from which various didactic materials can be downloaded (learning units, experimental protocols, tests, videos, podcasts, didactic comics, PPT presentations), together with various learning objects, software, tools and games suitable for science education. Other sections of the blog are dedicated to the websites and blogs of other teachers and colleagues, and include announcements and general news items. Some of these materials are shared and linked with other blogs managed by the same teacher. These include: "Matem@ticaMente", "Web 2.0 and Something Else". "Scientificando" has obtained a number of awards and is frequently referenced on important education and science portals whose role is to popularise science education.

METHODOLOGY

The blog reflects the different methodological approaches adopted by the teacher in charge of class work: e.g. peer to peer education, laboratory didactics, streaming and mastery learning, learning objects, e-learning, cooperative learning. The students work in groups at school as well as at home to carry out research and studies. Students work on scientific reports relating to laboratory experiments they have planned together, develop conceptual maps on their own or in groups to conceptualize the contents taught in class, which they afterwards discuss together. They also make posters and little booklets on topics of specific importance or interest.

Questo blog è stato creato al fine di rendere le materie scientifiche più interessanti e arricchire le attività in classe di riferimenti, spunti, materiali multimediali e strumenti. Gli studenti lavorano in gruppi realizzando ricerche, esperimenti, relazioni, mappe concettuali, ecc., e partecipano attivamente alla redazione e alla vita del blog. L'insegnante digitalizza e trasferisce il materiale sul blog, arricchendolo e animandolo quotidianamente con spunti e riflessioni di interesse scientifico.

DIMENSION

This initiative which was conceived by the teacher Annarita Ruberto is stand alone and self-financed. The impact of this initiative is at national level, as through the Internet the blog is addressing beneficiaries all over Italy. The blog is well-known and has great number of visitors: the average daily number of visitors accessing the blog is around 900 - 1.000 per day, with peak numbers sometimes reaching more than 2.000 registered visits per day.

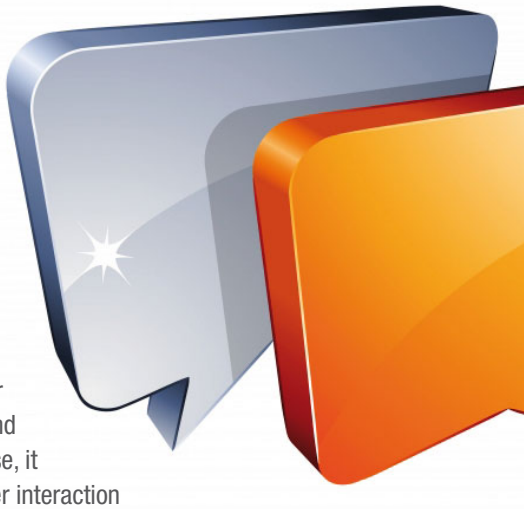
MULTIMEDIA TOOLS

The initiative involves the constant update of the blog which completes, enriches and documents the science education activities carried out in class by the teacher in charge. The blog acts as a form of repository for the activities carried out in class. These are documented in a multimedia format and enriched with comments, resources and suggestions from the teacher and the other users of the blog, including teachers and colleagues from the same school or other schools in Italy, as well as parents, friends and the students themselves. The documentation of the activities and the activities themselves are enriched through the blog and both complement each other.

In some cases the posts are addressing the students and offer materials so that specific topics discussed in class can be studied in greater depth. For example: "The vegetable cell"; In other cases, the teacher in charge of the blog addresses colleagues and readers of the blog in general, making available didactic units, materials and other useful teaching resources, like: "Let's know our cooking and that of others" (Conosciamo la nostra cucina e le altre). Contents also highlight news and events at both national and international level, for example: Rita Levi Montalcini.

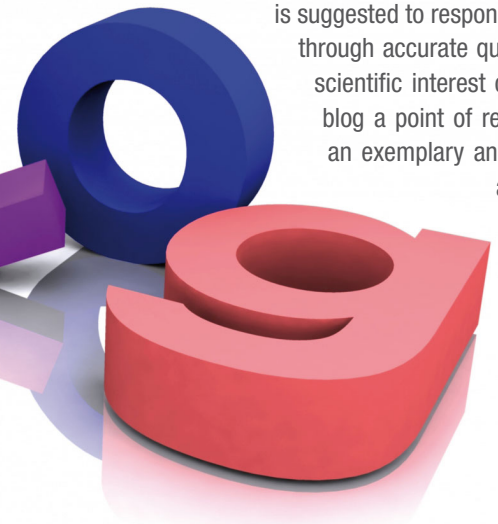
INVOLVEMENT OF PUPILS

The students participate actively in the editing of the blog with their contributions, study work and comments. Multimedia products developed by the students as homework or research are often published on the blog. For example the post in which the teacher publishes the first PPT presentation of three students from the Lower Secondary school, relating to their research about vertebrate animals. The students have also prepared a study about goldfish, which includes some drawings done at school. Other materials have been elaborated by the students and published on the blog: e.g. "The world of living beings and non living beings" - in which three students have prepared a synthesis of the topic, which was carried out in class; "The discovery of the sheltered sea: tour of the aquarium of Genoa" which includes grids describing the marine animals observed. This study was completed by a group of students as a homework assignment during their summer holidays.



TIPS FOR TRANSFERABILITY

To develop a blog is quite simple when one uses a free platform like the one used by the teacher in charge of this initiative (Splinder) or other similar ones like blogger, Wordpress, etc. It is easy to imagine a blog focusing on a specific subject or addressing students of higher secondary school. What is more difficult to succeed with is to constantly update the blog (for example updating it regularly, on a daily schedule), and especially to involve the students and other readers / users, stirring up their interest and their participation. For this purpose, it is suggested to respond to all comments promptly and without delay, try to foster interaction through accurate questions and to regularly visit, comment on and refer to other blogs of scientific interest or that deal with similar subjects. It is important to try to make the blog a point of reference for students and other interested readers, thereby creating an exemplary and up to date pool of knowledge that can be constantly accessed by an active community and that continuously contributes to the widespread distribution of knowledge.



HISTORY, MATHS, HISTORY OF MATHEMATICS

LA STORIA, LA MATEMATICA, LA STORIA DELLA MATEMATICA

This initiative is promoted by the **ISTITUTO COMPRENSIVO "C. GOLDONI"** and aimed at **Primary School pupils** from 6 to11 years of age.

More information is available here.

Organisation in charge: Istituto Comprensivo "C. Goldoni", Martellago (VE)
Email: veic838006@istruzione.it
Website: http://icmartellago.org/
Contact person: Silvano Locatello - Email: locatellosilvano@alice.it

INITIATIVE

The aim is to bring pupils closer to the construction of an image of mathematics as a discipline of research and discovery, that is integral to life and applicable to the cultural requirements of human beings, in contrast to the widely spread image of maths in society as a discipline to be learnt by heart. Two didactic strategies characterise this project:

1. to develop some knowledge about the use of numbers, starting by studying the use made by ancient peoples, to deepen the understanding of quantity, writing of numbers, describing the use of numbers, and their positional values;
2. to build a structured group work method, a "collaborative group", to foster positive communication and relationship dynamics for the construction of knowledge through the negotiation of ideas and meaning in a playful and fun way.

The activities carried out include: discussions in class, research and practical experimental activities in little collaborative groups, internet and library searches, interviews, meetings and written exercises including self-evaluation activities.

SUBJECT/S

The initiative focuses on mathematics and in particular on the history of mathematics, but includes also historical anthropological and linguistic elements. Starting with the question "Who introduced numbers and Why?" a process of research and elaboration of knowledge has been established through problem-based questions that stimulate pupils to reflect about their different hypotheses and to establish ways and tools to achieve verification and re-organisation of data. The process also involves in various ways other persons (parents, other competent adults, pupils from higher level classes) and has led to the discovery of different methods to count and represent the numbers that were used by ancient peoples. Within the activity the class has been split into three groups, each of them carrying out research on a particular counting system used by different ancient peoples (Paleolith, Maya and Sumerian). Considerable time is dedicated to the construction of specific objects and tools which have been used for counting purposes amongst ancient peoples and which are the subject of each study group. At the end of the year an exhibition is prepared to share the project contents and results with parents, other teachers and colleagues.

Questo progetto vuole promuovere un'immagine della matematica come disciplina che risponde ai bisogni vitali e culturali dell'uomo. A partire dalla domanda: "Chi ha inventato i numeri e perché?" è stato avviato un lavoro di ricerca ed elaborazione delle conoscenze attraverso un processo di domande-problema teso a far riflettere gli allievi di scuola primaria sulle ipotesi da loro stessi prodotte. L'iniziativa, che applica la ricerca di gruppo collaborativo, è ampiamente documentata sul wiki del progetto.

METHODOLOGY

The methodology adopted is that of research within a collaborative group, which foresees the division of the class in to smaller study groups which work together in order to fulfil a task and to maintain a role with the overall aim to improve learning. In this experience each member of the group has a role to perform that includes defined tasks and specific activities to be carried out together with other members of the group in order to complete the objective (established by the teacher). The roles have been defined following discussion with pupils and include: the manager, the secretary, the controller of serenity, the communicator, the observer (names of the roles defined by the pupils themselves). The role of the teacher is that of a "guide". Depending on the work to be carried out, the basis of group organisation is either one of collaboration (where different persons within the group carry out the same or similar activity and everyone is engaged in the same common work so that the group collectively reaches its objective) or one of differentiation (where different persons operate doing different activities, articulated and managed by the group itself and always with a common aim). The practical experimental sessions carried out in the laboratory are very important elements of the group work. Periodically the groups gather in plenary meetings in order that each group member can present their own work to their fellow group members.

DIMENSION

The initiative has been developed at regional level, but has had a national impact thanks to the awards obtained (GOLD award 2008, at national level). This particular initiative has been developed as a follow-on project from the experimentation with study activities conducted by teachers within the Maths Commission during 2006/2007 (Project of IRRE Veneto "The constructions of maths didactics in the classroom"), but also represents a didactic response to the study and educational requirements expressed by pupils themselves. The first external scientific reference to the project has been that from the R.S.D.D.M. - Bologna Group of Research and Experimentation in Didactics and Dissemination of Mathematics, made up by university teachers and teachers from all schools levels interested in experimentation and dissemination related to the didactics of maths.

MULTIMEDIA TOOLS

The multimedia documentation elements have required considerable collaboration and involved intense professional reflection and much sharing of the didactic experience. The production of multimedia tools has also involved a number of teachers from other schools (primary and secondary ones) in the Veneto region.

The wiki is the main repository which gives access to the general description of the project, and can be explored using different approaches: a structural one, provided by the index of the sections; a chronological one, provided by the "timeline"; and a conceptual one, provided by the "interactive map".

From the wiki the various different multimedia products can be accessed:

- the blog which represents a type of diary of the prosecution of didactic and documentation activities;
- the videos, both of interviews and documentation of activities of collaborative groups, grouped together in a playlist under YouTube;
- the Deli.ci.ous bookmarks and a list of relevant documents and multimedia files developed and shared using other applications like Slide Share, Vcasmo, Overstream, etc.

INVOLVEMENT OF PUPILS

The collaborative group offers many hints for involving pupils in the documentation, for example in the roles of secretary and communicator. For the future there is the idea to use the blog as a diary for the collaborative groups. The blog could facilitate the gathering and presentation of information and results, while at the same time also offering a place in which the data can be easily discussed by all.

TIPS FOR TRANSFERABILITY

To transfer this initiative it is necessary to get gradually familiar with the methodology of the collaborative group, both from a theoretical and practical point of view. The multimedia documentation is thought to be of help for reflecting on the process, to plan and improve the application of the methodology in the class and amongst colleagues. It is important to rely on a close and collaborative group of colleagues. On the wiki of the project are many materials (in Italian) to better understand how this initiative has been realised, see: Training, Activities, Cooperation.

THE FIFTH ELEMENT
O V ELEMENTO

This initiave is promoted by the **REGIONAL SECRETARIAT FOR EDUCATION AND CULTURE** and is intended for **Primary School** pupils from 6 to 11 years of age.

More information is available here.

Organisation in charge:
Regional Secretariat for Education and Culture, Madeira
Email: dpe@madeira-edu.pt
Website: http://dre.madeira-edu.pt
Contact person:
David José Patricio Fazendeiro - Email: davidfazendeiro@hotmail.com

INITIATIVE

The objective of the Fifth Element project is that of promoting the sciences among the pupils of the 1st Cycle of Basic Education (Primary Level), essentially those in the 3rd and 4th years of school (i.e. 8 to 10 years old). The main goal is to give pupils the opportunity to learn through doing (by experimentation). The aim is for the pupils to experiment, reflect and ask questions, thereby being better motivated to study science subjects.

As children in the age group 8-10 years old learn by doing and learn by thinking about what to do, this project seeks to provide the participants with the opportunity to learn through action and reflection on that action, in order to promote self-discovery, particularly in the area of science, which is the principle subject matter of the project.

The first edition of the project introduced during the 2008/2009 school year, was designed for pupils in the 3rd and 4th years of the 1st Cycle of Basic Education (Primary Level) in schools from the Municipality of Santana.

The teachers who oriented and designed the project went to the participating schools where they conducted experiments with the pupils in the field of natural science, contextualising them through a story-line which is subsequently included on the project website. Periodically, simple exploratory activities are proposed and all such proposals are intended to be coherent with the context of the story-line developed in the first phase of the project. In order to provide a concrete and sound informational base from which the pupils can approach their experimental studies, they have complete access to the story-line script and protocols detailing the experiments they have to do. When the experimental project work is complete they then return the results to the coordinators. The results are required, as with the original experiment, to be coherent with the context of the proposed story which has been designed in a manner that allows the experimental activity be an adventure in learning for the pupils. The pupils must furnish the results of the experiments they complete by e-mail and are guaranteed to receive prompt feedback to their outputs. This gives this project an extremely positive pedagogical characteristic, through the provision of on-going feedback and constant accompaniment for the pupils. Over the course of this phase, all the pupils will be awarded marks for the answers they return in order that the finalists can be determined. The scoring is done in accordance with the official regulations of the competition.

At the end of the process, the pupils with the most points will participate in the Grand Project Final. This consists of a “Treasure Hunt”, in which pupils must answer questions related to the activities they have carried out over the course of their study adventure.

SUBJECT/S

The initiative focuses on the Natural Sciences. The experiments and research questions are published on the website according to a schedule provided on the website itself. This schedule also indicates the period of time the pupils have to complete the challenge. The subjects of the activities undertaken are designed to be coherent with the scope of the National Curriculum of the 1st Cycle of Basic Education. The topics covered are many and include the following areas:

1. The Properties of Air
2. Buoyancy in Liquids
3. Solubility in Liquid
4. The Properties of Light
5. Electricity
6. The Properties of Sound

The activities are made available to the pupils on the website and are always contextualised according to the story-line initially presented at the start of the project. The pupils have access to the relevant protocol for carrying out the experiment they have been assigned. Once completed, they send the results obtained to the monitors of the project. The protocols for the experiments are prepared in advance by the project monitors.

Este projecto promove a ciência junto dos alunos do 1º Ciclo do Ensino Básico. O objectivo principal consiste em dar oportunidade aos alunos para aprender através da realização de actividades práticas e acima de tudo, descobrir a ciência através da acção e na reflexão sobre a acção. Periodicamente são propostas actividades exploratórias simples, contextualizadas numa história de aventura.
A grande final do projecto consiste numa "Caça ao Tesouro", onde os alunos respondem a questões relacionadas com as actividades realizadas ao longo da aventura.

METHODOLOGY

The project is carried out in 3 phases:
1st Phase - Promoting the Project - The Start of the pupils' adventure with science: In this first phase, the teachers who coordinate the project visit the participating school and explain the way the project works to both the pupils and their teachers. At this visit, the coordinators also provide the pupils with the context of a small story, which the pupils will have to complete through study and experimentation. Currently, six schools, comprising a total of 154 pupils, have participated in the project.
2nd Phase - Periodic Activities - The course of the adventure throughout the school year is articulated through the Internet site. During this second phase of the project, the teachers coordinating the project continue preparing and publishing the story on the website along with the experiments/research activities and questions to be disseminated to the participating pupils. These publications are made periodically according to the schedule given on the website - normally every two weeks. The pupils must furnish the results of the experiments they conducted by e-mail within the defined completion time as listed on the schedule. The coordinators award points to the answers received, in order to determine who will participate at the Grand Final.
3rd Phase - Grand Final - The pupils who receive the most marks for their work and are the best prepared will take part in the Grand Final: At the Grand Final, these pupils come together in one place, where they complete the adventure with a "Treasure Hunt", that is, in effect a Final Test, in which they must answer questions related to the activities carried out over the course of the adventure. For the 2008/2009 academic year 72 pupils contested the Grand Final.

DIMENSION

The initiative is essentially a regional one. In the first phase, the project is only directed at schools in the municipality of Santana, though the website activities documented within it are available for any school to visit (as of the 8/06/2009, 1723 visitors had accessed the website).

MULTIMEDIA TOOLS

The website supporting the project was created by the coordinators - Professors David Fazendeiro and Ivone Ferreira. It presents the entire theoretical framework of the project, the regulations, schedule, photo gallery, lists of participating schools and relevant contacts.
A PowerPoint presentation created by the coordinators is used to introduce the story-line to the classes. The scripts/protocols for the experimental activities are also prepared by the same persons.

INVOLVEMENT OF PUPILS

The experimental activities proposed are always framed within the story-line presented in the first phase of the project. In this way, the website is a means of continuous communication between the teachers in charge and the participating schools. The challenge placed in the form of a story-line leads to greater enthusiasm and involvement from the pupils in their activities, whilst at the same time promoting an appreciation of and a taste for science.
The resolution of the experiments must be done with the support of the teachers of the participating schools, which requires considerable involvement and commitment from persons within the teaching community. The pupils are not only learning, but are also constructing a story, which ensures their greater involvement in the on-going activity.
The results of the various experiments carried out always become part of the story and introduce the pupils to further novel challenges.

TIPS FOR TRANSFERABILITY

This initiative is easy to implement as long as the scripts / protocols and the story are adapted to the context in which the project is to be applied. It is necessary to have sufficient ICT knowledge and skills to create a website, and keep it both maintained and up to date.

FOQUETÃO - PHYSICAL CHEMISTRY

CLUB FOQUETÃO - CLUBE DE FÍSICA E QUÍMICA

This initiative is promoted by the **GENERAL SECONDARY SCHOOL OF CALHETA** and is intended for **Lower** and **Higher Secondary School** students from 11 to 18 years of age.

More information is available here.

Organisation in charge: General Secondary School of Calheta, Madeira
Email: ebsc@ebscalheta.pt
Website: http://ebscalheta.net
Contact person:
Marco Paulo Moderno Pereira - Email: pmarcopereira@hotmail.com

INITIATIVE

Clube FoQuetão - Physical Chemistry Club is a project that complements the curriculum of the Primary and Secondary Schools of Calheta, Madeira. The primary objectives of this project are to promote interest in the sciences and in the interpretation of everyday phenomena. The club's activities involve carrying out experiments in Physics and Chemistry with the objective of having the students draw their own conclusions about the "why" of things. These practical activities are filmed and placed on the project blog. The club is also responsible for the implementation of information campaigns about science in general. The team is made up of a monitor and a teacher, together with 12 students selected from both Lower and Higher secondary level schools.

Club activities are extracurricular in nature, taking place outside of normal school hours and are therefore non-obligatory. All activities undertaken are related to the school curriculum. The Club has a number of open places at the beginning of each school year. These are filled through the selection and enrolment of those students expressing a suitable degree of interest in joining. In the event a student member drops out or is excluded due to absence or unavailability, students on the waiting list are contacted so they can join the club.

During the various activities held in the school during the year - Club Week, Science Week, Halloween Party - as well as those conducted outside the school environment, e.g. the Regional Physics Olympics, Science and Technology Week, the students demonstrate some of the experiments they have already tried and are themselves responsible for explaining the observed phenomena to their colleagues.

During the school year, the Club also holds various presentations at the school for the other non-member students. Such presentations include different topics, for example that of "water-propelled rockets", explaining the scientific rationale or basis behind a particular phenomenon to the other students and by doing so raising their awareness of science.

SUBJECT/S

The scope of the initiative relates to activities in the scientific disciplines of Chemistry and Physics, with special attention given to the current contents of the school curriculum. Examples of topics studied and experimented with, include, to name but a few:

- Reactions of Alkaline Metals with Water,
- Magnetic Gliders,
- The Launching of Alcohol-Propelled Rockets,
- Heating Water in a Plastic Bag,
- Plasma Balls.

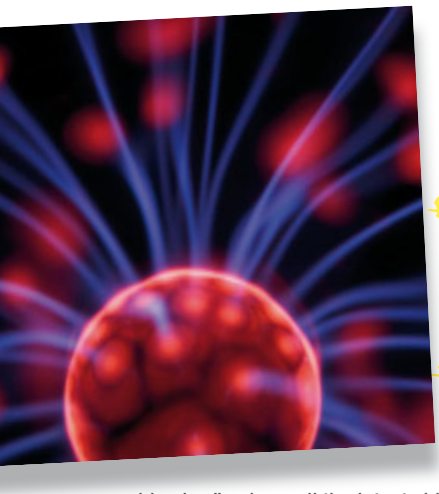
The club meets once a week, for a 90 minute practical session, during which the students, "young scientists", perform experiments using a tutorial provided by the teacher. The tutorial, created by the teacher, shows the steps to be followed when carrying out the practical activity. The students conduct the experiment on their own, according to the instructions and information provided in the tutorial. Whenever the experiments involve elements that may be dangerous or have a certain degree of safety risk, the experiment is conducted with help of the teacher and all relevant safety procedures (glasses, protective gown and gloves, etc.) are followed. The results are discussed by the whole group in order to find a reason for or reach the correct explanation or conclusion

Este Clube de Ciência tem como objectivo promover o interesse pela ciência através da interpretação dos fenómenos do dia a dia. Os alunos realizam experiências de Física e Química com o objectivo de os próprios alunos chegarem à conclusão do porquê das coisas. Os resultados são discutidos em grupo de modo a encontrar a explicação correcta. Deste modo, os alunos "aprendem a brincar". Estas actividades práticas são também filmadas e publicadas no blogue do projecto juntamente com os guiões das experiências.

for the observed outcomes. In this way the students "have fun and also learn". The practical activities are recorded and later published as part of the project blog, together with relevant support documentation, such as tutorials.

METHODOLOGY

The methodology is essentially based on a "hands-on" approach to the activities being undertaken. The group dynamics that exist allow the exchange and sharing of ideas, thus facilitating the group members to together build up a logical explanation for the observed outcomes of the experimental activities undertaken.



Students also use ICT / multimedia technology to source relevant background information and also to support the publication of video records of their activities on the project blog.

DIMENSION

The initiative while essentially local, also has a regional dimension through active participation in the Week of Science and Technology (Funchal, 14th - 17th April 2009), as well as other activities undertaken throughout the region.

MULTIMEDIA TOOLS

Other than the section available to students for their postings, the set up, management and maintenance of the blog is primarily the responsibility of the teacher. The blog lists the experiments conducted, and provides a chat box section, where students can converse with each other online. In addition both "a video bar", where all the latest videos are added and "a posting bar" which contains the most up to date postings, are made available to blog users. Other attributes of the blog include a complete listing of the young scientists participating, links to the different school websites, links to third parties and visitors that are involved or have access to the blog and a search box function within the blog itself. In addition to the relevant video, the posts also include the tutorial material relevant to each experiment carried out. This tutorial is prepared by the teacher and the students are also given the opportunity to include suggestions for follow on experiments they would like to undertake in the future.

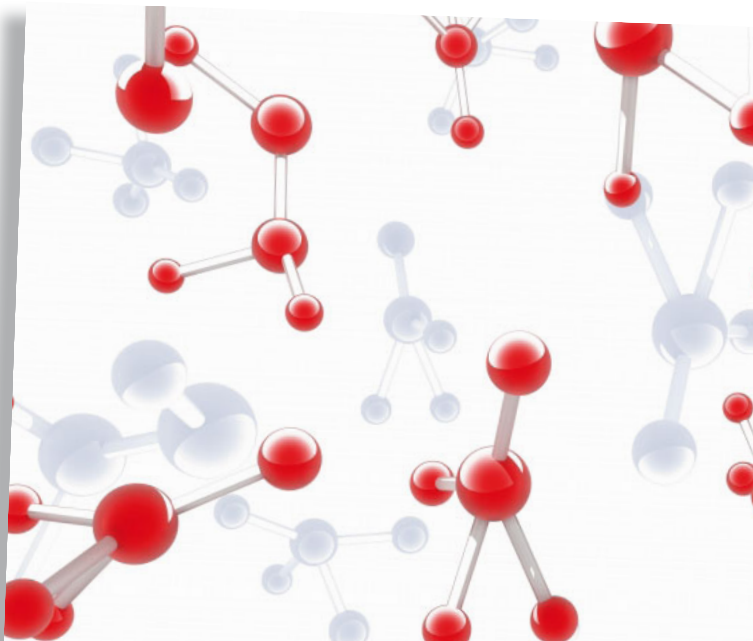
INVOLVEMENT OF PUPILS

The blog serves as a means of dissemination and interaction between student members of the club and the rest of the educational community. Students participate actively in the documentation process, starting from the point where experimental activities are initiated up to the point where these activities are published on the blog. The teacher is always responsible for monitoring this work.

While some of the students actually carry out the experimental activity following the steps detailed in the supplied tutorial, others are responsible for recording and filming the experiment. Normally, the teacher puts the posts on the blog, but sometimes they may be placed on the blog by the students themselves. The teacher is responsible for editing the videos and placing them online. The posts may be commented upon by the students or by any visitor to the blog. There is also a rating mechanism for each post, where visitors or other students can evaluate and vote on the quality of the material posted by describing it on a scale from poor to excellent. The teacher always tries to keep his participation in the activities to a minimum, essentially serving as a guiding element and giving support if there are doubts or queries that need further clarification.

TIPS FOR TRANSFERABILITY

This initiative is simple to implement because it is both coherent with the relevant curriculum in question. It is also suitable for students of different levels of education. The various guides themselves are readily accessible and freely available for use by other third parties and cover a wide variety of different practical activities. This initiative can easily be adapted for other subject areas, e.g. Mathematics, Biology, etc., provided the type of activities to be carried out are appropriately documented and supported. The teacher and students involved should have some ICT skills including the capability to create and manage a blog, as well as having video editing and publishing skills. In addition to the relevant computer and video equipment, it is necessary to have available appropriate laboratory equipment and facilities for conducting the experimental activities.



NATIONAL COMPETITIONS OF MATHEMATICS, BIOLOGY, PHYSICS AND PORTUGUESE LANGUAGE

COMPETIÇÕES NACIONAIS DE MATEMÁTICA, BIOLOGIA, FÍSICA E PORTUGUÊS

This initiative is promoted by the **AVEIRO UNIVERSITY** and is intended for **Primary**, **Lower** and **Higher Secondary School** students from 6 to 18 years of age.

More information is available here.

Organisation in charge: Projecto Matemática Ensino, Aveiro University
Email: helpdesk@pmate.ua.pt
Website: http://pmate.ua.pt
Contact person: Claudia Rego

INITIATIVE

The mathematics project was developed by the University of Aveiro with the goal of getting the entire school community involved in the promotion and dissemination of science, especially mathematics, physics, and biology and has been in operation for 19 years. Since 1990 a platform for computer-assisted learning has been developed, that not only embraces the various levels of education, from primary to higher education, but also develops content, for training (assessment, diagnosis, and training) as well as that for competition purposes. The sense of involvement created between students, teachers and the local community fosters a taste for the science subjects, helps combat student failure and related school drop-out rates, and also promotes the use of computers and the Internet, consequently enhancing the students' performance in their studies.

Each year, the Projecto Matemática Ensino (PmatE) organises five national competitions in mathematics: one for each level of the school system, from Primary to Secondary Level, and one competition that includes all levels of education. As a result of this initiative, other competitions dedicated to biology, physics and also the Portuguese language have been regularly organised.

Presented in the form of a game, and categorised according to the different levels of education, this software platform incorporates the knowledge attributes of the curriculum into a challenging game format, helping to overcome difficulties associated with traditional learning approaches and contributing to the construction of knowledge and a greater liking and appreciation amongst the students for the subjects being taught.

SUBJECT/S

The games cover all the contents of the school curriculum in mathematics, from primary to secondary level. A specific test is provided for each different school year (1st year Primary Level, 2nd year Lower Secondary Level, etc.). Each test consists of 20 sets of questions, each set of an increasing level of difficulty. The questions are provided in a multiple choice format with 4 answers for each question and 2 "lives" per level. The goal is to reach the last level of the game in the least amount of time. The same scheme is applied to games and competitions in the areas of biology and physics. Students can train at school or at home and they participate in the national competitions in teams of two. The students train during the year and meet at the University of Aveiro, normally at the end of April, to compete with fellow students from other schools around the country.

Este projecto tem como principal objectivo envolver toda a comunidade educativa na promoção e disseminação da ciência, especialmente da matemática, física e biologia. Foi desenvolvida uma Plataforma de Ensino Assistido por computador que para além de abranger os vários graus de ensino, do Básico ao Superior, desenvolve conteúdos quer no modo competição, quer no modo formativo (avaliação, diagnóstico e treino). O projecto fomenta o gosto pelas disciplinas indicadas, ajuda a combater o insucesso e o abandono escolar, promovendo também, o uso dos computadores e da Internet, favorecendo o seu consequente desempenho no estudo.

METHODOLOGY

Tests are based on the school curriculum and may serve as an additional tool to be used by the teacher to assess the students' knowledge in maths, biology and physics. To move from one level to the next, students have to choose the correct answer from amongst the four answers provided for each question, thus they should rationally think and apply the knowledge they have acquired during the school year.
Students train during the year with the help of the teacher and parents in order to participate in the National Finals at the University of Aveiro, where the winners are determined for each competition level. The competition level (degree of difficulty) relates to the particular year of schooling being undertaking by the participants.

DIMENSION

The initiative has a national dimension. Participation is open to all schools and is only limited by the competition rules that fix the maximum number of teams per competition. Each year the national competitions involve approximately 18 thousand students.

MULTIMEDIA TOOLS

The project's website includes information about the competitions (dates, contents, regulations, results) and events related to the particular science discipline that the project team promotes and participates in. The home page includes a slideshow showing pictures from recent competitions. Part of the website is also translated in to English. A private area is accessible to registered students and teachers. Besides having access to practice games, the teacher is also responsible for selecting the participating teams and entering his school and the chosen teams in the appropriate competition. There is no limit to the number of students/teachers enrolled on the platform, but there is a maximum number of teams per school that may compete in the events. In the teachers' area, the teacher has access to the results of the practice sessions of his students and can check the level they have achieved and identify which were the questions they missed or had difficulty with.

INVOLVEMENT OF PUPILS

During the school year, the students practice for the particular competition in which they will participate. On the platform, all the practice sessions of the students are recorded together with the results obtained (level achieved and time spent completing the test). This allows the teacher to check the difficulties encountered by individual students, as well as to select the students with the best results in order to organise the team for the competition. The students can practice together as teams or as individuals.

On the day of the competition, access is through the information area of the website and this area is only available while the competition is taking place. Besides this competition, the project team organises recreational and instructional activities on the university campus, including exhibitions and visits to university laboratories.

TIPS FOR TRANSFERABILITY

The core idea of the project is to organise on-line maths competitions involving students from the same or different classes / schools and it has the potential to be transferred to other countries and contexts, e.g. by using free or open source software such as Moodle, that readily allows the creation of quizzes and on-line tests. Students usually like to compete and tests and games can be useful method with which to assess the level of knowledge of a class or individual. Nevertheless, teachers should also be aware of the side effects of competitive approaches, that are likely to penalise less brilliant students in maths and may therefore act as disincentive to weaker students.

ROBOTICS CLUB
CLUBE DE ROBÓTICA

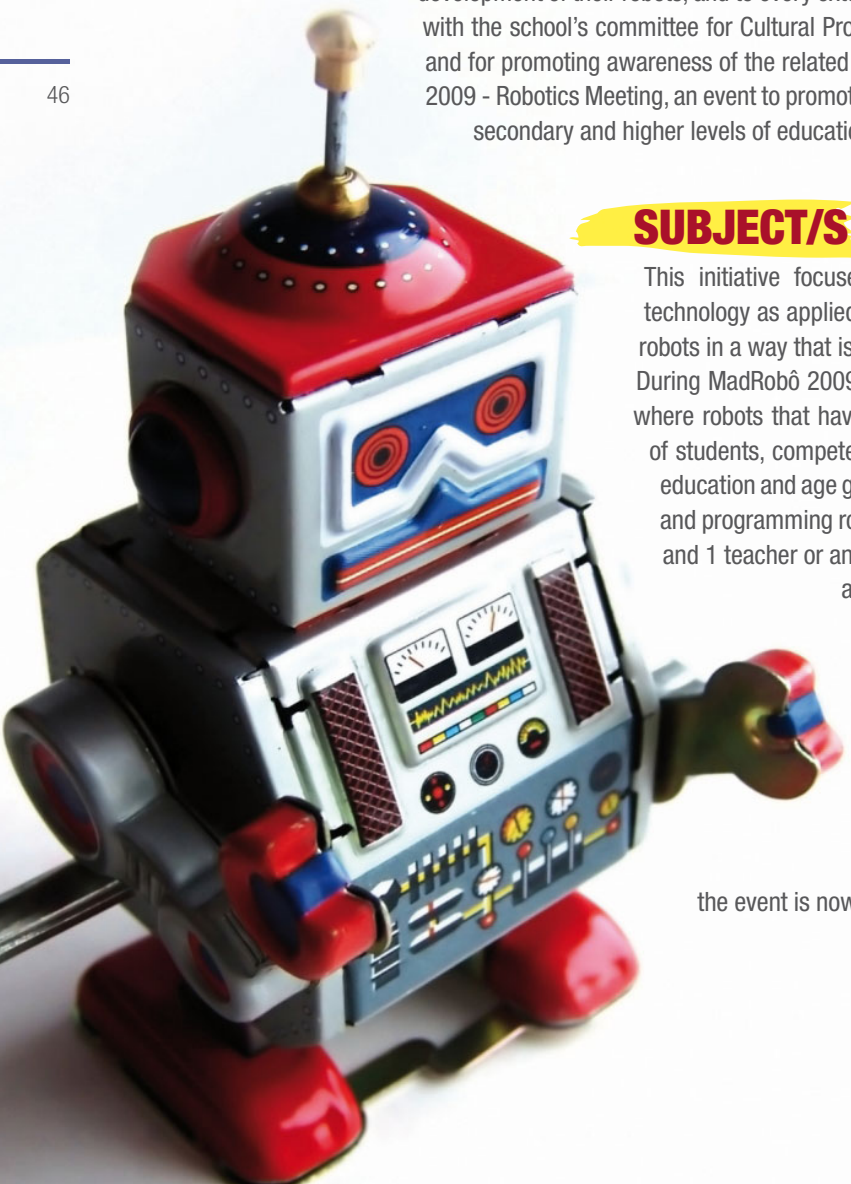
This initiative is promoted by the **SECONDARY SCHOOL OF SANTA CRUZ** and is intended for **Lower** and **Higher Secondary School** students from 11 to 18 years of age.

More information is available here.

Organisation in charge: Escola Básica e Secundária de Santa Cruz
Email: profebssc@gmail.com
Website: http://escolas.madeira-edu.pt/Clubes/tabid/4180/Default.aspx
Contact person:
Eduardo Nuno Novais Ribeiro - Email: eduardo_infor@hotmail.com

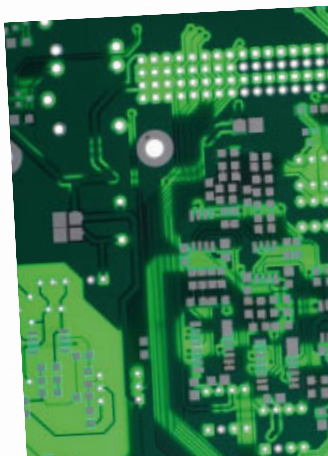
INITIATIVE

The Robotics Club is designed to promote both information and communication technologies as a format for both personal improvement and development and to develop students' skills in the areas of computers, mechanics, physics, mathematics and electronics, particularly in relation to robotics. The Club is an extra-curricular activity open to students in years 5 to 12 of the school system (i.e. students from 11 to18 years of age). Students enrol at the beginning of the school year and meet once a week for 90 minutes to programme their robot designs. They have an active role in the development of their robots, and to every extent possible, they work on their own. The Club works together with the school's committee for Cultural Promotion on a variety of activities for demonstration purposes and for promoting awareness of the related science subjects. In May 2009 the Club organised MadRobô 2009 - Robotics Meeting, an event to promote science and technology among young people from primary, secondary and higher levels of education.



SUBJECT/S

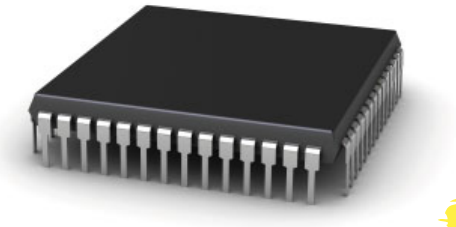
This initiative focuses on mechanics, physics, mathematics, electronics and technology as applied to the field of robotics. Students build and program several robots in a way that is as autonomous and independent as possible.
During MadRobô 2009 - Robotics Meeting, a series of competitions are organised where robots that have been designed, built and programmed by different teams of students, compete against each other, with specific contests for each level of education and age group involved. During this event a learning activity for building and programming robots is also organised, where teams of 4 persons (3 students and 1 teacher or another adult) learn how to build autonomous moving robots in a way that is simple and fun. Initially, a short training course is given in order to teach students the first steps in electronics, programming of robots and mechanical construction, after which a robot kit is given to the participants in order for them to assemble. Although it was originally planned for students in the lower secondary and higher secondary levels of education, the event is now also open to the general public.



O Clube de Robótica como objectivo promover as tecnologias da informação e comunicação como forma de valorização pessoal e ainda desenvolver capacidades no âmbito da informática, mecânica, física, matemática e electrónica aplicadas à Robótica. Os alunos têm um papel activo no desenvolvimento dos robôs sendo o seu trabalho, na medida do possível, autónomo. Durante o MadRobô 2009, o evento organizado pelo Clube, ocorreram um conjunto de competições entre robots concebidos, projectados, construídos e programados por equipas de alunos, havendo provas específicas para cada nível de ensino e nível etário bem como uma actividade de construção e programação de robôs.

METHODOLOGY

This initiative is based on a "hands-on" methodological approach. Students have an active role in the development of the robots and in all the activities of the Club as well. This methodology is in line with the goals of the initiative, that are not only, the development of skills in the area of programming robots, but also the development of critical senses, creative capacity and sense of responsibility. The initiative also fosters the development of social and organisational skills and the capacity to work in groups and cooperate in the resolution of problems.



DIMENSION

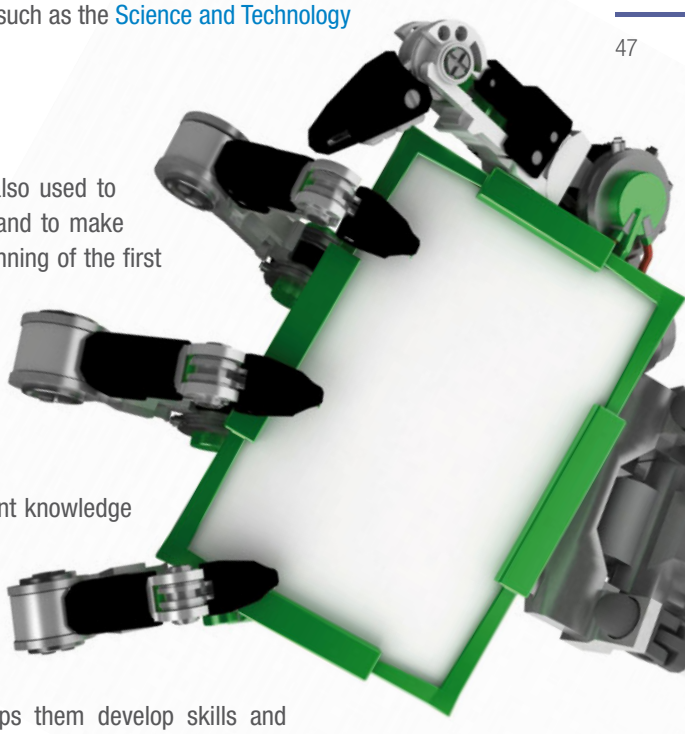
The initiative has both a local and regional dimension and impact. Besides the activities carried out in the scope of the school, the Club has also participated at the Science and Technology Week (Funchal, 14 to 17 April 2009) and therefore the initiative has had an expanded impact at a regional level. Furthermore, the Robotics Meeting - MadRobô 2009 was attended by many schools, students, and teachers, together with the general public. The Club has also on occasion been invited to perform demonstrations at various schools throughout the region.

MULTIMEDIA TOOLS

The blog is created and managed by the teacher in charge of the initiative and it is intended for use by all those who are interested in robotics, especially students and teachers. The blog promotes and documents by means of pictures and posts the activities carried out within the framework of MadRobô 2009, such as the competitions between robots built by the students. The blog also documents all the related events and initiatives in which the Club participates, such as the Science and Technology Week as well as other regional or national events associated with robotics.

INVOLVEMENT OF PUPILS

The students work in teams to create their own robots. These teams are also used to support dissemination activities, to raise the public's awareness of science and to make known the Club activities through demonstrations that take place at the beginning of the first term, at the end of each subsequent school term, and at the MadRobô event. On request the club visits other schools in the region, demonstrating to other students and their teachers the work done in the area of robotics.



TIPS FOR TRANSFERABILITY

This initiative is easily implemented, as long as those in charge have sufficient knowledge of computers and robotics to manage the activities and to guide students. The project is very appealing to those involved, both students and teachers alike. Students usually have fun by building robots and soon spontaneously try to be as autonomous as possible, which helps them develop skills and understanding in many scientific subjects related to robotics. The idea to create a club can be applied in different countries and contexts as it helps to develop social skills and in particular the capacity to work in groups and develop problem solving skills. The organisation of events, such as competitions and demonstrations in other schools and classes strengthens the team ethic and improves the member's ability to work together in an effective manner.

eTWINNING

eTwinning is part of Comenius, the EU programme for schools, and promotes school collaboration through the use of Information and Communication Technologies (ICT) in order to allow schools to easily form short- or long-term international projects in any subject area as well as taking advantage of social networking tools to discuss and share examples of good practice and pedagogical resources.

In the following section you will find some selected examples of eTwinning projects that deal with maths, science and technology (MST).

HEALTH NUTRITION IN PRIMARY SCHOOL

This initiative is intended for **Pre-Primary** and **Primary School** pupils from 3 to 12 years of age.
More information is available here.

MULTIMEDIA TOOLS

Blog (in Greek) - Ning Social Network - TwinSpace

INITIATIVE

In this eTwinning project involving primary schools from Greece, Romania, Turkey and Poland, children learned and exchanged information about a healthy diet, basic food groups and the food pyramid. They met dieticians, chefs and dentists, they did projects and puzzles, created delicious and nutritious menus, cooked, participated in quizzes and built their own notebook about a healthy diet.

SUBJECT/S and METHODOLOGY

The main subjects dealt with were health education, informatics/ICT and other primary school subjects. The main languages used were Greek and English. The pupils involved in the project were 6 to 12 years old. The work process includes the division in teams, the acquisition of knowledge about the food pyramid, meetings with dieticians, cooks and dentists, the creation of posters, the publication of pupils' projects on the school website, the development of a leaflet about project activities and its presentation to other pupils and schools that cooperated in the eTwinning project.

MULTIMEDIA TOOLS and INVOLVEMENT OF PUPILS

The tools used included chat, email, other software (PowerPoint, video, pictures and drawings), virtual learning environment (communities, virtual classes), and web publishing. Pupils were actively involved through the creation of posters and a leaflet, the publication of their projects on the school website and the presentation of activities to other pupils and schools.

MY TOWN IN NUMBERS

This initiative is intended for **Lower Secondary School** students from 12 to 14 years of age.
More information is available here.

MULTIMEDIA TOOLS

Website - Blog - TwinSpace

INITIATIVE

This is a maths project, elaborated by three groups of students of the same age (12 to 14 years), from secondary schools in Romania, the Czech Republic and The Netherlands. The project refers to the maths subject as a whole, covering topics such as: similarities and proportionality, other notions of geometry, magic squares, laws of motion, units of measure, volumes and message encrypting. The project has been well integrated in the curriculum, with the aim to diversify teaching techniques, use ICT to describe experiences report, communicate, and share results and students' ideas.

SUBJECT/S and METHODOLOGY

The first materials were presentations of the respective towns, schools, teams, including historical aspects of the places. The second one was the contest for the blog, with students creating logo proposals, either drawn by themselves or using specialised sites or software. Then, both teachers and students started to propose mathematical tasks for the partner schools and to discuss and compare the results. The communication among teachers was constant, both in the blog and by email. The students also used the forum. The project webpage was created by the Romanian team, with the contribution of all partners. The students' work was done consistently over time, both at proposing tasks and at solving them.

MULTIMEDIA TOOLS and INVOLVEMENT OF PUPILS

The work and the way to display the results was adapted to the age of students involved and for this reason, a lot of tools were used, such as a blog, webpages, Web 2.0 tools, as well as the eTwinning TwinSpace. All students used the eTwinning platform and its tools, they also communicated by email and looked for information on the Internet. It was a new and challenging way for them, because before they had used the computer mainly for chatting, playing games and searching on the Web. In addition to PowerPoint presentations, slide shows, puzzles representing well-known monuments in Bucharest, animations showing solutions to problems and word clouds of the texts of theorems were also created.

Furthermore, the project blog was both a tool for communication between the teams as well as a space for the material which could not be uploaded on the TwinSpace due to their format or size. Also the website had an important role for the project's visibility, including information about the project, presentations of the cities, schools and classes taking part in the project, the tasks submitted by each of the teams and the partners' solutions, as well as a link to the blog.

MATHS TO PLAY

This initiative is intended for **Higher Secondary School** students from 16 to 18 years of age.
More information is available here.

MULTIMEDIA TOOLS

Online magazine

INITIATIVE

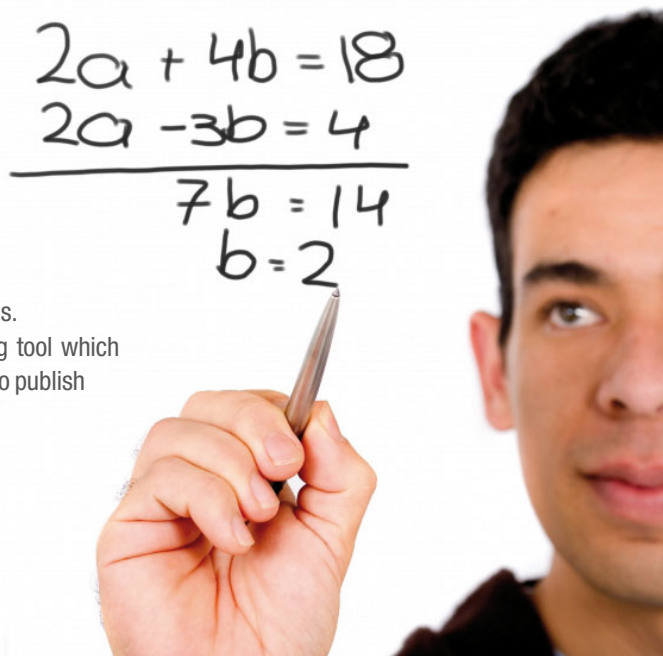
This eTwinning project aimed to reinforce student motivation for scientific subjects, to empower their scientific and L2 (English ESP) competences as well as to promote their European citizenship. These objectives were implemented through maths activities carried out in collaboration with schools from Italy, Luxembourg and France.

SUBJECT/S and METHODOLOGY

The project's goal was to make students understand that maths are interesting, fun and part of their lives. Maths in everyday life, history of maths, stories of men and women mathematicians, maths and logic games and puzzles, maths in art and architecture, and maths and gender are the topics that were dealt with. The approach was cross-curricular, so English was used to translate maths problems and scientific texts and to communicate with classes from the partner schools. Citizenship is a constant learning practice: communicating within the local group as well as with other European students, showing respect, awareness and acceptance of diversity (gender, culture, origin, etc.). The methodology was focused on practical and hands-on activities based on cooperation, peer-to-peer education and fun.

MULTIMEDIA TOOLS and INVOLVEMENT OF PUPILS

The target group was made up of thirty-five students aged 16 to 18 coming from different classes eTwinned with groups of students from the partner schools. The Italian team was composed of a maths teacher and an English teacher with experiences and skills in European projects. They cooperated with the teachers of the partner schools via email and Skype, in order to plan the activities and exchange materials. On the project website, the students showed their work and exchanged experiences. The project results are published on MagazineFactory, a publishing tool which provides school groups the opportunity to work as editorial staff and to publish their own "webzine".



ANCIENT TECHNOLOGY AS A BASE FOR TECHNOLOGY

This initiative is intended for **Lower Secondary School** students from 11 to 14 years of age.
More information is available here.

MULTIMEDIA TOOLS

Website with PowerPoint presentations, photos and videos

INITIATIVE

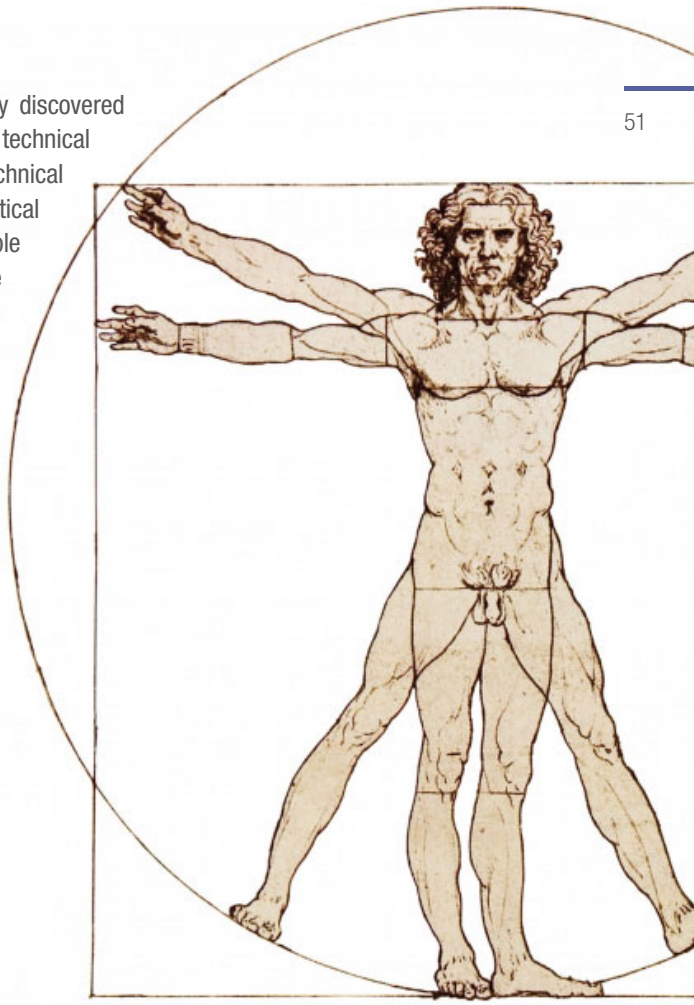
This project was an eTwinning cooperation between two lower-secondary schools from Greece and Italy. The project aimed to encourage and motivate students to discover prominent figures starting from Hellenic culture (e.g., Archimedes and Heron) and going up to modern scientists such as Leonardo da Vinci, who contributed to scientific and technical development. The knowledge and the discovery of these scientists of the past was made through the construction of miniature models found in the code pages of the past.

SUBJECT/S and METHODOLOGY

The main subject dealt with was technology. Moreover, the project was integrated in a range of further core subjects, such as history, science, computer studies, English and mechanics.
The activities carried out included the following: introduction of the eTwinning teams; design, planning and construction of models related to the fields of theatre, agriculture, transport, communication, flight, war, renewable energy; visits to important science museums; PowerPoint presentations of all the work done; common exhibition of the miniature models; visits of teaching staff and students to the eTwinned school.

MULTIMEDIA TOOLS and INVOLVEMENT OF PUPILS

The students worked in groups and actively participated to the tasks. They discovered the scientists of the past who contributed with their ideas to scientific and technical development; they designed, planned and organised the work; they used technical drawings to design miniature models; they identified solutions to solve practical problems using various tools; they learned the working principles of simple mechanics; they prepared a report describing the most important steps of the project; they prepared, organised and ran the models' exhibition. The tools used included: email, chat, forums, a blog, school webpages, MSN messenger, video conferencing, photos, videos and PowerPoint presentations.



CONCLUSIONS

The preceding chapters outline various initiatives undertaken by different groups and institutions from amongst the relevant partner countries contributing to the STELLA Project. These initiatives have been chosen as exemplars of "good practice" relating to the teaching and popularisation of science subjects at different school levels. However, it would also be accurate to describe the included initiatives as "selected practices", as the decision to include these particular initiatives is based on the application of both subjective as well as objective criteria as to what constitutes "good practice".

Invariably, in making a decision to include a particular initiative as being an exemplar of "good practice" leads one back to the central and all important question of what are the main factors that are considered to constitute elements of "good practice". Obviously in this case, it relates to those that both introduce and promote innovation in the way science is taught in schools, and that do so with a measurable level of success.

Therefore the term 'innovation' is central to the concept of "good practice". This is not unexpected, as the poor uptake, lack of appreciation and understanding of science and its importance to the development of the modern knowledge society, both amongst students and the general public at large, necessitates that new and novel approaches to its teaching are urgently required.

Innovation may be defined as the process of making changes by introducing something new e.g. new practices or ideas. Inherent in the current use of the term "innovation ", is that it refers to something done successfully and in a significantly new way. Those who are directly responsible for an innovative idea, concept or product are often called pioneers in their field.

In understanding the successful use of innovative ideas in the teaching of science, it is essential to be able to identify:

- What are the critical factors that distinguish these new "winning ideas" in the field of teaching Maths, Science and Technology (MST) subjects from those that are or have been less successful?
- What are the pedagogical concepts that when applied stimulate greater levels of student interest and the curiosity to learn?
- What motivates them so deeply that they feel confident and eager to delve into the MST subjects, to grasp the knowledge, to internalize it and even to come up with their own creative and innovative ideas? and
- How can these new learning concepts be disseminated successfully, so that other teachers and pupils and the teaching community at large can make use of them?

The exemplars of good practice previously detailed in the various chapters, have presented successful ideas that cover a broad range of subjects, learning contexts and culturally diverse settings. The ideas presented include small scale, localised approaches for enriching singular lessons in the individual classroom, as well as initiatives with a wider dimension having impact at both a regional and national level and often being developed as long term projects (covering a period of several years) which are often incorporated into school curricula at regional or national level. Irrespective of the scale of the initiative, what is it that they have in common that makes them innovative and successful?

In analysing the critical success factors associated with the successful application of the selected practices, it is important at this juncture to distinguish between the different Technical and Pedagogical aspects applied.

On a technical level, all of the initiatives make use of at least one multimedia tool, for example, a PowerPoint Presentation or a dedicated website where relevant access to background information, pedagogical resources, feedback, current information and support tools is readily

available. Multimedia tools provide an effective basis for the dissemination of any innovative idea amongst broader sections of the community (educational, the public at large, etc.) and not just amongst the persons directly or originally involved in launching or developing the initiative. The more an initiative makes use of modern information and communication technologies the easier it can be accessed, shared, discussed and further developed.

Multimedia tools support the continuous evolution of new concepts and initiatives. Technical aspects, however, can also constitute an important element of the pedagogical concept and its success. These contributions are manifested in different ways. On the one hand, multimedia tools act as information sources and by facilitating information transfer (communication) can increase the attractiveness of a learning subject simply because young people are excited about using technical devices. Their positive attitude towards using these devices may lead to a more intensive or rigorous examination of the information provided and invites them to entertain new ideas and also grasp new concepts and approaches to different issues, thus supporting their self-learning and development.

On the other hand, for a subject like informatics that deals with computer-based technologies the pedagogical content, learning objective and learning paths themselves make use of and are supported by the very technology that is being taught. Furthermore, modern information and communication technologies may be used for developing and implementing collaborative learning scenarios, either amongst individual classes at one school or amongst many schools in different regions or indeed different countries (eTwinning).

However, as the choice of good practices illustrates, an innovative and successful initiative of how to teach MST subjects in a new and more attractive way is not necessarily linked to the use of multimedia tools. There are many examples of initiatives that have provided or created learning environments which make it possible for the pupil to literally 'grasp' an abstract idea or even the opportunity to experience for themselves the significance and relevance of a topic in a realistic setting. Students experience the "real thing" and enjoy an integrated learning experience that includes touching, sensing and thinking.

In actual fact, it would seem that two success factors are at play here. On the one hand, initiatives like 'Maths with Lego and Matches' or 'Physics of Karate' help to transfer an abstract piece of information (such as a mathematical equation) into a context that is familiar to the pupil. This approach provides numerous points of contact / reference for a pupil's previous knowledge and may generate his or her confidence in being able to learn and process the new aspects of knowledge encountered. On the other hand, being in contact with a real environment (i.e. a real laboratory), may increase the feeling of significance and relevance of a subject to a pupil's life.

STIMULATING TEACHERS' AND STUDENTS' ENGAGEMENT IN SCIENCE EDUCATION THROUGH THE USE OF ICT-BASED TOOLS AND INVOLVEMENT IN INQUIRY-BASED EUROPEAN PROJECTS

Kearney C., Gras-Velázquez, À. and **Joyce, A.**

European Schoolnet (EUN), Brussels, Belgium, http://www.eun.org

For more information, please contact: C. Kearney - Email: caroline.kearney@eun.org or À. Gras-Velázquez - Email: agueda.gras@eun.org

INTRODUCTION

In Europe only 22% of students aged 20 to 24 study Maths, Science and Technology subjects (MST) (Durando, Wastiau, & Joyce 2009). This lack of interest in MST subjects extends beyond Europe with ten times more students taking non-science honours examinations in 2009 than science examinations at Patna University in India (Mishra 2009), as well as a declining interest in science from students in the USA, highlighted by the US National Science Foundation's 2003 report (NSB 03-69, 2003). These statistics are of concern considering we need an adequate output of scientific specialists to foster a dynamic and competitive knowledge-based economy (Lisbon 2000). To achieve this goal we need to increase participation in MST studies and careers, especially the number of women. Possible reasons for the lack of interest in MST subjects include lack of motivation from teachers (Pollen 2009), stereotyped thinking of parents and teachers towards science and technology careers especially concerning women (Gras-Velázquez, Joyce & Debry, 2009), unattractive and 'overstuffed' curricula giving only a superficial approach to science and scientific method, and limited views of the science profession as only consisting of white lab coat jobs (Lipsett 2008). The science projects European Schoolnet is currently involved in, including STELLA as well as other projects described below, are examples of initiatives being taken to meet these challenges. As a major report for the Nuffield Foundation and the Rocard report on science education in Europe have recently noted, developing and extending the ways in which science is taught is essential for improving student engagement (Osborne and Dillon 2008; Rocard 2007). European Schoolnet supports the argument that a reversal of school science-teaching pedagogy from mainly deductive to inquiry-based, 'hands-on' and other innovative methods is necessary if we are to increase interest in science (Rocard 2007). The European projects described below encourage this approach. Finally, another factor considered important for raising students' enthusiasm for science (as for other subjects for that matter) is to incorporate ICT-based tools, which young people are familiar with and find naturally engaging, into the teaching and learning of science subjects.

USING ICT-BASED TOOLS TO MOTIVATE STUDENTS

Research projects like European Schoolnet's Inspire and Games in Schools have focused on how ICT-based tools can help tackle motivational issues. In a classroom, teachers have the possibility of using learning objects to increase students' interest in the subjects at hand (Kay & Knaack 2008). Learning objects are digital (usually web-based) resources that can be used and re-used to support learning (Bratina, Hayes, & Blumsack, 2002). It is believed that their use increases students' motivation by providing them with visual, and usually interactive, representations of the topics discussed.

European Schoolnet's Learning Resource Exchange (LRE) for schools is a repository of Learning Resources, covering virtually every curriculum subject and includes resources created by Ministries of Education, other public bodies, as well as resources developed by teachers themselves (LRE 2009). The LRE for schools has at the moment almost 40,000 resources from 25 providers (LREforschools 2009), with a significant number for science topics such as maths, biology, physics and natural sciences. Although their benefits are widely assumed or even accepted, little research exists on actual proof of an increase in interest from students and teachers in MST specifically as a direct result of the use of learning objects in class (Kay & Knaack 2008). To change this, the INSPIRE project (Inspire 2007) supported by the Lifelong Learning Programme of the European Union, has set up a limited validation observatory where 60 schools in Europe have used, tested and analysed the use of digital learning objects in the field of MST. Through this experimentation, special attention is being given to (1) the impact of these "new teaching methods" at the level of pupils and their motivation, (2) the analysis of the pre-requisites to be defined for enabling the teachers to integrate these new techniques in their pedagogy, (3) the critical success factors to be mastered at the level of the teacher and the school for the generalization of such practices. Although the report will not be published until September 2009, initial results already show positive comments from teachers on the use of Learning Objects in class, as seen for example in the following comment from a German teacher on the Inspire Learning Object P3-5-3, 'Changing Sounds':

- "The educational content of this Learning Object, demonstrating the range of sound waves and the dependency of tone height and volume, suits the 10th grade very well.
- After using it successfully myself, I can only recommend it!"

(Lepper, S. 2008)

There are also some negative comments regarding language and/or technical problems with the Learning Objects, as seen in the remarks of a Portuguese teacher below:

- "The Learning Object should have more instructions and not only be in English
- The option "More information" is not available
- It works only in black and white
- There is no possibility to increase the size of the image on the screen"

(Sousa, C. 2009).

These positive and negative comments are examples of input provided by teachers to policy makers, which will contribute to finding solutions to tackle the decreasing interest in MST.

European Schoolnet has recently published a study entitled How are digital games used in schools?, which presents digital games as a popular ICT-based tool among young people, with a significant learning potential. Between April 2008 and March 2009, more than 500 teachers were surveyed and more than thirty political decision makers and experts were interviewed. Six case studies and a review of the scientific literature were also carried out, in addition to an online community of practice used to provide material for a forthcoming practical guide for teachers, Digital games in schools: A handbook for teachers. The teachers' survey showed that teachers' most common expectation and apparent result of using digital games in science and other lessons, was an increase in students' motivation. Moreover, several pilot experiments in the classroom use of games have demonstrated their benefits, not only in terms of motivation, but also in the development of key skills and knowledge of the subject being taught.

The case studies and the great majority of teachers surveyed confirm that students' motivation is significantly greater when digital games are integrated into the educational process. The pupils seem to appreciate that this approach takes account of their everyday reality. They like the fact that it gives a concrete purpose to the work they are asked to do and that it enables them to be active in their learning as players, while appreciating the 'play' element involved. This increased motivation sometimes seems to be linked to the greater self-confidence that some pupils develop especially when using games in the classroom. Their previous knowledge of games gives them the opportunity to guide and help other, less experienced students. With or without previous experience of games, the best pupils also have the chance to help others, and they derive satisfaction from this. In addition, the ways in which mistakes and different learning paces are managed in a game take the drama out of learning. Such features are

mentioned by the teachers as giving new levels of confidence, especially to pupils defined as 'less good' by traditional educational criteria. Finally, the study demonstrated how digital games used for science teaching, as for other subject learning, motivate students to interact with traditional teaching aids as well as produce their own work.

In addition, wider studies looking at ICT-based tools in general have indicated:

- Use of simulations may help to improve understanding of complex scientific phenomena, particularly those that are not observable with the human eye (Jimoyiannis & Komis, 2001)
- Visual modelling software can help students to grasp the underlying mathematical patterns and principles that scientists use to describe the world (Carney et al. 2002, Schecker, 1998)
- ICT-based experiments, whether simulations, or even better, distance-based 'web' experiments can support 'hands-on' approaches where schools are not able to provide laboratory environments (Xplora, 2005).

Improved understanding of science often increases it's attractiveness for young people, as it counters their view that science is difficult to understand and is a subject in which it is hard to achieve good grades.

EUROPEAN PROJECTS

Projects such as Xperimania, Xplora and Futurenergia increase students' and teachers' interest in science as they involve activities that move away from the traditional lecture-style teaching model and encourage stimulation through involvement in collaborative, dynamic European projects. These projects promote inquiry-based activities to encourage students and teachers to explore the world scientifically by engaging in active construction of meaningful knowledge.

The Xperimania project, coordinated by European Schoolnet on behalf of Appe - Association of Petrochemicals Producers in Europe -, aims to help students aged 10-20 and their teachers to understand the wide variety of applications of petrochemistry and how this relatively new and fascinating science has contributed to the evolution of many day-to-day items. The project invites students to participate in a variety of activities such as online chats with experts from the petrochemistry world and a competition designed to get students to devise their own hands-on experiments on materials and properties to enhance chemistry and physics learning.

The Futurenergia programme, coordinated by European Schoolnet on behalf of PlasticsEurope, aims to raise awareness among young people aged 11-18 about the importance of energy efficiency through online classroom activities, debates and competitions. It covers three main areas including: energy efficiency as a result of design impact and material selection on energy consumption; climate protection through reducing greenhouse gas emissions; and resource efficiency through conserving natural resources and sustainable development. Futurenergia encourages teachers to integrate innovative inquiry-based approaches into science teaching in schools, and offers a set of activities and educational materials that are based on innovative practices, as well as stimulating opportunities to interact with peers across Europe. The programme is designed to promote and disseminate science teaching experiences that are based on problem-based inquiry; hands-on and minds-on activities; teamwork and individual work on open-ended questions; cross-curricular activities; and relevance of science content in the school context.

Another European initiative aimed at stimulating interest and excellence in the pedagogy of science is Xplora, the European gateway to science education. Its services are targeted to science teachers, as a resource to encourage compelling, innovative teaching, to raise young peoples' interest in studying science and pursuing scientific careers. Xplora is managed by European Schoolnet together with a consortium of partners and more than 12 science museums across Europe, providing a space for informal and formal science learning to meet. The project of which it is a part, PENCIL, is funded by the European Commission Directorate General for Research as part of the Science and Society action of the Sixth Framework Programme. The Xplora gateway offers activities, tools, resources, background articles and other teaching material such as eCourses developed for teacher training and direct classroom use. It offers exciting new resources such as web experiments, collaborative projects and database projects. Xplora provides the technical infrastructure to allow innovative teachers to focus and excel in their science teaching. It has a dedicated team of teachers from Europe responsible for developing material, disseminating it in their regions and guiding the development of the gateway, to ensure the portal's services stay in touch with the reality of classroom life.

CONCLUSIONS

Students are naturally inquisitive and curious about learning how the world works through science. They simply need their natural enthusiasm to be guided by motivated and inspiring teachers who are ready to use stimulating ICT-based tools and take part in dynamic European projects. There is no more convincing way to encourage teachers to enhance their science teaching and pupils' learning by embracing these new methods, than by presenting the views of teachers who are already actively benefiting from doing so. So, why use ICT-based tools for science learning? Well, according to the teachers that already do, they:

- "are fabulous learning resources that engage young people"
- "provide a link with a world the kids know and are confident with"
- "allow students to enjoy themselves while learning, so they learn better and quicker"

(How are digital games used in schools, European Schoolnet, 2009).

The following comments illustrate what teachers perceive to be the benefits of participating in European inquiry-based science projects, such as Xperimania and Futurenergia:

- "New and exciting opportunities to make science learning fun"
- "Competitions are always a real incentive for young people to immerse themselves in a topic"
- "Contact with other European science teachers and students"
- "It is satisfying for students to see their work online"
- "Improvement of scientific literacy"
- "Better student relations and teacher-student relations"
- "Attractive learning environments and fun and simple hands-on activities"
- "Encourages creativity, interdisciplinarity and active learning"

(Stories from Xperimania and Futurenergia, European Schoolnet, 2009).

Finally, it is stimulating European projects like STELLA, which aims to collect, catalogue and disseminate good examples of science education practice, enabling the production of this eBook, which European Schoolnet together with other key MST education stakeholders hopes will further the development of innovative methods and the sharing of experiences among the European science education community.

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STELLA PARTNERS

Amitié - private training and research centre, Bologna (Italy) - project coordinator
http://www.amitie.it

Francesca Magrefi - e-mail: fmagrefi@amitie.it
Sibylle Moebius - e-mail: smoebius@amitie.it
Pier Giacomo Sola - e-mail: pgsola@amitie.it

Institut National Polytechnique de Lorraine (INPL), Nancy (France)
http://www.inpl-nancy.fr

Cyrille Raymond - e-mail: cyrille.raymond@nancy-universite.fr
Philippe Leclère - e-mail: philippe.leclere@nancy-universite.fr

Private Vocational School for Multimedia, Computer Graphic Design and Animation, Sofia (Bulgaria)
http://www.codam.net

Gospodin Jelev - e-mail: jelev@codam.net
Yoana Minkova - e-mail: yminkova@nbu.bg
Liliana Zdravkova - e-mail: l.zdravkova@codam.net
Daniela Minkovska - e-mail: daniela@tu-sofia.bg
Snejanka Georgieva - e-mail: sneja@tu-sofia.bg

Institut für Lern-Innovation - ILI (FIM NeuesLernen), Erlangen (Germany)
http://www.fim.uni-erlangen.de

Sabine Rohleder - e-mail: sabine.rohleder@fim.uni-erlangen.de
Evelyn Schlenk - e-mail: evelyn.schlenk@fim.uni-erlangen.de

Education Department of Madeira (DRE), Funchal (Portugal)
http://dre.madeira-edu.pt

Rafael Santos - e-mail: rsantos@netmadeira.com
Sandra Proença - e-mail: sproenca@netmadeira.com

in cooperation with **European Schoolnet**, Brussels (Belgium)
http://www.eun.org

Dr. Àgueda Gras-Velázquez - e-mail: agueda.gras@eun.org