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**EDUCATION AND TRAINING 2010  
WORK PROGRAMME**

**Cluster 'Mathematics, Science & Technology' (MST)**

**COMPENDIUM  
of  
GOOD PRACTICES in MST**

**Peer Learning Activities (PLA) in  
FRANCE, LATVIA, THE NETHERLANDS, NORWAY , PORTUGAL and SWEDEN  
2006, 2007, 2008 and 2009**

Drafted by Yves Beernaert, external consultant, GHK  
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## 1. INTRODUCTION : THE MST CLUSTER AND THE PLA OR PEER LEARNING ACTIVITY

### The Cluster and its priorities

Peer Learning is a central element of the 'open method of coordination' in education and training and, as confirmed by the discussions in the Education Council, is seen as a crucial tool with considerable potential to support education and training reforms. The second phase of the Education and Training 2010 work programme involves different activities using various working methods depending on the nature of the thematic priority being addressed. The aim is to ensure a flexible approach that takes fully into account the specific needs of countries and of thematic priorities in terms of policy development and implementation.

On the one hand, Peer Learning Activities (PLAs) have been developed since 2005 by clusters of countries sharing common interest in a thematic priority. Their aim is to bring policy implementation closer to national needs and situations. On the other hand, activities planned also include other methods of work: seminars, conferences, thematic and expert networks, studies and research, expert groups, support from Cedefop, ETF and Eurydice.

In that context, the Commission has set up a cluster on the specific thematic: “**Maths, Sciences and Technology**”. The word “cluster” is used to mean the grouping of interested countries around a specific theme, corresponding to their national policy priorities and key areas of the E&T 2010 work programme, and on which they have expressed a desire to learn from other interested countries, or to share with others their successful or unsuccessful experiences.

The MST Cluster is composed of **13 countries (CY, DE, DK, FR, IS, LV, MT, NL, NO, PT, SE, SK and UK)**. The MST Cluster has been set up to follow the European MST benchmark and to improve participation in MST studies and careers, especially regarding women (E&T 2010). It also contributes to prepare scientific specialists for the Barcelona objective of reaching 3% of GDP in research. Moreover MST is one of the eight key competences for Lifelong Learning.

### The priorities of the MST cluster are:

- Modernizing pedagogical methods;
- Enhancing the professional profile of teachers;
- Ensure transitions from secondary to tertiary;
- Promoting partnerships between schools, universities and industry;
- Addressing the needs of special groups;
- Improve female participation in MST studies and careers.

### Examples of good practice

The present text brings together examples of good practice that participants experienced to the four PLAs organised so far in the area of Maths, Science and technology:

- The first PLA was held in the Netherlands from 13 to 17 November 2006 focusing on the Dutch Delta Plan Science and technology.
- The second PLA was held in Sweden from 21 to 24 May 2007 focusing on maths education.
- The third PLA was held in France from 8 to 12 October 2007 focusing on renovation in science teaching in France: an inquiry-based science education approach.
- The fourth PLA was held in Norway from 14 to 17 April 2008 focusing on increased recruitment and better quality instruction in MST. A joint promotion of MST in Norway.
- The fifth PLA was held in Portugal from 13 to 16 October 2008 focusing in the action plan for maths and the plan for the promotion of science.

## **Contents of the compendium**

The examples of good practices presented in this compendium are extracted from the initiatives experienced during the Peer Learning Activities organised by the host countries in cooperation with DG EAC. Thematic areas and programme were designed according to the priorities defined by the MST Cluster. The list of examples will be completed and updated with the upcoming PLAs.

- PLA in the Netherlands - November 2006  
The Delta Plan Science and Technology / Delta Plan Bèta Techniek
- PLA in Sweden - May 2007  
Action Plan for the Promotion of Mathematics Education
- PLA in France - October 2007  
Renovation in Science Teaching: An Inquiry-based Approach
- PLA in Norway - April 2008  
A joint promotion of Maths, Science and Technology
- PLA in Portugal - October 2008  
Action plan for mathematics and plan for promotion of science
- PLA in Latvia – December 2009  
The science and maths reform 2005 - 2011

The Compendium can best be used in conjunction with the full reports of the PLAs to be found on the website of DG EAC: [http://ec.europa.eu/education/policies/2010/objectives\\_en.html#math](http://ec.europa.eu/education/policies/2010/objectives_en.html#math)

## **2. MAJOR NATIONAL INITIATIVES OR ACTION PLANS**

### **2.1. The Delta Plan Science and Technology in the Netherlands (NL)**

The Delta Plan is a major plan to promote science and technology education launched by the Dutch Ministry of Education and Science in 2004.

The long-term objectives are to have more employees that make a contribution to innovation. This should lead to more attractive, more differentiated and more popular education in science and technology throughout the sector, manifesting itself in a lower dropout rate and more graduates from the vocational sector and S&T university study programmes. It should also lead to more attractive career prospects for knowledge workers and, especially, among scientists, engineers and researchers on the labour market.

In concrete there should thus be 15% more graduates from the higher S&T study programmes in 2010 than there were in 2003, greater balance between the intake of men and women, higher intake of women and ethnic minorities, more foreign students and knowledge workers and better international recruitment position for scientists and engineers.

The implementation of the Delta Plan Bèta Techniek<sup>1</sup> is the responsibility of the Platform Bèta Techniek. The Platform was commissioned by the government, education and business sectors to ensure sufficient availability of people who have a background in scientific or technical education. The Platform targets schools, universities, businesses, ministries, municipalities, regions and sectors. The objective is to ensure that the future supply of knowledge workers will meet the future demand.

The Delta Plan Science and Technology is divided into the 5 subprogrammes outlined below. Each of those programmes are briefly highlighted in the present text:

- VTB: Verbreding Techniek Basisonderwijs (Enlargement Technology Primary Education)
- Universum (supporting schools with a science profile in general secondary education, HAVO and VWO)
- Ambitie or Ambition (supporting lower and upper secondary vocational schools: VMBO and MBO)
- Sprint (More students in science in polytechnics HBO and universities)
- Act (Promoting appealing careers in technology)

Full information on the Delta plan Science and Technology is to be found on:

<http://www.deltapunt.nl/>:

### **2.2. The Swedish action plan for the promotion of mathematics education (SE)**

A Delegation was set up in the spring 2003 to analyse the situation and to come up with a action plan with concrete proposals to increase the interest in and motivation for maths education across Sweden. The action plan developed subsequently contains four proposals to enhance the quality of maths education in Sweden. The action plan took on board successful initiatives that existed before the Delegation's report and the action Plan were drafted. The action plan also took stock of successful initiative implemented successfully before the Delegation drafted its report.

The four key proposals suggested of the action plan are outlined below.

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<sup>1</sup> Bèta means 'science'!

Support and develop activities to increase interest in and provide greater insight into the value, role and significance of maths in everyday and working life, in science and society:

- More focus on maths by the science centres (see visit of the NAVET Science Centre)
- Developing the Kangaroo competition further as to contribute to make maths more fun for children (see information about the Kangaroo competition)
- Increase interest in maths through various initiatives such as the INTIZE mentoring activities of engineering students of Chalmers University of Technology (cf Intize initiative)
- Focus on how to use maths concretely
- Information about maths for parents with flyers in childcare centres
- A brochure focusing on cooperation school and companies to strengthen the interest and motivation for maths (cf initiative of the European Round table of Industrialists ERI on maths)
- More research on this topic

Train qualified teachers in maths on all levels for all children, young people and adults.

- Attract more teachers to become maths teachers
- Improve initial teacher education
- More in-service teacher training through various pathways such as going back to university for one semester or organise school-based in-service training with teams of teacher (cf the Learning study method).
- More research on the topic.

Support teachers and coordinate all the positive forces promoting better maths education:

- Spread information about innovative maths teaching and learning through website, blogs, examples of good practice (cf. Nämnarem, Kollegieblocket)
- Create a network of maths teachers and create a link between teachers in schools and university (cf. Mattebron)
- Organise maths conferences: the biennials and the regional biennettes
- The organisation and development of the municipal network of math developers or ambassadors.
- More research on this topic.

Clarify aims, goals, content, assessment

- Enhance clarification of national documents as to aims, goals, contents and assessment
- Discuss in depth with teachers new aims and objectives of maths education
- Look into different (creative) ways to assess maths
- More research on those elements especially on the assessment.

Subsequent to the Maths Delegation and its report, the Swedish Ministry of Education and Research and the Swedish National Agency for School Improvement commissioned the NCM or National Centre for Mathematics Education to see to the implementation of the four proposals.

### **2.3. Innovations in MST in France**

#### **2.3.1. Renovation in Science-Teaching: An Inquiry-based approach (FR)**

This initiative focusing around the Main à la Pâte initiative or Hands on science approach, originates from a visit of members of the Academy of sciences (Pierre Léna, Yves Quéré and George Charpak) (1992 Nobel Prize) to a Chicago ghetto. La main à la Pâte began in France in 1996 supported by the French Academy of sciences and by the Ministry of Education.

Ten years later, this initiative has become a key innovative mechanism in France. It is very well structured and is the basis for the reform of science education in the primary schools and in the collèges (lower secondary schools). It gives a strong logistical and pedagogical support to the teams of teachers and schools.

Key content elements for La Main à la Pâte

- inquiry-based approach, develop hypotheses, experimentation, testing, collective reconstruction to raise interest and motivation for sciences
- pupils are the key actors, teachers are coaches
- stimulating reasoning, critical thinking, democratic debate,
- mastering of the mother tongue both spoken and written
- acquiring various key competences and skills through science teaching and learning
- overcoming social barriers., promoting social cohesion and inclusion
- science linked to developments in society
- the development of open-source contents

Key elements as to the support structure:

- Strong cooperation between Lamap and the Ministry of national education of France
- large dissemination, valorisation and training of teachers
- strong networking of all those involved in the renovation
- the cooperation with the scientific community
- the cooperation with the local, regional community and authorities
- development and sharing of (jointly) developed pedagogical and didactic tools and instruments
- scientific and pedagogical coaching a.o. through scientific consultants and through the support of a network of 15 pilot resource centres in France
- transfer of expertise and training towards other interested countries; international cooperation and exchange
- the support of a high quality interactive website

By prompting pupils to use argument, whether oral or written, this process takes part in language learning, in acquiring an independent attitude that is heedful of others. It is based on teachers achievements, the networking of their skills and the creating of effective synergies with external actors, inspectors and educational advisers, college of education training staff (IUFM), teaching specialists in science and other subjects, scientists, researchers, engineers, students from science universities or from the national colleges (Grandes Écoles), parents.

Many teachers experience a privileged opportunity of working as a team, see the opportunity to give meaning to their action and point this out. In many classes considered as "difficult" they have managed to mobilize their pupils who have discovered a completely new awareness of self-control and control over their surroundings. The experiment, which was extended from 5000 classes to some 350.000 of classes since 1996. It has an Internet site which provides opportunity for exchanges and dialogue between scientists and teachers and makes available numerous helpful resources.

For full information see the La Main à la Pâte website:

<http://www.lamap.fr>

### **2.3.2. The PRESTE reform in France (FR)**

The PRESTE, Plan de Rénovation de l'Enseignement des Sciences et de la Technologie à l'École or the Plan for the renovation of the teaching and learning of sciences in the primary school (abbreviated in French to PRESTE) was developed and implemented in order to promote within the primary school an approach based on scientific investigations. The idea is to propose to the curiosity of the pupil objects and phenomena of the world surrounding them and to articulate or link to one another scientific learning, the use of mathematics and use of the numerical world. In this way this programme builds upon the underlying philosophy of the Main à la Pâte initiative, initiated by professor George Charpak, 1992 physics Nobel Prize, and member of the Academy of Sciences. The renovation in the teaching of sciences intends to give to all the pupils the basic elements of science education described in the school programmes.

Key elements of this approach are:

- The pupils observe a phenomenon and formulate their questions.
- They imagine and implement experiences; they document themselves.
- They exchange and argue amongst themselves; they confront their points of view and formulate their results orally and in writing.
- They confront their results to established knowledge.
- They learn to listen to each other, to respect each others' point of view and to take into account the advice of others.

The time tables and programme of the primary school were defined by law on 25 January 2002<sup>2</sup>. They entered into force at the beginning of the school year 2002-2003 for the elementary course 1<sup>st</sup> year, at the beginning of the school year 2003-2004 for the preparatory course and for the middle course 1<sup>st</sup> year, at the beginning of the school year 2004 – 2005 for the elementary course 2<sup>nd</sup> year and the middle course 2<sup>nd</sup> year;

The programmes of the primary school, divided into fields, distribute the teaching of sciences in the fields of "Discover the world" in cycle 2 (CP and CE1) with a weekly timetable of 3 to 3, 5 hours and "Scientific Education" in cycle 3 (CE2, CM1 and CM2) with a weekly timetable of 2,5 to 3 hours.

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<sup>2</sup>published in the BO out of series n°1 of 14 February 2002.

To bring about such a through in-depth renovation of science teaching and learning all the levels and all the stakeholders of the educational system have been mobilised and numerous partnerships have to be set up. It is important to reach a large cohesion with the different educational mechanisms and structures that exist in the country.

Although the PRESTE Plan is limited to the primary school, lower secondary schools can associate themselves to the plan for renovation.

They can associate themselves to the PRESTE innovation by:

- Facilitating access of the pupils of the primary school to special science rooms and to scientific equipment in the lower secondary schools;
- Putting at the disposal of the primary school teachers the expertise of the specialised secondary school teacher.

Cooperation between primary schools and lower secondary schools also contributes to facilitate the transition from one to the other. There are steering committees to monitor and steer the implementation of the PRESTE plan for renovation at national level (for the whole country), at the level of the Académie (more or less a Region)<sup>3</sup> and at the level of the Départements.

The support to be given by the Académie mainly concerns documentation, expertise on pedagogical products, ICT training and mobilising the partners of the scientific community.

To this effect each Regional Centre for Pedagogical Documentation (CRDP) is associated to the implementation of the PRESTE plan.

The IUFM or initial teacher training institutions are important actors for the follow-up in each Académie as the training provided by the IUFM has to be in conformity with the requirements of the PRESTE plan.

The full text of the PRESTE plan for renovation in science teaching and learning is available in French on the following website: <http://www.education.gouv.fr/bo/2000/23/ensel.htm>

For the implementation of the new programmes, an important effort was made to support and help teachers by making available to them exercise sheets, knowledge sheets and other accompanying documents that can be downloaded from the site of the National Centre Of Pedagogical Documentation(CNDP). <http://www.cndp.fr/ecole/programmes/accueil.htm>

### **2.3.3. EIST, Enseignement Intégré de Science et de Technologie au Collège (FR)**

The Integrated teaching and learning of sciences at the lower secondary school is an experiment or pilot project resulting from the partnership between the Ministry of Education and the Academy of Sciences: [http://www.academie-sciences.fr/enseignement/guide\\_06.pdf](http://www.academie-sciences.fr/enseignement/guide_06.pdf)

At the moment two académies are involved in this experiment.

The experiment, within the framework of the orientation law for the future of the school and based on the implementation of the modernised programmes of scientific disciplines and on the definition of the common base of knowledge and of the competences was implemented at the beginning of the school year 2006-2007 in the sixth class of the Collège<sup>4</sup> (lower secondary school) and is being implemented also now in the fifth class of the Collège. In most cases it was implemented for a trimester period; in some cases for the whole year.

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<sup>3</sup> Académie= a ‘pedagogical ‘ region in France; an administrative unit in The French education system. Not to be confused with an Academy

<sup>4</sup> This is the first of four years of lower secondary education. Fifth class is the second year

The Aims of EIST are:

- Developing the pupils' curiosity and giving them the taste of experimental sciences and of technology;
- Implementing the investigation approach prescribed in the new science programmes;
- Building an integrated scientific education implementing the programmes of three disciplines (chemistry-physics, Life and Earth sciences, technology);
- Facilitating the transition from the primary school to the first year of the lower secondary school (Collège).

This experiment is based on:

- The autonomy of the local public education institutions ensuring major scope for initiative for the educational teams;
- The willingness of the heads of schools and their pedagogical teams, ready to take part in these experiments for a four-year period;
- An appropriate and adapted support and training;
- The teachers' disciplinary competence and their willingness to apply their competence within the framework of a broad vision of science and of technology;
- The implementation of the experiment in a significant number of sixth classes as from the first year onwards;
- The creation of a multidisciplinary team, to implement the project, including systematically teachers of the three disciplines: physics-chemistry, Life and earth sciences and technology, and possibly of other disciplines.

The general objectives of the pilot project mentioned above can be translated into operational objectives within the Collèges:

- The teachers of the three disciplines (chemistry-physics, Life and Earth sciences, technology) have to be associated in a common and joint work;
- Organise an integrated teaching of sciences and technology, given by one teacher during at least 30% of the school year (3,5 hours in the 6th form);
- Test the steps to be taken to involve up from the 6th form the teachers of physics and chemistry by adding half an hour to the timetable of the pupils.

To facilitate the monitoring and the comparison at national level, a common work will be set up to select indicators so as to measure to which extent the acquisition of knowledge and competences is promoted linked to science and technology and to measure if this integrated teaching of sciences has an impact on the number of pupils taking scientific and technological studies in the further years of the collège and the lycée.

Each pedagogical team that takes part in the pilot project has to define its characteristics and the directives for its work. A contract will be drafted that will mention, for each lower secondary school, the objectives to be reached by the pilot project, the modalities of the pilot, the means available, the persons involved, the partners to be associated, the support or monitoring to be envisaged and the evaluation to be carried out. The contract will also clearly mention that the pilot project will last four years. This contract will be signed by the collège and the recteur d'académie and will be revised on a yearly basis taking into account intermediate results, unexpected effects and contextual developments.

## 2.4. The MST Strategy: “A Joint Promotion of MST” in Norway 2006-2009<sup>5</sup>

In order to provide the Norwegian society and the individual with the necessary MST competence in the coming years, the main challenges are to:

- encourage young people, and especially girls, to choose study in MST in upper secondary education and to make career choices related to MST;
- strengthen MST in teacher training and raise the MST qualifications of teachers;
- improve the quality of MST teaching developing and spreading good practices;
- increase the cooperation between education and working life in order to create a greater sense of relevance and to encourage recruitment.

The strategy’s overall goals:

- improve the MST competence in the whole educational system, in working life and in the general public;
- increase the recruitment to working life and education in MST;
- instil positive attitudes to MST among everyone in the educational system and among the general public.

The strategy has five key goals:

Goal A: Strengthen MST in kindergartens and primary and secondary education

Goal B: Improve teachers’ qualifications and teacher training

Goal C: Development of MST in higher education and research

Goal D: Provide Norwegian working life with the MST competence that is needed

Goal E: Increase the MST competence and improve communication to the general public

Each of those goals are translated into several sub-goals. For each of the five goals and sub goals **indicators** have been developed to see whether the goals are achieved!

In the long term it is necessary to improve the situation regarding MST in the primary and secondary education. This requires measures to increase the teachers’ competence in both subjects and methods. The key here is teacher training, continuing education and training, and subject-didactic research and practices.

In the short and intermediate term it is necessary to strengthen recruitment, to make career opportunities more apparent, and to strengthen contact between education and working life must be strengthened. The media also have to play an important role to support this process.

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<sup>5</sup> The full text of “A joint promotion of mathematics, science and Technology (MST)” is available on the following

website :[http://www.regjeringen.no/upload/KD/Vedlegg/Grunnskole/Strategiplaner/Strategiplan\\_for%20real\\_fag\\_engelsk.pdf](http://www.regjeringen.no/upload/KD/Vedlegg/Grunnskole/Strategiplaner/Strategiplan_for%20real_fag_engelsk.pdf)

## 2.5. Innovation in MST in Portugal

### 2.5.1. The Portuguese Plan of action for mathematics (PT)

The Portuguese Plan of action for mathematics which is composed of six main action lines:

- **The Mathematics Plan: Teams for success** or the sustained development of school projects focuses on the improvement of students' mathematics learning (from 5th to 9th grade);
- **The new Mathematics programme for Basic education;**
- The promotion of professional development programs for teachers teaching at all cycles of basic education (1st to 9th grade);
- The creation of a database of educational resources for mathematics;
- The assessment of school mathematics textbooks;
- The reorganization of teacher education programs.

#### Mathematics Plan/Teams for success

Teams of teachers can apply with their schools to implement innovative three-year projects for maths that have to focus on:

- Adequate and significant learning to enhance maths competencies and motivation for maths;
- Diversifying teaching strategies;
- The creation of partnerships within the maths classroom;
- The promotion of extracurricular activities;
- Making use of the accompanying support and focusing on interdisciplinary approaches;
- Creating space for teachers planning and working together;
- Promoting actions to involve parents and guardians.

So, within the Mathematics Plan, each school develops its own project, based on the knowledge of the characteristics of its educational context and of the potentialities and needs of its students and teachers. As such, each school defined the goals of its own project as well as the strategies it considered necessary to attain those goals.

A specific mechanism, explained below, was designed and implemented in order to provide the scientific and pedagogical support for the development of all these projects. This mechanism was thought in terms of 5 big national geographical regions, and it encompasses two structures: a national accompanying committee, AC, and a large group of accompanying teachers (AT). Amongst other activities, the accompanying committee coordinates the development of the Plan of Mathematics at the national and regional levels as well as the work of each region's group of accompanying teachers. The accompanying teachers, 80 in total, provide the scientific and pedagogical support for the school projects, mainly through direct contact with those schools.

Schools involved get special support in two ways. On the one hand every maths teacher involved in innovation gets the help of **a support teacher in the classroom within the school**. There is no difference between the two teachers; they are both experienced maths teachers. The main aim, however, is to promote joint preparation, co-teaching, joint development of teaching materials and joint reflection and in-depth discussions on the maths teaching. The two teachers discuss what the students do and how they do or will have to do it. They try to solve possible problems together so as to enhance the quality of both their teaching. The two teachers very often hold both formal and informal meetings. It is not a mentoring scheme it is two experienced teachers learning together in

their classroom practice. It is a true partnership between two teachers teaching the same subject so as to improve the teaching of both.

On the other hand the teachers in the school get support from **80 accompanying teachers (AT)** who work across Portugal with the teachers in the schools. Each of those AT teachers accompanies 15 schools. The 80 AT liaise with the National Committee (composed of 10 key experts in maths education) for the implementation of the Maths Action Plan. They in their turn get support from institutions of higher education. The AT teachers would meet on a monthly basis with the teachers in each school. And give them scientific and pedagogical support.

This mathematics plan has been highly successful as it has involved so far **95% of the 2<sup>nd</sup> and 3<sup>rd</sup> cycles of all Portuguese compulsory schools. 462.465 pupils, 18058 classes and 52.618 teachers have been reached so far. 3 MIO € have been invested per year** in the action plan for mathematics to support teachers and to buy new equipment. It is remarkable that no school that got involved in the innovation as to maths education, dropped out so far.

The 1<sup>st</sup> year the schools involved get 3000 € of which 1000€ can be spent on equipment and 2000 € of extra time for the teachers involved. The next year they only get 1000 €. In fact the schools get - on average - money for 12 hours for the extra support teacher which represents half a normal weekly teaching load.

The Plan is based on 5 basic principles: Autonomy, professional recognition, institutional contextualization, project methodology, co-responsabilization

The first three year action plan for maths education is near completion in June 2009. Another three year action plan along the same lines and with the same objectives will be announced soon so as to start in the next school year 2009 – 2010 as there is the political will and support to go on with it.

### **The Mathematics programme for Basic education**

Better maths learning and teaching requires an adjusted programme of which the aims are:

- to promote the acquisition of information, knowledge and experience in maths and develop the capacity of integration and use of maths in diverse situations;
- to develop a positive attitude towards maths and enhance appreciation for maths.

The following general objectives of the adjustment of the maths programme for Basic education were mentioned:

- Enhance knowledge, facts, procedures;
- Promote understanding of maths;
- To enable learners to deal with multiple representation forms
- To enable them to communicate and reason mathematically and to solve problems;
- To make connections, to do maths autonomously and to appreciate maths..

Before the adjustment to the maths programme for basic education was made there was an open discussion for three months involving mathematicians, maths societies, maths educators, parents, publishers etc.

The adjustment of the Mathematics Program is organized by cycles and no longer by grade levels, and encompasses, for each one of the cycles, the definition of goals, mathematical themes, methodological orientations and all aspects related to curriculum management and assessment. In order to meet the goals set by the programme, a set of actions was defined that support the implementation of the adjusted program.

These actions support the schools and the teachers in such a way that whenever the adjusted program will become implemented, its development may be done in an integrated way, favouring a close connection amongst the various cycles and amongst the remaining curricular areas, moving away from an approach based on isolated disciplines or grade levels. These actions contribute to the creation of adequate conditions to the development of the scientific, didactical and curricular knowledge of the teacher, given that this knowledge is vital for the improvement of Maths.

The same support structure as for the Teams for Success is put in place to help introduce the new Maths programme for basic education. The universities prepare the teachers of the 3<sup>rd</sup> cycle of the compulsory school and of upper secondary schools. The 'politécnicos' prepare the teachers that teach maths in the first and second cycles of the compulsory school. This also means that universities and 'politécnicos' have to work together as the new curriculum wants to have close cooperation across the teachers of the three cycles of the compulsory school and if possible also cooperation with upper secondary school.

An important element is that in every school project a cluster of six classes (overarching the three cycles of the compulsory school) has to be involved. Teachers of the 3 cycles have to be included so as to stimulate the dialogue and cooperation between the different teachers. This cooperation is the biggest challenge as teachers are not used to this.

At the moment in 2008 some 40 experimental classes are trying out the new basic maths programme working with specific maths themes and transversal items. The use of the new programme is not yet compulsory as the new textbooks are not yet ready. Close cooperation between the maths specialist and the publishers at all stages will contribute to have new textbooks that facilitate the implementation of the new basic maths programme.

### **2.5.2. Ciência Viva , the National Agency for Scientific and Technological Culture, Portugal**

Ciência Viva , the National Agency for Scientific and Technological Culture was created in 1996 to promote public awareness of science and technology. It promotes and supports science education projects at school, placements for secondary school students in research laboratories during the holidays, the Science and Technology Week, MIT professors going to school, debates with scientists, the FORUM Ciência Viva bringing together many projects, summer science activities for the general public and a network of interactive Science Centres throughout the country, in collaboration with universities and local authorities. The team is composed of 27 people: the director, 8 content support people and 18 administrative and financial support staff.

Ciência Viva's goals are carried out using three main instruments:

- **A program – Ciência Viva in School** – to support and stimulate the hands-on teaching of Science. Ciência Viva provides support to education projects that develop practical activities and promote science and technology culture in basic and secondary education schools. The projects are generally developed in partnership with research institutions, local authorities or scientific associations.
- **The deployment of nation-wide science awareness campaigns**, stimulating scientific interest and providing the opportunity for **the whole population** to meet and discuss with the scientists from several different areas of knowledge;
- **A national network of science centres**, designed as interactive spaces for promoting science to the general population, but also as platforms of regional development – scientifically, culturally and economically – by establishing partnerships with the most important regional players.

The three tools or instruments mentioned above can function thanks to financial support given to numerous projects. The projects selected and funded are the result of a **national call for projects**. This national call for projects (<http://www.cienciaviva.pt/concurso/>) is a financial instrument to develop the human and material conditions that are necessary to a stimulating and active science learning process. The projects involve several different stakeholders such as schools, scientific societies, universities, research labs, private companies, municipalities etc. .

These three tools or instruments can function thanks to a clear political support and consequent financial investment, for which some European funds are used, together with national support. The investment is made through projects that are presented to the Agency by many different actors with recognized expertise in the area of S&T promotion.

One of the areas where the investment is more pronounced is the **Ciência Viva in School** program, where **national calls for projects** from schools are regularly open.

The objectives of the National call for science education projects are manifold:

- Develop hands on science activities and experimental science education for schools and the large public;
- Promote partnerships between schools and scientific or research institutions;
- Organise and use to the best existing resources;
- Develop educational resources for dissemination;
- Stimulate participation in international projects.

Since 1996, 6 calls for projects have been held, and more than 4000 projects have been funded. Until now, over 3,000 schools, 7,000 teachers and up to 600,000 students were involved. School projects get on average 5000 to 7000 €. The National call for projects makes use of the European Regional Development Funds of the FEDER in the regions in Portugal that are eligible for this FEDER support. 50% is national funding and 50% is European funding for the regions eligible for FEDER funding. For Lisbon which is no longer eligible for FEDER support, the national support is 100%.

In 2005 1254 applications were submitted. They were evaluated by a multidisciplinary evaluation panels working with 13 thematic sub commissions. 932 projects were approved and subsequently only 906 contracts were drafted and signed. Information about all the funded projects is available in the database: <http://www.cienciaviva.pt/concurso/bdprojectos/> . Some examples of the resources that the projects have created can be found in <http://www.cienciaviva.pt/oficinaweb/projectosweb/> Most of the applicants are schools and universities. The university projects (some 109) are usually larger projects and they are all focusing on schools (compulsory and upper secondary) and not on university students!

So far the National call for science projects has been quite open which leads to a great variety of projects that are funded but make it difficult to monitor the projects. Future call for projects may be more targeted to facilitate monitoring and better evaluation. Evaluation of the projects is at the moment limited to the reports of the projects that are sent to Ciência Viva that analyses them.

**The FORUM Ciência Viva** which is organised every so many years with representatives of a large selection of projects (100 to 150) funded within the framework of the call for projects. It is an opportunity to make contacts with teachers, researchers, representatives of H.ED institutions, NGOs, local authorities etc. involved in projects. It is also an opportunity to promote and start developing new projects. In November 2008 some 160 will thus meet.

## **2.6. The science and maths reform in Latvia 2005 – 2011**

The key problems of the Latvian economy were the lack of science and technology professionals and the insufficient number of students in science fields due to the unpopular image of science, the inappropriate learning process and the inappropriate preparations and in-service training of MST teachers.

To solve those problems the goals of MST education had to be changed in the curriculum and cooperation between various actors and stakeholders had to be promoted. To support these activities Latvia participated in comparative education researches and made use of key reports published (Rocard & Nuffield reports).

### **The three phases of the reforms**

All reforms developed and implemented since 2005 had followed the same model of three phases: a preparation phase, a piloting phase and an implementation phase. Cooperation between the various stakeholders such as the schools, the teachers, the universities and the employers has contributed to the success of the reform.

During the preparation phase the subject standards were developed focusing on teaching and learning goals of MST subjects and on the learning outcomes. New curriculum and syllabi were designed focusing on methodological approaches and strategies. New teacher support materials were developed adapted to the new curricula. Syllabi and teacher education programmes were developed to promote the use of new methods and materials

During the piloting phase a limited number of schools introduced the new curricula and syllabi and make use of the new support materials. They received new equipment and in-set teacher education. They received support from expert teachers.

During the implementation phase information about the reform was largely spread, school administrators were trained, more teacher training was organised, all schools that were involved in the teacher training got the materials, exchanges of experiences amongst the schools were set up and monitoring of the pilots was organised.

### **Scientific and mathematical literacy**

It was decided that MST teaching and learning had to contribute to the acquisition of skills: problem-solving, communication, digital, social and entrepreneurship skills. Those skills should be acquired by using IBSE working with case studies, with texts, discussions, presentations, writing, by using ICT, by combining within MST lessons group work, cooperative learning and individual work and by using new methods (games, simulations, workshops, fieldwork and project work).

It was hoped that the reform of MST would contribute to the demands of Latvian society: reinforce the necessity to think creatively and critically, teach study skills, pay more attention to practical activities, link maths and science to real life and to professions and trades and promote more non-traditional teaching and learning methods and approaches. It was also hoped that the reform would be able to address the demands set to the teachers such as the use of different teaching strategies, the use of modern technologies, the need to focus more on cooperation between teachers and the reinforcement of planning and realising outcomes.

### **Indicators**

It was decided to use the following indicators prove that the reforms have indeed led to a contemporary teaching and learning process in science and maths: the students' understanding of

science and maths, the use of the scientific inquiry method (IBSE), the link with real life, contemporary teaching and learning strategies used by teachers and the use of ICT in MST. Evidence has been gathered making use of these indicators that the MST reforms have indeed a positive impact on the teaching and learning of those subjects.

### **Project I : “Curriculum Development and In-service Training in MST ” (2005-2008)**

The objective of this first ESF project was to modernize the curriculum, to develop support materials for MST teachers and to improve their capacity to work with the new curriculum and the new support materials. The Project was designed with an aim to address the problems in MST in secondary schools (grades10–12).

The Project Outcomes were very clear and have proven to be efficient and effective:

- A modernized curriculum in the upper sec. school (grade10-12) in biology, chemistry, mathematics, physics and science;
- 15 sets of teacher support materials were developed and distributed;
- More than 6000 students got advanced curriculum by using the support materials developed during the Project;
- 50 pilot schools became regional methodical centres;
- 2950 teachers improved their qualification through in-set teacher education;
- Enhanced professional capacity of field experts in MST education.

### **Project II: „Science and Mathematics” (2008-2011)**

The project was designed to continue to consistently implement the ongoing changes in MST education started in 2005 so as to enhance the sustainability of the reforms.

The objectives of the second ESF project “Mathematics and Science” were to:

- Develop training content in natural sciences and mathematics subjects 7th – 9th class period, emphasizing students' research activities and practical skills to use the knowledge gained in school to real-life situations, to promote information technology in teaching;
- Provide methodological support to teachers and students in natural sciences and mathematics learning of the general education;
- Prepare a variety of materials for teaching methods, student performance evaluation, as well as a variety of visual materials for teachers and students in both printed and electronic format;
- Develop MST teachers, and industry experts, and future teachers' professionalism in dealing with the modernized training content, and develop teacher support materials;
- Encourage student interest in science and mathematics, through extensive collaboration with universities, research institutions and entrepreneurs.

### **Key problems**

Key problems in implementing the two ESF projects were the fact that in soviet time school education had been very teacher centred and that now education had to become student centred. Furthermore it proved to be difficult to change especially the old teachers' attitudes and habits. Sustainability of the innovation in maths and science after the 2 ESF pilot projects

A key challenge is the sustainability of the innovative changes implemented. A university has proposed to be actively involved in further developing or implementing the changes. The links with the universities and especially with the teacher training for MST within the two pilot project which lead to the involvement of university professors and future teachers are also important elements to

enhance the sustainability. The universities have received and are using all the materials developed within the framework of the 2 ESF pilot projects.

Cooperation has also been set up with centres and universities in other European countries such as SLO in the Netherlands and the Science Centre (of Stems) in York.

Latvia is also investing in cooperation with its neighbouring country Estonia which can be beneficial to both countries.

### **Budget for the two ESF pilot projects**

The two pilot projects represent an important financial input into science and maths teaching and learning: 8 million Lats or 13 million euro for the first project and 3 million Lats or 5 million euro for the second project

### **3. INITIATIVES BY LEVEL OF EDUCATION AND BY SPECIFIC TOPICS**

#### **3.1. Pre-primary school**

##### **Pilot project in pre-school maths (1-5 years old) in Sweden**

The Swedish National centre for maths Education is involved in an innovative pilot project to promote maths in pre-school as pre-school should try to ensure that children develop the ability to discover and use mathematics in meaningful contexts and situations, develop their appreciation of the basic characteristics of the concepts of number, measurement and form, as well as the ability to orient oneself in time and space. Basic assumption for such a pilot project is that the pedagogical activities should be related to the needs of all children in the pre-school, where care, nurturing and learning together form a coherent whole.

The project is based on interaction adults and children, on what children learnt from each other, on exploration, the desire to learn – through play, social interaction, exploration and creativity, observation, discussion and reflection, based on children's and teacher's experiences and interest.

The specific goals of the project are to observe children's mathematics, to offer and stimulate experiences, reflections on development of early mathematics, to develop competences in studying, analysing, communicating and challenging children's abilities, to show the excitement and creativity of mathematics, to highlight the importance of playing and variation in children's thinking and learning, to support teachers' networks after the project.

The project focused on very concrete approaches of maths such as finding expressions and ideas of maths in nature, in cultural heritage and in everyday situations. By working in this way maths education is very often combined with other areas such as cultural heritage education.

The first part of the project was the organisation of several seminars for teachers: May 2003, half a day – NCM supervisors visiting preschools, Aug 2003, one day and a half – project presentation and discussion, Oct-Nov 2003, half a day twice – Number and Spatial sense and Feb-May 2004, half a day three times – Sorting, graphs, real world situations, play, evaluation, Children's literature.

In between these seminars the teachers met for half a day. They tried different activities with the children, made interviews, wrote a logbook, which formed the basis for the meetings. The pre-school managers were involved and participated in at least two meetings.

The project has resulted in very interesting pedagogical material to promote maths in the pre-primary school which will be disseminated largely and a number of national conferences where the NCM-team had seminars with about 3000 pre-school teachers altogether.

#### **3.2. Primary Education**

##### **VTB (Verbreding Techniek Basisonderwijs) (NL) Start young for later**

The objective is to link in the primary school exploratory learning and technology with the fields of learning as a means of creating a modern, innovative and motivating learning environment for children. VTB, together with regional networks constitutes a major reform in primary education. There are already 1,330 primary schools working in the programme. Teacher training colleges are involved too. They translate the key technology aims into competences for future teachers. A total of 2,500 primary schools will be given an extra impulse with VTB up to 2010. The results of this pilot will then be valorized towards all primary schools. The knowledge infrastructure will be strengthened by the establishment of a center of expertise, linking various databases and lecturers.

### **The added value of VTB:**

- Extra energy and dynamism: schools can fulfill their own ambitions;
- Technology will become anchored in school policy;
- Schools can promote themselves in their surrounding areas;
- Expertise will be combined and promoted;
- Integrating subjects will become easier through broadening them within VTB;
- Schools will be supported regionally by a network made up of schools, businesses, technology centres, guidance services and science centres;
- Smoother tie-up between primary education and the first years of secondary education.

### **The Nysgjerrigper project (Inquiry-based science teaching method), (NO)**

This is an initiative by the Research Council of Norway with the objective to enhance the interest of children for science and to improve the science teaching in primary and lower secondary schools. The initiative is largely based on the inquiry-based science teaching approach. It is compulsory to work with this kind of project in every primary school. The quality of the way in which the method is applied depends largely on the interest and the motivation of the teachers.

Nysgjerrigper offers a variety of science resources to stimulate children's curiosity, interest and imagination for science and technology. Experiments, articles and multimedia are, among other things, designed to enhance knowledge and awareness of research activities. There is a magazine, a website, a working manual for teachers, a science fair with prizes and an interactive manual on the website: <http://www.nysgjerrigper.no/>. There is also a teacher support group. Members of that team are experienced teachers that give in-service training to teachers in other schools to explain how they can work with the method.

The Nysgjerrigper Method is a method by which children are invited to come forward with scientific problem. All children suggest topics or issues to be looked at. The teacher makes a choice together with the children as to the topics to be studied in the classroom. The topics looked at are all very close to the real life situation of the children.

Here are some examples of such topics which become scientific issues in the classroom:

- Why do pancakes have different pattern on each side when you bake them?
- Why do blood vessels look blue under your skin while the blood is red?
- Why is God always depicted as a man?
- Why does only one egg break when you smash two eggs against each other?

The Nysgjerrigper project works in 6 steps: children wonder why something is happening in a certain way, then they try to answer the question why is it like this?, they draw up a plan for the work in small teams, they collect data, they compare and discuss what they have found out and they report to each other. Thus children are invited to find such a topic which raises questions. They then decide on an approach to solve the problem and formulate hypotheses. They subdivide the task and in subgroups try to solve the problem by looking for answers. The answers are checked and verified scientifically. The whole process is documented on paper and ends with a report and other products.

The whole process is evaluated. It is usually spread over 2 to 3 weeks 3 hours a week during the school year.

### **Teacher education programme for experimental science teaching (PT)**

The general aim of this programme for experimental science teaching in the elementary school is to have more teachers use this method so as to improve experimental science teaching and to increase the interest and motivation for science with children in the first three years of the compulsory school. This programme was started in 2006-2007 and is now in its final and third year. Extension to the kindergarten and to the second cycle (years 4, 5 and 6) of the compulsory school is being studied. From 2006 to 2008 the programme was limited to the Portuguese regions of which the 18 institutions of higher education were involved in the programme.

Experimental science teaching has been clearly defined and is composed of the following elements or phases:

- The identification of the problem or question to be the basis for the experimental science teaching;
- Reflection and discussion with the pupils what they think about the problem or question;
- Drafting an activity plan to carry out the project activities;
- Carrying out the activities planned;
- Collecting data concerning the activities carried out;
- Drawing conclusions about the problem or question investigated.

To achieve the aims of the teacher education programme for experimental science teaching :

- **Didactical knowledge** has been made available to teachers through individual support and through in-service training. Teachers must learn how to implement the experimental science teaching in the classroom
- **Didactical materials** have been developed to help the teachers. This has led to the development of **six didactic** guides so far. These guides enable to implement the experimental science methods in six areas. More guides are scheduled to be developed.
- **Didactic resources and equipment** appropriate to work with experimental science teaching have been made available to schools.

**The six didactic guides** have been developed to support the experimental work. They all have a part for the school teacher and a part for the pupil. The part for the science teacher is composed of the following elements:

- Curriculum framing: where does the material fit into the curriculum;
- Aims and objectives of each experimental activity proposed;
- Conceptual framework elements: what do teachers have to know to teach these materials to pupils;
- Activities presented taking into account the levels of the pupils and the year in which they are in the compulsory school;
- The learning outcomes to be achieved as to the conceptual procedures and activities
- Guidelines for pupils' assessment.

The part of the guides for the pupils is composed of the following elements: Registering, Activity planning, Data collection, Conclusions to be drawn and Answers to assessment questions.

This programme is implemented through three-year pilot projects for which school apply A network of 18 institutions of higher education (4 universities and 14 politécnicos) help the schools by making available to them teacher educators (154 in 2008-2009) to support them. Schools apply to be involved in the innovative action. Support staff of the institutions of higher education goes to the schools to help them but on regular occasions in-service training and support sessions are also organised in the institutions of higher education. The teacher educators help the science teachers as

peers. The teacher educators do not act as inspectors or as passive observers. All the extra work of the teachers is outside their normal working time and is not paid. Only travel is paid if they attend in-set at the higher education institution.

Each higher education institution organises every year a final meeting with all the science teachers and the teacher educator. Such a conference is composed of the following elements: speakers on a specific science topic, oral presentations and poster sessions by science teachers, exhibitions about work carried out in schools and presentations made by students.

In July 2008 a national conference was organised for all those involved (science teachers, teacher educators, institutions of higher education, national committee members etc.) in the three year programme.

This programme is coordinated by a National Commission composed of representatives of the Ministry of Education (DGIDC), an External evaluation Commission and the 18 coordinators. The National coordination commission meets three times a year. In between they communicate by e-mail. It deals with the following issues:

- See to the implementation of the programme as decided with the key stakeholders;
- Make the selection of the themes around which didactic guides are developed;
- Propose the equipment to be made available to the schools in the project

This programme concerns thus **18 institutions of higher education, 154 teacher educators from higher education institutions, 2989 teachers of 2100 schools and more than 54.000 pupils.**

All the extra work is done outside the normal working hours which shows the commitment of the teachers. Teachers are expected to be physically present in 63 hours of activity related to the project and to invest as much in autonomous learning activities. This means for every teacher involved an investment of 126 hours.

The investment of the teachers is, however, in the near future to be integrated in the evaluation of the teacher's work which is being developed at the moment in Portugal. The new Evaluation system at the level of the teachers thus will take into account efforts invested by teachers in innovation. It is hoped that this will encourage teachers to be more involved in innovative initiatives in their schools.

### **La main à la Pâte (FR)**

This French initiative clearly addresses science education in the primary school. It was expanded upon earlier as it is a national strategy. (Information above !)

### **The Plan of action for mathematics (PT)**

This Portuguese initiative clearly addresses maths teaching in the primary school. It was, however, expanded upon earlier. (Information above!)

## **3.3. Secondary schools**

### **The UNIVERSUM programme: Better off with science (NL)**

Schools are invited to create for themselves a specific profile in science education. 100 pioneer schools are involved at the moment. Monitoring, auditing and meetings allow schools to share experiences, proven concepts and good practices with each other, thus working together to build national innovation. Each Universum school can link up with a partner school, which it supervises and which may develop into a such a school school.

### **The added value of Universum:**

- Schools can create a distinct profile for themselves in science;
- Strong appeal for pupils, parents and (future) teachers;
- Schools take a structured approach to improving quality based on a compass that education institutes developed themselves;
- Access to an active network for advice, expertise, feedback and practical assistance;
- Taking a leading role with new developments in the science subjects and in
- developing the new science subject: Nature, Life and Technology;
- Connections to a network of universities, polytechnics, knowledge institutes and businesses;
- The Universum school is close to social developments, which facilitates a smoother transition to higher education;
- Close cooperation with Jet-Net, the network that brings young people and businesses together.

### **The AMBITION programme: Backbone of the knowledge-based economy (NL)**

The Ambition programme at VMBO (Lower VET schools) level try to bring the education programmes of VET schools and regional technology centres more into line with young people's preferences and the demands of the labour market. Pioneer schools show that relevant, appealing education inspires more young people to choose technical studies and to progress to continuing education and work. Through shared knowledge and experience, the Ambition Programme invites schools to innovate and achieve excellent performance across the full scope of technology. Forty schools can sign up each year. An interactive process of monitoring young people, teachers and school management makes it clear which innovations have an impact. In the VMBO programme, the Science and Technology Platform works with the Techno-centres, Schoolmanagers and Platforms representing VET.

The Ambition Programme for MBO (upper secondary vocational schools) has started in 2007 with 7 schools. More than 20 schools will ultimately be able to participate. They make that choice based on the ambition of making intermediate VET education as appealing as possible to all those involved. Attractive, relevant VET education brings on more students, while improving progress and graduation into the labour market.

### **The added value of Ambition:**

- Schools profit from the latest insights in student enrolment, professional fields and teaching;
- They share knowledge with their institutions to introduce innovations that lead to greater achievements;
- Receive support from the Platform in realizing their ambitions.

### **Scientific work with youngsters at school of IPATIMUP (PT)**

IPATIMUP is The Institute of Molecular Pathology and Immunology of the University of Porto, a major institute involved in cancer research. It is part of its policy, its mission and vision to be involved in several activities to promote the interest in science and research.

Overview of projects of IPATIMUP towards schools

- Open Lab: it offers the opportunity to students from upper secondary school to be involved in research and make experiments supervised by a researcher during two weeks; at the end they make a written and oral presentation.
- Auto lab: a project that consists of a car with pedagogical boxes that goes to the schools;
- Cancer mobile: It is a project that works on cancer prevention;
- Science lab: a project offering youngsters to do research and carry out experiments in cooperation with the Museum of Transport and Communication;
- Promotion and internationalisation of life sciences in North of Portugal;
- The magic of sciences
- Wake up for science.

Furthermore IPATIMUP has other science activities ranging from: lectures at schools, Science on Monday which consists of visits to IPATIMUP, participation in science exhibitions and conferences on scientific and research topics especially related to cancer.

IPATIMUP has several protocols of cooperation with organisations and bodies in the local or regional community that results also in various activities such as:

- Oporto and children: experiments with kids in the first cycle of the compulsory school;
- Training sessions for primary school teachers that help them in the teaching of science;
- Bring also a friend: inviting a youngster interested in science to one of the activities;
- Junior's university enabling young people to have a taste of university and research
- Cooperation with the Town of Trofa to promote science education
- Life sciences during the holidays: summer activities for families and the public at large to raise awareness for science and research.

IPATIMUP pays special attention to the socio-economic background of the youngsters

### **The maths and science reform in the secondary school in Latvia 2005 - 2011**

It was composed of two ESF projects

Project I: "Curriculum Development and Teacher In-service Training in MST" (2005-2008)

The objective of this first ESF project was to modernize the curriculum, to develop support materials for MST teachers and to improve their capacity to work with the new curriculum and the new support materials. The Project was designed with an aim to address the problems in the MST in secondary schools (grades10–12).

The Project Outcomes were very clear and have proven to be efficient and effective.

- A modernized curriculum in the upper sec. school (grade10-12) in biology, chemistry, mathematics, physics and science;
- 15 sets of teacher support materials were developed and distributed;
- More than 6000 students got advanced curriculum by using the support materials developed during the Project;
- 50 pilot schools became regional methodical centres;
- 2950 teachers improved their qualification through in-set teacher education;
- Enhanced professional capacity of field experts in MST education.

Project II: „Science and Mathematics" (2008-2011)

The project was designed to continue to consistently implement the ongoing changes in MST education started in 2005 so as to enhance the sustainability of the reforms.

The objectives of the second ESF project "Mathematics and Science" were to.

- Develop training content in natural sciences and mathematics subjects for the 7th – 9th class period, emphasizing students' research activities and practical skills to use the knowledge gained in school to real-life situations, to promote information technology in teaching;
- Provide methodological support to teachers and students in natural sciences and mathematics learning of the general education;
- Prepare a variety of materials for teaching methods, student performance evaluation, as well as a variety of visual materials for teachers and students in both printed and electronic format;
- Develop MST teachers, and industry experts, and future teachers' professionalism in dealing with the modernized training content, and develop teacher support materials;
- Encourage student interest in science and mathematics, through extensive collaboration with universities, research institutions and entrepreneurs.

### **The development of new MST teacher support materials in Latvia**

In the framework of the MST reform in Latvia new teacher support materials (TSM) were developed by different divisions within the project implementation unit of the VISC or State Education Centre: the teacher support materials division, the division dealing with methodological approaches, the IT division to develop IT and interactive tools, the professional development division in charge of developing the in-service training of teachers and the project implementation division.

The TSM consist of four parts: TSM for teachers, TSM for students (with a.o. worksheets), printed works and CDs and DVDs.

The TSM were developed in three phases: the preparation of the TSM, the piloting of the TSM and the implementation of those TSM.

The working groups within the TSM division were composed of experienced maths and science teachers, university lecturers and experts with PH.D. The WG members were selected on quality criteria: they had to be experienced and good maths or science teachers, they had to be open to new developments and approaches and they had to have a good academic background at least a Master's in science or maths or a PH.D. This contributed to have research centred activities and to develop TSM that took into account recent developments in MST research. The working groups were influenced by the contacts with experts of other countries through study visits or attending conferences and seminars.

In detail the following activities took place: workshops were organised to plan the contents of the TSM, the TSM were developed, the TSM developed were reviewed by experts, if necessary the TSM were improved, a workshop was held to further discuss the TSM, finally the final versions of the TSM were given to external experts for a final review.

### **The development of IT materials such as CD and DVD**

Various IT materials (CD, DVD) have been developed as TSM to support the new MST curricula and syllabi. The materials are divided into three categories: self-learning materials, video materials for teachers and educational films that can be used in the classroom. In this category excerpts of TV broadcasted programmes and educational games are also included.

They were developed by experts. While developing the materials special attention was given to see to it that the IT materials linked as much as possible with reality. Special attention was also given to the interactive nature of the IT materials and to the fact that teachers could find good materials on the internet. Many of the materials facilitate simulations for maths and science. All the materials can be easily accessed on the website of the maths and science reform.

## **Piloting of the curriculum and TSM or teacher support materials**

Key to the success of the MST reform was the piloting of the TSM. 12 schools were involved in the piloting from 2005 to 2008 and another 38 from 2006 to 2008, but 26 are involved in the 2nd phase from 2009 to 2011. The schools selected to be pilot schools were a mixture of all the different kinds of schools in Latvia: small schools, big schools, rural schools, urban schools etc. spread all over Latvia. In every pilot school one teacher was involved for maths, physics, chemistry, biology and natural science. Those teachers were supported by a team coordinator who stimulated the team of teachers involved, observed the lessons, solved practical problems during the piloting and organised how the in-set seminars were attended.

Lessons given by teachers using the new TSM were observed by two experts. Every teacher in each pilot school was visited once a year. Attention was paid by one of the 2 experts to the class management by the teachers and the other one paid attention to the students. Thus the first one would pay attention to the pedagogical methods used stimulating various models of cooperation within a class and IBSE. The other expert, coordinator of VISC project management unit visited all lessons of all pilot teachers. Each of the observers filled in a form with information as to the pedagogical methods used and the time spent on the various activities.

The teachers were invited to use the following criteria to evaluate the quality of the TSM: are the TSM adapted to the age of the students concerned, is there enough time within a lesson to work with the materials, are the tasks to be carried out with the TSM clearly enough explained. The teachers could give feedback in writing or electronically. At the end of each chapter of the TSM conclusions were drawn based on the feedback of all the teachers in all pilot schools. The analysis of the remarks of the teachers then led to suggestions for improvements.

The experts observing the lessons filled in a separate form. In this form they focused on whether the TSM material had been clearly understood by the teachers, the links the TSM had with real life and the contribution the TSM made to enhancing the inquiry skills.

Questionnaires also had to be filled in by the pupils, by the expert teachers and by the teachers themselves. At the end those teachers involved in the piloting had an extra questionnaire. There was also a questionnaire for the school coordinator. Focus groups were also organised involving teachers, school coordinators and students.

Feedback was given to the teachers involved in the piloting based on all the data collected during the observation sessions and with the questionnaires. This happened during seminars for the teachers of the pilot schools

In the first pilot project no differentiated TSM materials were developed but in the second ESF project differentiated materials are being developed for specific groups of students such as talented students or slow learners.

## **The new maths and science curricula and the "Mathematics and Science" reform in Latvia**

The new curriculum for maths and science has been developed taking as an overall basis the national standards of compulsory basic education and general secondary education approved by the Cabinet of Ministers. The national standards focus on the aims and principles, on the mandatory contents of education and on the principles and procedures of evaluation to be used.

Based on those standards the subjects standards are developed stressing aims and principles they are based on, the contents (in learning outcomes) to be achieved and how those learning outcomes have to be assessed. Once the subjects standards agreed, the curriculum is developed drafted in the form of syllabi. Based on those teacher support materials are developed.

A distinction is made between the subject as such, education components and spheres of education. The education components focus on creativity, self-esteem, social skills, mathematical literacy, learning skills, analytical and critical thinking skills. The spheres focus on self and society, the fundamentals of science and technology and arts. All these elements are integrated into maths, natural science, biology, physics, chemistry and geography. The ultimate object is to promote the harmonious development and education of every student, to promote his or her sense of responsibility, to develop the foundation of further (lifelong) learning and ensure the acquisition of knowledge, skills and attitudes for private and public life.

### **The curricula of science**

In accordance with the essence of scientific literacy, curricula in all science subjects – physics, chemistry, biology and science – are structured in three blocks (or three structural components): “Nature and Technology”, “Scientific Enquiry” and “Scientific Aspects of Human, Society and Environment Interaction”.

“Nature and Technology” considers diversity and unity in nature; structure, processes and regularity in nature; and engineering (technology). “Scientific enquiry” is structured in accordance with the work of a scientist: forecasting and planning, questioning, formulating hypotheses, development of experimental skills through investigation, collect data and analyse results and evaluate the results possibly explaining them, work with verbal and visual information sources and ICT. “Scientific Aspects of Human, Society, and Environmental Interaction” – forms a context that helps the student to understand why scientific literacy is vital and why the appropriate skills are to be acquired. Components are: the study of science discoveries, inventions and research values, technology’s influence on society, individual/social influence on environmental quality.

The curriculum has been developed systemically and is adapted to all science subjects and compatible with the mathematics curriculum. Curriculum objectives emerge from science educational objectives. For example, deepened understanding on physical processes in nature and technology is put forward as the objective for acquiring physics in secondary school by improving the skills of scientific enquiry and encouraging students to take joint responsibility on ensuring sustainable social development.

### **The curricula for maths**

In order to reach the mathematical literacy, it is equally essential:

- To manage definite set of mathematical facts (aggregate concepts, regularities, algorithms, methods);
- To improve the skill of noticing connections, generalisations, concluding reasonable judgements;
- To obtain experience of identifying problems, develop them by using mathematical methods and to interpret the results.

The maths curriculum involves three blocks: “Mathematic models”, “Scientific enquiry” and “Scientific aspects of human, social and environmental interaction”. “Mathematic models” – stresses knowledge on mathematical models, their diversity, the knowledge on mathematical methods and skills to use them. “Scientific enquiry” directs the improvement of cognition and communicative skills through scientific enquiry, problem solving, judgement conclusion, communication and cooperation. “Scientific aspects of human, society and environmental interaction” – concerns context and is directed to understanding the role of mathematics in everyday life and mathematics’ role in the development of other sciences, society and the individual by allowing recognition of results and

methods of mathematics as science, evaluation of experience and empowerment in the use of mathematics.

### **3.4. Higher Education**

#### **Attracting more students in maths education in higher education (SE)**

Enhancing the interest for maths education especially in higher education has to do with working on the transition from the upper secondary school to higher education. A project focusing on transition from the upper secondary school to higher education originated from the fact that attention was raised on this issue through several reports. These reports showed that students failed in maths for a variety of reasons, there was a content gap, a culture gap, there was weak knowledge of algebra and arithmetic, the admission requirements had been lowered and there was limited cooperation between secondary schools and higher education to prepare the transition between the two.

Hence it was decided to start two projects to work on the transition from secondary to higher education. The first project is a three year project involving 29 universities. The second project is a one-year project involving 22 upper secondary schools.

Within the 3-year project the Göteborg University, in collaboration with the NCM, was given the assignment to develop an internet-based transition course ([www.math.se](http://www.math.se)), to organise national meetings to bring together key people concerned by transition issues and to stimulate local meetings also between all those concerned by the transition problems. This concerned mainly teachers from upper secondary schools, students in their final year of upper secondary school and lecturers from universities or university colleges. The internet-based course ([www.mattebron.se](http://www.mattebron.se)). has been very successful so far as 4000 to 5000 students have already taken this course.

These two initiatives may be complemented by other activities such as: secondary school teachers giving maths courses in the first year of the university or university college, university lecturers going to schools are experienced university students mentoring or tutoring secondary schools students as in the Swedish INTIZE project. Closer cooperation between universities and secondary schools should also see to it that university professors are informed about the changes in the maths curriculum at secondary school level. Gradually universities have realised that the problems with maths are not mainly due to the pupils but are due to the teaching at the university and to the lack of cooperation between the university and the secondary school. Similar work will be done at the lower levels of the education system such as the transition from lower secondary to higher secondary schools.

#### **Scientific work with youngsters during summer holidays at IPATIMUP (PT)**

During the summer holidays, short placements in scientific laboratories are organized for secondary education students. Students work in research laboratories, where they are given specific simple scientific tasks, sometimes including field work, for one week or more. The aim is to give them a clear idea of the realities of research, in topics as diverse as mathematics, biotechnology, robotics or cancer research. Several of the best Portuguese scientific institutes, as IPATIMUP, participate in this activity on a regular basis, and both students and researchers have found it a very positive experience. This initiative is now widespread involving some of the best scientific institutions across the country and more than 5500 secondary school students had the opportunity to participate since 1997. The final objective is also to give to students that go to higher education in the near future a real taste of what scientific work is all about. Experience shows that most youngsters that participate in those summer camps go into scientific careers and research careers.

## **Cooperation with university and initial teacher education in Latvia**

The Latvia state University lecturers have been involved in the development of the teacher support materials (TSM) either as experts in drafting and developing some of the materials or to evaluate the materials during the pilot phase so as to improve them. They acted as experts in observing teachers in the pilot schools testing out the new pedagogical materials.

Pre-service teachers were informed about the objectives of the reform in maths and science and they were initiated into the teacher support materials that are used in the schools within the reform. It was also possible for pre-service teachers to have an internship or placement in a pilot school involved in the maths and science reform so as to experience the innovation which was being implemented.

All university rectors have been informed about the developments related to the reform of maths and science. In general it was stressed that young professors are open to innovation whereas it was more difficult to convince the older professors.

### **3.5. Cooperation across different levels of education**

#### **The SPRINT programme: Science and technology at top speed (NL)**

The key objective is to cherish science and technology talent. Scientific knowledge and skills are wanted on the labour market and offer students important assets for their future.

Education has to respond better to this need. More variation in the width and depth, close-knit networks with secondary schools and vocational training, close cooperation between higher education and academic institutions are developed. Sprint also encourages good cooperation with businesses, research institutes and alumni networks.

#### **The added value of Sprint:**

- Sprint links in with the internal ambitions and innovation policies of polytechnics and universities;
- Active support with the network in the form of advice, expertise, feedback and various forms of practical assistance;
- Access to networks of ambitious science schools and pupils;
- Extra attention to student enrolment, progress and graduation;
- Support in realizing continuing learning tracks and in educational innovation to offer students more variation;
- Better supply of future researchers at universities;
- Broader options for strengthening ties to businesses;
- Option of developing educational programmes offering interesting content, which combine quality with appeal;
- Educational institutions gain a clear picture of the progress of their educational innovation. Sprint is a learning programme.

### 3.6. Qualified teachers

#### **The learning study: professional development of maths teachers in Sweden**

The learning study is a **school-based in-service training for maths using** to contribute to professional development of teachers in a team approach within a school. . This is happening in cooperation with a university which is supervising and monitoring the initiative in its initial phase.

The "Learning Study" is an arrangement inspired by the Japanese "Lesson study" and by the idea of "Design experiments". The point of departure for a Learning study is a specific object of learning (i.e. something the students are supposed to learn). A group of teachers, usually together with a researcher, try to find as a powerful way of teaching the particular object of learning as possible. They do so by drawing on their experiences, earlier research, their mapping of the students' pre-understandings and on a specific theory of learning. They plan and carry out a lesson (or a series of lessons) and try to find out how the students have appropriated the object of learning. Their observation of the lesson(s) and their analysis of the outcomes give them additional information to be used for revising the lesson plan. A new cycle of pre-test, lesson, post-test, evaluation is then carried out. The whole Learning study may comprise 3 or 4 such cycles. The participants learn from each other, from the students and from the theory. Again and again it is found that seemingly subtle differences in how the object of learning is dealt with during the lesson, yield dramatic differences in how it is appropriated by the students.

A learning study is a systematic attempt to achieve an educational objective and learn from that attempt. It is a design experiment that may or may not be a lesson study. Such a study is a learning study in two senses. First, it aims at bringing learning about, or more correctly, at making learning possible. The students will thus learn, hopefully. Second, those teachers involved try to learn from the literature, from each other, from the students, and not least, from the study itself.

The cycle of a learning study comprises the following steps:

1. Choosing and defining a specific set of educational objectives. These have to be capabilities or values to be developed during one or several lessons.
2. Finding out the extent to which the students have developed the capabilities or values targeted before the teaching begins.
3. Designing a lesson (or series of lessons) aimed at developing these capabilities or values. The planning work must take into account the existing knowledge of the students, the teachers' prior experiences in dealing with the objects of learning, and the research literature.
4. Teaching the lesson (or lessons) according to the plan.
5. Evaluating the lesson (or lessons) to see the extent to which the students have developed the targeted capabilities or values.
6. Documenting and disseminating the aim, procedures and results obtained.

For further information: : [http://www.educ.umu.se/presentation/publikationer/lof/lofu\\_nr1\\_2007](http://www.educ.umu.se/presentation/publikationer/lof/lofu_nr1_2007)

#### **In-service teacher education in Mathematics and Science reform in Latvia**

To successfully implement the modernized curriculum and provide teachers support in the implementation of the subject standards and subject's teaching and learning programmes developed within this project, in-service training programmes were developed for teachers of mathematics, physics, chemistry, biology and science. These programmes were devised in accordance with the

modern science education, mathematics, and technologies, based on modern research findings as to the development of teachers' in-service training programmes.

The target groups for the in-service training were clearly defined: first the teachers of maths and science (biology, physics, chemistry, natural science); secondly the teachers of the pilot schools, thirdly the field experts in maths and science (supporting the teachers in the pilot schools) and finally the school's administrators (heads, deputy heads). All MST teachers could gradually participate in the in-service training.

Overall four different forms of in-service training were organised: a) learning together activities on a school by school basis, b) working together activities involving the school and people dealing with the ESF project, c) the organisation of seminars for teachers and lectures by experts from various countries and d) in-service training courses for the teachers of maths and science.

a) **The "Learning together" training activities.** These training activities on a school by school basis were composed of the following elements: the MST teachers shared their experience in implementing the reform, information was given on how to improve their MST teaching, training of the expert teachers or the teacher-mentors was organised, internships of pre-service MST teachers were organised in the pilot schools so that future teachers got acquainted with the MST reform. These learning activities were built on the observation of the lessons in the pilot schools using the special observation tools, the analysis of the data collected and the feedback given to teachers.

b) **The "Working together" training activities.** The schools and the teachers were trained on how to work with the boxes containing the teacher support materials. The key agents of the pilot project implementation unit focused on piloting the teacher support materials, observing and analysing lessons and giving feedback, training teachers to use the new laboratory equipment and using ICT to support their maths and science lessons.

c) **The seminars with experts / teaching staff of universities** focused on the changes to be brought about in the curricula of maths and science. They also paid attention to the changes to be made as to the training programmes for pre-service science and maths teachers. There were also various seminars organised with key experts of various countries expanding on key topics related to the maths and science reform.

#### **d) The four modules of the in-service training**

Module I – "General Didactic Approaches to Contemporary Teaching-Learning Process" – offers teachers topics to facilitate the understanding of science, modern curriculum and innovative approaches to studies. It offers information on how to plan the teaching-learning process and how to organise assessment as to the learning outcomes described in the subject standard and subject's teaching and learning programmes. It gives information about the succession of curriculum elements and the relations between science and mathematics.

Module II – "Varied Methodology for Subject Teaching-Learning Process that Promotes Students' Cognitive Activities" – offers teachers an opportunity to improve their understanding of how to organise the teaching-learning process taking into count contemporary theories on teaching and learning. It trains them to use different study methods and forms. The module aims to introduce teachers to the novelties of the subject, and, in agreement with the objectives set in the subject standards, to show a way of stimulating students' cognitive activities in order to master a modernized content.

Module III – “Scientific Enquiry in Subject Teaching-Learning Process” – proposes MST teachers which methodology to use to organise students’ inquiry based / experimental activities to develop their processing skills in science . The module intends to make teachers acquire different skills required for organizing laboratory and research work. It enables them to work with different devices / apparatuses and substances. It aims to introduce the MST teachers to the methodology of organizing student scientific enquiry in order to develop their science processing skills.

Module IV – “Application of Information Technologies in Teaching-Learning Process” – helps teachers implement modern technologies (ICT) into the teaching-learning process. The module informs them about the broad application of information technologies (IT) in the teaching-learning process of MST. It provides teachers with an opportunity to acquire some practical skills for using IT in the classroom.

### **Organisational aspects**

Teachers registered on the project website to attend an in-service training seminar. Two-day seminars were organised with a month’s interval. In between the two seminars assignments were given to the teachers to be implemented in the classroom. Interactive seminars were organised in the schools to train the new pedagogical methods.

### **Quantity of in-set plus quality assessment**

72 hours of in-set were organised for the teachers of maths and science (grades 10 to 12) in the 2005 – 2008 phase.

54 hours of in-set were organised for basic schools that had not been involved in previous training

36 hours of in-set training was organised for the teachers of grades 7 to 9 who attended the 72 hours of courses already organised from 2005 to 2008

In order to assess the in-service training programme and the quality of the materials and their suitability for teachers’ needs, piloting was carried out. During piloting, the assumption was proved that in-service training courses provide the most essential support for teachers in the implementation of modernized curriculum and approach, in the application of methods stimulating cognitive activities, in the application of new equipment and devices, in the improvement of students’ scientific enquiry, as well as in the application of Information Technologies to master a particular subject. The feedback from teachers who participated in the in-service training was very positive stressing that this training had been very useful and supportive to their work in the framework of the maths and science reform.

### **3.7. Stimulating learning environments**

#### **The Inquiry-Based Science Education (IBSE) method: FR, NO and PT**

THE IBSE method is used in different countries in Europe. La Main à la Pâte in France is based on it and so is also the Nysgjerrigper (Curious Peter) project in Norway. Teacher education programme for experimental science teaching is also a good example of this method.

Information is to be found elsewhere in this compendium about those three initiatives.

The inquiry-based approach is composed of the following phases:

- Activate the curiosity of the pupils, raise the interest and curiosity of the pupils for a scientific problem or challenge;
- Move from the state of curiosity towards an educational project; invite pupils to express in words what the problem is about; the use of language is key at this stage to define the problem or challenge;

- From the definition of the problem to planning the inquiry-based project; defining the steps to be set to implement the project;
- Implementing the project activities planned; this is usually done in various different ways (tests, experiments) according to the teachers in the classroom;
- When the activities are implemented comes the confrontation of the results with the reality; comparing the concrete results or outcomes with the expected results; individual or collective validation of the outcomes is part of this phase;
- Conclusions are drawn highlighting which scientific knowledge has been acquired; possible links are made with new scientific problems;
- Making the link between science and ethics, technology, (political) decision-making, the making of choices.

By prompting pupils to use argument, whether oral or written, this process takes part in language learning, in acquiring an independent attitude that is heedful of others. It is based on teachers achievements, the networking of their skills and the creating of effective synergies with external actors, parents, inspectors and educational advisers, college of education training staff, teaching specialists in science and other subjects, scientists, researchers, engineers, students from science universities or from other institutions of higher education.

Difficulties in promoting and implementing the inquiry-based approach are:

- the fear of primary school teachers of doing experimental work in the classroom;
- the resistance against innovation: fear of the unknown;
- the fact not to be trained to be involved in active pedagogy;
- the fact that the hierarchy of the school is not always convinced that science teaching is useful as a contribution to different other aspects of education.

The Nysgjerrigper project also applies the IBST method. It works in 6 steps similar to the Main à La Pâte methodology:

- children wonder why something is happening in a certain way,
- then they try to answer the question why is it like this?,
- they draw up a plan for the work in small teams,
- they collect data,
- they compare and discuss what they have found out and
- they report to each other.

Thus children are invited to find a topic which raises questions. They then decide on an approach to solve the problem and formulate hypotheses. They subdivide the task and in subgroups try to solve the problem by looking for answers. The answers are checked and verified scientifically. The whole process is documented on paper and ends with a report and other products. The whole process is evaluated at the end. The project is usually spread over two to three weeks at an average of 3 hours a week during the school year.

The advantages of working with this method are the following ones: children learn to work together to solve a problem, the interest for science is raised, they acquire skills in research methodology e.g.

by gathering and comparing data and they apply ICT and the use of the internet in their science work. The project also has an impact on children's attitudes towards science

### **Hand-on maths / Matematikverkstad (SE)**

The objective of a mathematics workshop is to create an environment within the school where the learning and teaching of maths is facilitated. Usually such a hand-on workshop is a classroom that is arranged and furnished in such a way that everything which is around will invite learners to work with figures, shapes and symbols. Hands-on materials such as everyday objects and things, educational materials and games are all brought together in one room or placed around and used by the teacher to stimulate the learning of maths. The materials can be used by the teachers in various ways: they can use them as a practical starting point before tackling some theory or vice versa. It depends upon the choice of the teacher.

Everyday objects may be things like buckets, decilitre measures, measuring-tapes, empty boxes, strings, clothes-pegs, bottle caps, dice, stones, leaves and so on. Ordinary everyday things can be brought into the math workshop and used to explore and explain all kinds of mathematical content. Educational materials, things that have been explicitly designed to help students to learn mathematics. E.g. multicubes, digi-blocks, Cuisenaire rods and geostrips. Games, both in society well-known games (monopoly, chess, mancala) and games explicitly designed to be used in math teaching (e.g. the algebra horse race).

A maths workshop helps teachers to plan and realize stimulating maths teaching. When they are planning a lesson they don't have to "run around" looking for things – such as hands on materials – they need, they don't need to bring anything from their own kitchens, they don't have to go shopping. Everything they need is to be found in the maths workshop.

It's a place where the teachers gather and share their knowledge. Teachers say they are very satisfied to know where to store hand on materials, activities, ideas and so on that they get in touch with on courses, from internet, in booklets etc.

Students say it's a place where you get curious, inspired and want to achieve a little bit more. Both teachers and students emphasize: It's funny! – to teach and to learn maths in the maths workshop. The most common is that the class spends one lesson every week in the maths workshop and the rest in the ordinary classroom.

The colleagues in charge of the hands-on maths workshop at NCM support the Swedish teachers with conferences and courses. Last year they ran two big conferences with about 600 teachers. Earlier courses were held for more than 350 teachers from over a hundred schools in Stockholm and now more are planned for the rest of Sweden. A book has been written on how to build, use and develop a maths workshop. A Norwegian version also exists! A Study circle was created on the NCM website that teachers can use when they want to read the book in a team and start to build a maths workshop. A project plan is available to help schools that want to create a mathematics workshop.

For further information: <http://ncm.gu.se/mv>

### **The Robotics Open project in Portugal (and beyond) (PT)**

The Portuguese Robotics Open has been taking place since 2001, and has reached impressive numbers of participants for the size of the country (700 from high schools, 100 from Universities) in recent editions. The objectives of this initiative are to increase the interest with motivated young people in science and technology in general and robotics in particular.

It is also an objective to make young people aware of the economic importance of robotics that represents an important technological niche for the Portuguese economy. Several activities and competitions with robotics exist for the different age levels of youngsters: the junior league and the senior league. These activities take different forms according to the age of the pupils involved. Special attention is given to the gender issue with the Robocup Dance competition. Cooperation with companies is also part of this project. Next to this there is also Robocup Soccer and Robocup Rescue.

Robotics is definitely a catalyst to promote science and technology with youngsters. Furthermore it promotes various values and competencies with young people such as cooperation and communication skills next to scientific and technological skills and competences. Important is also the involvement of youngsters in international events such as the Robocup world competition which was organised in Portugal in 2004. Companies are also involved in the robotics activities although still in a limited way. More efforts will be made in the future to involve more companies.

### **CENSUS VIVO: a different way to teach statistics in schools in Portugal (PT)**

The objectives of this project, developed by the University of Minho with the support of Ciência Viva, were:

- To increase interest in maths working with students using real data and statistics concerning the population and key current issues in Portugal;
- To increase the interest for maths and statistics by linking up with the real world in which the youngsters live;
- To expand, reinforce the need of applied maths linked to the awareness about the population in which we live making use of real data;
- To attract more students in maths education in higher education studies.

The implementation of the project was composed of four phases: the youngsters first discover Portugal through facts and figures, secondly they got to know better the community in which they live, thirdly they learned to deal with data and finally they learned to take command in certain situations making use of knowledge acquired through data.

Different kind of activities were implemented within the project so as to make students aware of the usefulness to work with data. Specific issues were focused upon such as why work with a sample and not with the whole population, teach students to work with confidence intervals etc.

### **Ethno-mathematics in Portugal (PT)**

This project, developed by the University of Trás-os-Montes e Alto Douro (UTAD) with the support of Ciência Viva, had several objectives:

- Increase motivation for the school in general and maths in particular;
- Bring the school and the family closer together;
- Focus on cultural and ethnical national heritage to promote education in general and maths education in particular.

The work of the project was subdivided in different phases. First there was preparatory work carried out by the team of university professors and educators working with the teachers in the schools. The second phase was the thematic framing where the links are made between maths and other elements such as cultural and natural heritage, ethnic heritage etc. The third phase was the phase of the work with the students. This can take different forms: work in the classroom, fieldtrip and experiments. In this phase the project also linked up with families and parents. This science projects

link up with the concrete social reality so that science projects contribute to enhance equal opportunities, social inclusion and active citizenship.

The term ethno mathematics was used to express the relationship between culture and mathematics. The term ethno describes "all of the ingredients that make up the cultural identity of a group: language, codes, values, jargon, beliefs, food and dress, habits, and physical traits." Mathematics expresses a "broad view of mathematics which includes ciphering, arithmetic, classifying, ordering, inferring, and modelling. An important component of mathematics education today should be to reaffirm, and in some instances to restore, the cultural dignity of children. Ethno mathematics enables to connect with the children's reality and bring the surrounding world of the child in the classroom. Just as literacy has come to mean much more than reading and writing, mathematics must also be thought of as more than, and indeed different from, counting, calculating, sorting, or comparing.

### **Working with talented children in Latvia**

Different Olympiads which are organised in Latvia not only for technology and sciences, but also in other areas such as arts and household or domestic science, self and society (social studies) and languages. By focusing on different areas those Olympiads do not only focus on the talented children in maths, science and technology but also focus on different areas of secondary studies where the less bright students may be studying. The basic idea is that every child has a key talent which deserves recognition.

Olympiads are organised at school level, at regional level, at national level and at international level. The same selection criteria are applied at school, at regional and at national level.

There is no direct connection between the Olympiads and the curriculum but notwithstanding this they are very popular with Latvian youngsters. In some cases teachers will prepare the pupils thoroughly to participate in those events. Several medals (gold, silver, bronze medals or merit awards) are won on a yearly basis in various disciplines listed in the scheme above

### **3.8. Involvement of / partnerships with companies**

#### **The ACT Programme: Appealing careers, innovative businesses (NL)**

The ACT Programme helps employers to take a structural approach to availability and better deployment of scientists and technical experts. For example, science and technology action agendas have been drawn up for technical sectors and an inventory has been made of the 'human talent' dimension of the key innovation areas. The aim of this is to guarantee the ongoing availability of talent for the strong innovation clusters in the Netherlands. Integrated regional action plans are also being implemented in active innovative industrial core areas, such as in Eindhoven, Limburg and Twente. The Casimir programme shows that public-private mobility makes the job of researcher more appealing. It will be enlarged towards the future.

#### **The added value of ACT:**

- Reduce the shortage of science and technology staff;
- Businesses and institutions strengthen innovation and competitive capacity by;
- Systematically developing talent for their company;

- Benefit from pooled strengths in the network and resources of the Platform, Syntens<sup>6</sup>, Techno-centres, regional and local governments;
- Employers benefit from the extensive network of ambitious science and
- technology-oriented educational institutions;
- Businesses and institutions benefit from each other 's knowledge and from successful, sometimes unorthodox concepts;
- Improve the image that younger generations have of the world of science and technology;
- Researchers gain valuable experiences that strengthen their career potential.

### **Jet-Net (NL)**

Jet-Net was set up in 2002 between five major companies, the economics and educations ministries, Dutch employer's organizations and intermediary organizations in the education sector. Its prime aim is to stimulate increased interest among high school students to pursue their studies and future career in Science and Technology. Direct encounters with technical experts from the businesses give pupils a much better image of working in the technology sector, which allows them to choose a better course. Lesson modules, 'engineers for the classroom' career guidance and all sorts of excursions offer pupils a fresh new image of technology in businesses and its value to society.

### **Facts and figures**

- Target increase of annual enrolment in higher science and technology education: 5000 students;
- 25 active (mainly large) industrial companies (with over 60 operating units or company locations) in all regions;
- An additional 180 individual engineers and technologists of a wide range of companies participate in school briefing sessions for students;
- 125 participating schools;
- 300 science and math teachers are involved on a regular basis;
- Average input: 25k / 35k euro per school/year;
- Effective outreach: 25.000 students per year participating in Jet-Net activities.

Special teams are assigned to assist the Jet-Net companies in quality development and in formatting the various types of program components, thus facilitating effective relations with the schools. Jet-Net makes a substantial contribution to the overall innovation of pre-university education.

Programs are established between individual schools and companies, ideally covering the entire school period. They are both geared to add practical context to the science curriculum but also to enlighten students on the broader career prospects in industry and technology.

Various activities are implemented:

- Jet-Net Excursions and guest lectures: as part of an initial orientation program companies assist schools in allowing students to develop a general understanding of industry and technology.

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<sup>6</sup> Syntens : an organisation supporting innovation at all levels of the Dutch economy !

- Jet-Net Workshops and projects : students are given group assignments in which they learn to present a report on specific themes, or to develop a solution to a specific technological problem.
- Jet-Net Individual assignments : company staff can assist individual students, e.g. in setting up their end of school thesis.
- Jet-Net Regional and national Events : Jet-Net Career Days and teachers event. During the former each year approx. 1500 students of Jet-Net schools aged 16-17 years are invited to participate in a major educational event offered by the Jet-Net companies. The latter are designed by Jet-Net companies to further enhance their joint programs and to provide teachers with a broad outlook on current trends in industry and technology and to allow the companies to better understand the needs of the schools.

For more information, see the website: <http://www.jet-net.nl/start.html>

### **Cooperation with companies in Latvia**

Various forms of cooperation exist of which two examples are given below

#### **Latvia's State Forests Company**

Latvia's State Forests Company (LSF) considers nature to be the best class in the world and thus organises many activities to raise the awareness of youngsters (and adults) as to the importance of the forest in the life of every individual and in the economy of Latvia.

The specific activities linked to school education are set up in close cooperation with the Ministry of Education and Science and the State Education Centre (VISC) and in cooperation with schools. These environmental programmes are closely integrated into the new maths and science curricula.

The materials used during those environmental activities are certified by the Ministry of Education and Science and VISC, showing they comply with the maths and science curriculum. The methods used by LSF are the interactive and creative methods also promoted through the maths and science reform projects.

Latvia's State Forests Company works in schools with teachers and students and organises various events – field work activities – in the forest. It is the free choice of the schools and/or teachers to participate in LSF initiatives. So far some 200 of the 1000 Latvian schools make use of the offer of LSF involving some 15,000 students.

Environmental guides are trained so as to be able to work with youngsters. Thus there are forest days or pick nicks in the forest, trees are planted together with youngsters (15,000 to 20,000 a year), events such as MST in the forest are organised plus various so-called mammadaba events.

Within the latter there are mammadaba master classes, forests Olympics, field trip excursions for children and children camps, seminars for teachers to train them how to use nature in their lessons. Working with students in the forest definitely leads to better learning, to better taking care of the environment and to better health for all those involved.

#### **Grindex, Baltic Pharmaceutical Company**

The Grindeks Foundation for Support of Education and Science has several education activities of which the overall target is to support the development of science and promote specialists' growth and professionalism in engineering, natural sciences and pharmacy and raise its' prestige. The target

groups are: secondary school teachers, lecturers of Vet schools, students of universities and Latvian scientists. By doing this it contributes greatly to the aims of the ESF reform in maths and science.

This overall target is translated into the following aims: support higher and secondary education to improve their material and technical equipment (labs and chemistry classrooms) and teaching aids; award grants to teaching staff of secondary professional, secondary and higher education establishments, award grants to students of specialities necessary for pharmaceuticals, present material support to training aids (e.g. books, brochures), give awards and financial support to the best scientists such as the “Gold Owl” awarded to experienced scientists and the “Silver Owl” which is awarded to young scientists.

It promotes cooperation with the Ministry of Education and Science of Latvia; with secondary professional schools to develop quality of studies a.o. through participation in common projects for EU funding; with the Talent Development Foundation – which gives aid especially to gifted youth of Latvia and with youth organisations for common projects for young people.

It thus organises professional / vocational courses for students conducted by Grindeks employees. It offers internships in JSC Grindeks for local and foreign students. It develops career movies about job opportunities’ in the field of chemistry. It organises study trips to JSC Grindeks for students and teachers.

### **3.9. Students as mentors or tutors of pupils or teachers to promote MST**

#### **The students of the Stichting Techniekpromotie of the TU Delft (NL)**

Students of the Technical University of Delft are involved to promote science and technology with school children. They work half a day or one day with pupils in the secondary school on science topics such as building robots, building a small bridge etc. They contact the schools to see whether they are interested in having them. In 2006 they reached 40.000 children during 200.000 contact hours. Student get a student-assistantship contract for 4 hours a week during which they promote science and technology with pupils. The cost of one hour is less than 4 €. The activity is seen by the students as an important element of social entrepreneurship.

For further information: <http://www.techniekpromotie.nl/>

#### **The INTIZE initiative: Engineering students mentoring secondary school pupils (SE)**

Students from Chalmers University of Technology and Göteborg University offer pupils – especially in poor and disadvantaged neighbourhoods- the unique opportunity to receive free private tutoring lessons in mathematics from the beginning of the lower secondary school all the way through to upper secondary school. Every week, more than 250 upper secondary school pupils travel to Chalmers to meet their mentors. Every mentor is responsible for four upper secondary school pupils. Those pupils receive in their second year the opportunity to tutor the lower secondary pupils.

With the approval of the head of the school and the teachers, the students invite the pupils to come to the university during the weekend. They organise help and tuition and also sports activities. During soccer matches the pupils meet other players from companies such as engineers, marketeers etc. This creates an indirect opportunity to motivate young people for future work in a company.

Intize's mentors help break the myths about maths by convincingly explaining the purpose and the value of mathematics to the students, which enables the students to be more open to and involved in all of the opportunities that a strong mathematical foundation provides. In addition, the students

become accustomed to and are welcomed in to the dynamic university environment, where positive role models and future prospects are ubiquitous.

On the one hand the university students mentor the upper secondary school pupils as to maths and on the other hand they train upper secondary school pupils to act as mentors towards lower secondary school pupils. Research has indeed shown that pupils can best be motivated by peers or fellow pupils that are not too different in age. In this way the project also promotes active citizenship at different levels.

The university students commit themselves to be involved during their free time and they accept to be trained to do their job of mentoring efficiently. It is a bottom-up initiative totally driven and implemented by the university students. The university support the initiative morally and financially

The students act as natural role models and are accepted as such.

Effects on the pupils:

- It heightens their self-confidence in general;
- It strengthens their motivation for maths learning and makes them see better how maths can contribute to their personal and professional life;
- It broadens the horizons of the pupils concerned;
- It helps them make their choice of their future studies and of their future professional career; its is an important element in guidance;
- It changes the way in which they see maths;
- It makes them feel more included in the Swedish community at municipal level;
- It has an impact on their active citizenship.

Effects on the students, mentors:

- It increases their communication and intercultural skills;
- It strengthens the integration of their own knowledge and competence as to maths;
- It contributes to their feeling of active citizens.

Chalmers' University of Technology has developed an optional course of "Social or societal entrepreneurship" (of 5 ECTS credits) which a student can take as part of this normal curriculum.

For further information: [http://www.intize.org/index\\_eng.php](http://www.intize.org/index_eng.php)

### **The MECHATRONICS project : engineering students helping Vet pupils (FR)**

The project is based on links between Ms. eng. students and VET pupils through industrial design projects. The first objective of the Mechatronics project is to ensure a better understanding of problems related to the design and implementation of technical systems involving a balanced combination of mechanics and electronics. For the first time in their education, students have an opportunity to learn through practical experience how to devise a system in accordance with functional specifications.

The Mécatronique /Mechatronics projects aim first at the modelling, the design and the manufacturing of complex systems, involving a balanced combination of mechanics and electronics. This tries to reproduce the development methods used in the car or air-plane / air manufacturing industry, where mechanics, computer science, electronics, design, and manufacturing are closely associated. Ten different subjects are offered, including the design of a flying drone, the design of

autonomous robots (Coupe de France de Robotique "E=M6") or the design of a vehicle for the Marathon-Shell competition.

The second objective is to make students aware of problems related to working in teams, with different levels of skills, in long-term projects. Within the context of this course, students therefore work in project groups in conditions that are similar to those to be found in industry. They have an opportunity to work closely with students studying for a BTS, Bac Pro and BEP in technical colleges which are partners of the École des Mines in the various phases of a project that extends throughout the second year. Thus, Ms. eng. students from Ecole des mines de Paris work together with BTS students from vocational schools (dedicated to mechanics, electronics or industrial computing) half a day per week through a whole year under the supervision of professors from each institutions. For the manufacturing phases, BTS students can involve in the project younger students from vocational high schools. Students and professors use a "PLM platform" (Product Lifecycle management platform) equipped with several softwares. In 2006-2007, the ten projects involved 117 Ms. Eng. students, 94 BTS students and around 20 professors from the Ecole des mines and from 10 vocational schools.

A substantial part of the work consists in gathering the information required for decision-making during the design phase. The results of some of this research are communicated to all of the students in that year. With that aim in mind, an "information manager" is appointed in each group.

From the beginning of the design phase, students from the BTS, BEP and Bac Pro departments of the partner technical colleges are involved for manufacturing the mechanical components of the projects. The École des Mines students must handle communication and the organization of work with these institutions in order to conduct the manufacturing phases satisfactorily.

The electronic, monitoring and industrial computer components of the projects are usually designed and manufactured on the spot, but partnerships can be envisaged, for certain projects, with the technical colleges which have an electronics department.

The design of the mechanical part is carried out with the Catia software. A collective working area and a project management software must also be used. Other types of software are made available to the students to respond to specific needs, particularly for electronics.

The students are required to present their work on the occasion of two vivas (at the end of the third and at the end of the fourth semesters). The results are assessed through the vivas but also through documents drafted and submitted by the students who must also include specifications, a design report and a maintenance manual.

Since 2003, this pedagogical experience showed very positive results in terms of:

- possibility for students to realize a complex system in industrial working conditions;
- comprehension of the human problems related to working in a team;
- mutual respect between students from different scientific cultures and professional skills;
- pedagogical enrichment for the professors of both institutions;
- enhancement of the self-confidence of the BTS students;
- motivation for the younger students in the vocational schools for undergraduate studies.

Information in French: <http://graduateschool.paristech.org/cours.php?id=76980>

In English: <http://graduateschool.paristech.org/cours.php?id=76980&langue=EN>

### **Scientific coaching of teachers by engineering students (FR)**

Studies have shown that the teaching of science was not popular in the primary school in France. Only 3% of the primary school teachers were teaching explicitly sciences. This had to do with the fact that primary school teachers in France, before being trained as primary school teachers, get a bachelor or licence. When they have finished their bachelor's degree they apply to an IUFM, an Institut de Formation des Maîtres or Teacher Training Institution. Most of the bachelors (some 80%) that apply to become teachers have not studied exact sciences during their bachelor studies and during the two years at the IUFM there was a clear lack of time to upgrade their science teaching knowledge and skills. Hence many primary school teachers with a non scientific background feel very insecure when they have to teach sciences. Within the frame work of the Main à la Pâte initiative schools can ask for the support of engineering students to support the primary school teachers in the teaching of science. Thus a partnership is set up between the engineering school and the primary school. Lower secondary school may also benefit from this initiative.

Special attention is given within this initiative to the following elements:

- The training of the students to be 'mentors' or students. The students have to know they do not replace the teacher but support him. They back up the teacher in the classroom when it comes to specific scientific knowledge.
- The teacher also has to be prepared before they accept an engineering student as a support person in their classroom. The cooperation between the teacher and the student has to be prepared, followed-up and evaluated.
- Credit systems are developed so as to integrate the efforts and the time of the engineering students into their normal curriculum. Sometimes their investment can be up to six months in a school.

One project is "Accompagnement en Science et Technologie à l'Ecole Primaire (ASTEP)" or Support in science and technology at the primary school.

The Ecole des Mines de Nantes, a school of engineering, has been involved for the past 12 years in building an original partnership with local primary schools and educational institutions. This partnership aims at encouraging and facilitating inquiry-based science learning at primary and secondary school.

It consists of :

- primary school teachers' coaching by engineering students and professors,
- training workshops for primary school teachers,
- secondary teachers' coaching by PhD students.

The main goal is to get primary school teachers more self-confident in scientific teaching, after working in pairs during a few months, and to help secondary teachers carrying out experimental inquiries in their classroom.

The Ecole des Mines simultaneously developed since 1996 hands-on learning for its own students: learning by doing, problem-based and project-based learning ... all ways of teaching strongly impacted by Main à la Pâte (hands on Science) experiences.

According to the audience's wishes on Wednesday afternoon, the presentation will describe either organisation, rules and requirements, main data, advantages or outcomes of this partnership. These include new skills for engineering students and for the Ecole des Mines' educational methods.

The main conclusion is that both primary and secondary schools, on the one hand, and universities and engineering schools, on the other hand, could gain a lot if bridging a little the gap that naturally exists between them.

On 5 and 6 December 2007 a conference will be held with the title "The pupil, the teacher and the scientist: sharing science and technology". This event will give the opportunity to understand Science and Technology coaching, so as to enable all people to feel concerned and to become responsible citizens taking into account scientific and technological developments in our present-day society.

Further information: <http://astep2007.emn.fr/>

### **Junior College Utrecht (NL): Motivating gifted secondary kids for scientific careers**

Traditionally, in Dutch senior secondary schools little attention is paid to differences in abilities within a class. In 2004, Utrecht University and schools from the Utrecht region decided to develop a radical initiative to tackle this issue: the Junior College Utrecht JCU. This is a school for the last two years of VWO (pre-university education). JCU started in 2004 with 25 5VWO students that were selected from 13 schools. It is located at the University College Utrecht campus. JCU-students follow all their physics, chemistry, biology and mathematics lessons in the JCU. The other lessons are followed in their own schools. A special two year curriculum has been developed, taught by eight secondary teachers from partner schools and by a number of university teachers. The initiative was planned as a pilot project for 3 years. In 2005, the 2004 group passed to 6VWO a second group of 50 students (two classes) was selected. In April 2006, the first group took the final examinations. A new group of 50 students was selected and started in August 2006. Many students are interested in participating in the JCU. The 'JCU open day' attracted 170 interested students and their parents. About 75 students are selected by their schools to apply for the JCU. They will be invited for an interview and about 50 students are selected to start in the course.

The JCU has two main goals, one aiming at the education of talented students and one at the innovation of science education in upper secondary schools: to offer an interesting and challenging science education program to talented and motivated students (age 16 – 18) and to provide a working place to partner schools for innovation of the science and mathematics curricula.

As JCU is at the university the secondary school pupils have the opportunity to meet and mix with university students who thus a role model effect on the pupils.

The JCU curriculum has five characteristics that are different from science curricula in regular VWO (general secondary) schools.

1. Accelerated pace: subject matter from the national VWO syllabuses biology, physics, chemistry and mathematics is taught in a shorter time than on usual VWO schools. Thus, a half year time is saved to study topics beyond the syllabuses.
2. More comprehensive: the curriculum is taught in a more comprehensive and profound way than at the regular schools. E.g. the students do lab work using university lab facilities; more attention is paid to theoretical and research backgrounds of syllabus subject matter.
3. Focus on coherence of sciences: as all JCU-students study the full science and maths curriculum, it is possible to pay much attention to the coherence of the sciences and on interdisciplinary projects.
4. Stimulating students' inquiring attitude: there is much room for asking questions and finding answers, for developing their inquiring mind. There is an inquiry curriculum line implying open inquiry assignments in the subjects as well in interdisciplinary projects. This results in two big investigation assignments guided by researchers from Utrecht University.

5. Enriched program: topics beyond the syllabuses are taught. Seminar or lectures, excursions to a university lab, or of a project or university modules of a large size taught by university specialists, elaborating issues at the front of research.

For further information:

<http://www.uu.nl/uupublish/homeuu/onderwijs/overigonderwijs/juniorcollegeutr/30984main.html>

### **The Teach First Initiative (a.o. in Latvia)**

“Teach First” is an independent charity launched in 2002 to bring excellent teachers into challenged secondary schools across the UK. The mission is to address educational disadvantage by transforming exceptional graduates into effective, inspirational teachers and leaders in all fields.

Teach First aims to close the achievement gap by helping top graduates become excellent teachers in challenged schools, committed to leading in their classrooms and overcoming the obstacles of deprivation in order to increase the access, achievement and aspirations for the thousands of young people that lack the opportunities that many others take for granted. Long-term, the goal is to develop Ambassadors into leaders who will create the systemic change necessary to improve these statistics in a national scale.

Teach First combines excellent initial teacher training with volunteer coaching, networking opportunities and a bespoke leadership development programme. Teach First believes that by giving exceptional graduates the opportunity to teach and make a difference in the most challenged schools, it is equipping tomorrow’s leaders in all fields with the motivation, skills and understanding to address educational disadvantage at all levels.

In partnership with supporters in both education and business, participants work to achieve Qualified Teacher Status during their first year as well as ‘learn to lead’ through the combination of leading the learning of their students, and the additional leadership development training. The skills the teachers acquire and practice over the two years are aimed at developing leadership so they will be successful whether they choose to stay in the classroom or pursue a different path. Components of the programme include: training on strategy/marketing/finance, skills workshops and master classes, coaching, and networking events.

After two years, the Ambassadors (alumni) choose either to remain in schools or move into other sectors in which they have the opportunity to use the experiences and insights they have gained in teaching to inform future decision-making in a way that will positively impact education. As of February 2009, 55% of Teach First Ambassadors remain in teaching, with 57% of these currently moving quickly into school leadership positions.

Almost two-thirds of those Ambassadors who move into other sectors continue to stay involved in the Teach First mission through pupil mentoring, school governance or undertaking other school support positions.

The Leadership Development Programme is currently under review and from 2009 onwards will focus on three key areas, Leading Learning, Leading People and Leading Organisations. These three areas will lead to a Master’s level qualification. Each strand will have tailored core and optional experiences to develop the learning of participants and apply it to the school and other contexts. Teach First works with a range of high quality providers and consultants to deliver the bespoke training that is offered across the country.

### **Girls and MST : mentoring, promo-teams VHTO (WITEC) (NL)**

This initiative run by VHTO which is also the national coordinator of WITEC (Women in Science, Engineering and Technology in European Countries) can also be seen as a mentoring or tutoring initiative such as the promo-teams and the mentoring activities. See full description in 3.10. below!

### **3.10. Women in scientific jobs**

#### **Promoting girls in MST, VHTO (WITEC) (NL)**

VHTO, a National expert organisation on girls/women and science/technology makes an effort - in many different ways - to increase the involvement of women and girls in technology education, the technological employment market and government policy. VHTO has a great deal of (quantitative as well as qualitative) data about female technology students and engineers, and up-to-date expertise about technological education and fields of employment. VHTO employs this expertise (among other things) to realise improvement in the following areas:

- Quality improvement and expanding the allure of technology education;
- Supporting junior female engineers and assisting them in their career development;
- Support in the recruitment and career policy of the technological business community;
- Improving the connection between technology education and the knowledge and interests of girls in secondary education.

As a result of being the national coordinator of WITEC (Women in Science, Engineering and Technology in European Countries) VHTO is able to set up and test initiatives in the field of women and technology with transnational partners. Participation in this European network offers possibilities for translating foreign renewal impulses to the Dutch education & employment market.

VHTO is organising the following activities:

- Speed dating: young girls of about 15 about to make a choice in secondary education, talk with female professionals in science and technology.
- Promo teams: universities involve female students when organising public information and recruitment activities in S & T.
- Mentoring: a woman with broad work experience (mentor) is linked to someone with little experience or to some still in training (mentee).
- Work shadowing: one or more female secondary school pupils or students are taken to the workplace by a female professional.
- Visiting lecturers: they go to schools to give lectures about S & T.
- Equilibrium. This publication concentrates on the combination between worktime and private life time.
- Employable' is a research project on careers of male and female engineers.

For further information: <http://www.vhto.nl/>

#### **The Swedish Network Women and Mathematics (SE)**

The aims of the network Women and mathematics in Sweden are: to create contacts between those who are interested in women's/girls' conditions in studies or research of mathematics to spread information on projects and research about women/girls and mathematics, to suggest speakers

(preferably female) in subjects concerning women and mathematics and to be a national sub-organization of IOWME (International Organisation of Women and Mathematics), (Grevholm, 1991).

After ten years of activity in the network some additional aims were formulated in 1999:

50 % girls in all mathematics courses at upper secondary school, 50 % women in mathematics course at university level, 50 % women among the doctoral students in mathematics, more researcher education programmes in mathematics education must be developed, 40 % women among the senior lecturers at university, five female professors of mathematics. All textbooks at all levels should be inclusive for both girls and boys. All teachers should get in development work and competence development experience from gender perspectives in mathematics education.

The Network Women and mathematics has placed the issue of gender and mathematics on the agenda in Sweden and it contributed to making women visible in mathematics (i. e. video, TV-program) worked on raising awareness of research results on gender issues. It created lasting documentation on gender and mathematics ( i. e. five conference books) and proved that women are there and are willing to contribute in mathematics. It also inspired research and essays by students and teachers on gender issues.

The network is one long-lasting intervention programme and must be visible and active. Such a programme is one possible efficient way to implement research into practice, express criticism and create action and activity based on research. The evidence that supports this claim consists of the collaborative work of many women over a long period of time. It is the efforts of many teachers and women in education over many years that create the success of the network.

All the initiatives and actions are taken by members in the network. A sixth conference took place in 2005 with still more research presentations than before. A group of four younger women was elected to lead the network as the founders withdrew. The next conference will be in 2008. New members register regularly in the network. The international Newsletter of IOWME is distributed regularly.

For further information: <http://www.mna.hkr.se/matematik/kvinna/english.html>

### **The ROSE research study**

(see under research)

### **3.11. Projects involving cities, regions etc.**

The Ariane cities project (a.o. FR) <http://www.villes-ariane.org/>

The Communauté des Villes Ariane (the community of Ariane cities) is a network of about twenty European cities involved in the ARIANE programme. The purpose of the Network is to promote education and training in Space activities by:

- facilitating interactions between those involved in secondary, vocational and university training,
- encouraging the development and dissemination of new teaching methods,
- stimulating students' curiosity and interest in scientific disciplines and encouraging them to choose these study options,
- enabling students to meet and interact with the relevant education authorities.

### **Different activities set up:**

Intercultural Seminars that have already become a tradition ( this year end of March). The 30 young participants from across the nine cities can visit the EADS facilities, visit Paris and continue learning about the importance of European cooperation in space.

Scientific Holidays for high school students in Toulouse. These Holidays bring together 25 high school students from 9 Ariane cities for a very successful programme of scientific and intercultural activities. The full-day visit to the Cité de l'Espace (Space city) is one of the highlights, as it provides an ideal learning experience on space science, engineering and applications.

Summer School for aerospace engineering students and young professionals is a four-week course bringing together students and young professionals from the nine cities. The course focuses on the next generation launchers for Europe, as well as their ground facilities for propulsion testing and launch. The syllabus starts with one day of intercultural training and team building exercises, and takes advantage of the space propulsion test range at Lampoldshausen and the availability of expert lecturers from Arianespace, CNES, DLR, EADS-Astrium, ESA, SNECMA/Safran, and the Universities of Bremen, Liege, Toulouse and the International Space University.

The "REVA internet portal project" is the virtual platform for meetings, data sharing and dissemination for REVA: *Réseau Educatif des Villes Ariane* (Ariane Cities Education Network).

### **Municipal Maths education supervisors (ambassadors), (SE)**

To support teachers and coordinate all the positive forces promoting better maths learning and teaching, it was decided to launch in Sweden a network of municipal maths supervisors composed of experienced maths teachers called Matematikutvecklare. They are not inspectors but have to be seen more as pedagogical advisors for maths. The network is the responsibility of the municipalities.

The supervisors or ambassadors are selected and appointed by the municipality with the clear mission to promote maths education and to support teachers of maths at the level of (action-) research and development work. The development work they do is seen in the long-terms and thus doesn't have a short term approach. They may be exempted part-time of teaching or not as this depends upon the decision of the municipality for which they work. Maths supervisors have to attend 3 conferences (two two-day conferences and a one-day conference: 5 days in total) a year as training when they become maths supervisors.

They are involved in the following activities: share and disseminate good practice and experience amongst maths teachers, be involved in Research and development work in Maths and develop the network of teachers at municipal level. Some of them are also actively involved in Learning study/Lesson study activities to promote professional development of teams of teachers in schools. They are supported by a website: <http://www.matematikutvecklare.se>

Each municipality has also received a set of support materials – books and manuals – that can support the work of the Maths supervisors. It gives the supervisors information/knowledge about actual research and development work and projects in maths. It gives possibilities to share experiences about development work in mathematics. It gives to the maths supervisors examples of how to plan, implement and evaluate development work.

It contributes to create and develop networks on a local, regional and national level. They are aimed to be a link between schools in the municipality, the university, the university college, teacher education institutions. There are 22 such centres in Sweden and they get funding from National Agency for School Improvement to support the supervisors.

In each municipality there is a local educational authority and a head of the local educational authority. These heads usually have their own networks in which they discuss issues concerning school. There are about 20 such networks in Sweden. The heads of the local educational authorities and the networks are informed during a personal visit of representatives of NCM so that they can give a good support to the supervisors.

### **3.12. The evaluation of Innovative pilot projects**

#### **Mid-term review of the Dutch Delta Plan Science and Technology**

A midterm review of the Delta Plan Science and Technology was carried out by Organisatie- en Adviesbureau B&A Beleidsrendement. independent audit commissions evaluated each of the sub programme . Afterwards a global review was also made This showed the strategies applied to be successful overall but it also showed that in certain areas the targets were not (yet) achieved. The review also showed that the Platform itself is the right structure to help to implement such a major plan to promote science and technology. Key is the sustainability of the efforts in the future once the plan comes to an end.

Based on this review new key elements are focused upon for the final two year of the plan:

- The professional development of present and future teachers;
- Turning schools into learning organizations;
- Enhancing the mobility of science teachers from secondary schools to higher education,
- Offer research possibilities for science teachers of schools for some years;
- Attracting more girls into science and technology studies / jobs and
- Promoting science and technology with students of migrant / disadvantaged origin.

#### **The evaluation of the Main à la Pâte Initiative: a comprehensive grid (FR)**

The Lamap has developed an evaluation grid to be used to observe the way in which the teachers apply in science education the inquiry-based science education approach in their classroom. The evaluation grid is used to measure the impact of the monitoring and support put in place by the 15 resource centres of Lamap to help teachers implement the IBSE method. the final objective of the use of this grid is to see to it that the resource centres get information to improve the support and monitoring they give to the science teachers and the schools.

As mentioned earlier the 15 resource centres give different kinds of support and monitoring to science teachers: they organise in-service training, they give individual support to teachers in the classroom, the give support over the Internet or there is support by scientists also in the classroom. Furthermore the teachers receive several kinds of resources: pedagogical documents, kit on certain themes of the science programme. It is expected that after 3 years of monitoring and support 75% of the teachers in one geographical area will use and apply the IBSE approach.

When an evaluation tool had to be developed to assess the way in which the teachers applied the IBSE approach it was decided to use an observation grid and not a questionnaire. The tool had to be sufficiently simple so that many observers could easily use it. It had to be specific enough to be able to distinguish between the IBSE approach in a class and other ways of working. The grid was developed by the team of the Lamp in close cooperation with academic representatives of the Latin American country, Colombia, plus representatives of the Lamap resource centres.

A pilot grid was developed and tested in 22 classes by a dozen of observers, two per class.

The observation grid focuses on 22 characteristics to be observed and for each characteristic there are 5 levels of appreciation. As to the 22 characteristics 4 focus on the contents of the classroom session, 3 focus on the material and the infrastructure in the class available, 7 focus on the activities

of the teacher, 4 on the activities of the pupils and 4 on the written work or traces produced by the pupils in the special cahiers of logbooks they use individually or in group. The 22 items are grouped into 6 large categories and a weight is assigned to each of those.

Between 2002 and 2007 some 60% of the teachers involved in the Lamap activities have benefited from this evaluation exercise with the grid. The results show that many teachers successfully apply the IBSE approach but that further attention is required in specific areas.

For further information: <http://www.lamap.fr>

### **Evaluation of the first strategy for MST in Norway**

The second MST Strategy: "A Joint Promotion of MST" in Norway 2006-009 was developed taking into account the conclusions and the recommendations of the **evaluation of the first strategy** carried out by an external independent consultancy company, Ramboll Management. This evaluation looked at the following elements: the impact, the relevance, the way in which the 1<sup>st</sup> strategy had been implemented and the utility and the sustainability of that strategy.

As to the impact the evaluation report stressed that there was no baseline to start from, that there was no clear goal structure and that there were no indicators mentioned in the strategy to measure the effect. The impact on the teachers was also found to be limited probably due to the low level of teacher qualification as to MST. The evaluation, however, pointed at the fact that many teachers wanted to specialise in MST and update their qualifications. It also highlighted the insufficient recruitment of MST teachers and the lack of urgency by school heads and school owners (the municipal or county authorities) to deal with this problem. The evaluation pointed out that the more the teachers are motivated for MST (by being better trained in MST) the more motivation is created with the youngsters'.

As to the relevance the evaluation pointed out that initiative set up within the 1<sup>st</sup> strategy are relevant but it revealed that the goal structure was too complex. There was too much focus on outputs and not enough on the possible impact. It showed that the absence of indicators made it hard or impossible to measure what had been achieved.

As to the implementation of the strategy and the way in which the plan was governed, the evaluation pointed out there was an impressive commitment of all the stakeholders and there was a relevant organisational structure. It showed that not enough use was made of result based management and the governing signals had been weak. Reporting proved to be rather superficial and that not enough attention had been given to follow-up activities during the implementation.

As to the utility and sustainability the evaluation pointed out that there was a lack of documented results. Hence it was difficult to show the utility and to pinpoint elements that proved that the changes brought about were sustainable towards the future.

The main specific recommendation of the evaluation was to focus on the further qualification of teachers as the better the teachers are qualified the more impact they had on motivation and attitudes as to MST learning with themselves and with the pupils. The main general recommendation was to focus on more measurable goals and to have less goals overall in such a strategy plan. Better documented results and outcomes had to be more clearly communicated to all stakeholders which would also contribute to sustainability. It was also suggested towards the future to work with performance management based on clear indicators.

**Performance management** starts from the impact expected or wanted, defines the results, focuses on the output and only then sets up and implements the activities to reach the impact expected. Too

often policy plans start from the activities and go the other way around. Performance management can be either evidence-based or based on presumptions or a combination of both.

The 7 steps of performance management are: establish impact goals, establish a theory of change, develop indicators, set up monitoring measures, organise monitoring reporting, schedule evaluation, and finally focus on clear reporting towards all the stakeholders.

### **The evaluation of the Plan of Action for mathematics in Portugal (PT)**

There is NO external evaluation by external experts that are not actively involved in the activities. However several self or internal evaluation activities are carried out:

- Each of the schools involved has to draft an annual report taking into account guidelines given to them;
- The AT teacher makes a synthesis of his or her 15 school reports highlighting key elements;
- The regional reports of the AT are read by the AC
- The AC draft a national report with findings and recommendations for improvement.

Most visible effects are:

- The cooperation between the maths teachers involved in the teams of success;
- The various forms of collaborative work between teachers leading also to the joint production of materials;
- The spreading from this innovative approach from maths to other subjects;
- The motivation of the maths teachers to contribute to innovation;
- The increase in motivation for and interest in maths of the teachers.

The AT found out through the contacts with the schools that the following strategies and practices seem to be progressing in the framework of the plan for maths education in the schools involved:

- There is more focusing on problem-solving activities;
- Much more focus is also given to investigation approaches;
- Games are used to make maths more attractive;
- Maths is integrated into project work;
- Computers are more actively used to promote maths education;
- Interactive boards are also more used;
- All sorts of manipulations are integrated into the maths lessons.

The internal evaluation by the AT together with the schools revealed some weaknesses:

- The lack of clear indicators to assess what is happening;
- The lack of time to innovate as teachers involved do this on top of their normal workload;
- The pressure of the need to cover the programme;
- Teachers do not know how to use new methods, equipment and approaches
- There is not enough time and opportunity to get more in-service training on the new approaches and methods;
- The universities and 'politécnicos' do not prepare the teachers well to work with new methods and approaches;
- Not enough information and training is given in advance to the maths teachers involved;
- The unsatisfactory role of the teachers involved;
- The lack of support given by some of the AT teachers

## **Evaluation of the experimental science teaching programme in Portugal (PT)**

There is both an internal and external evaluation of the experimental science teaching programme for the elementary school. The internal evaluation takes place involving all the stakeholders. The external evaluation is carried out by an independent evaluation commission.

The key elements on which the internal evaluation is built are the following:

- The national criteria for experimental science teaching set by the national committee;
- The observation of the science sessions in the classroom by the teacher educators;
- The filling-in of an on-line survey drafted by the national committee members
- The individual portfolio compiled by each teacher mentioning what the teacher did, what the pupils did and which difficulties they met.

The internal evaluation revealed the following strengths perceived by the science teachers

- The support of the teacher educators that contributes to improve the teachers' competences as to experimental science teaching;
- The fact that they are able to reconstruct more easily their scientific knowledge;
- The clear methodological orientation given in the didactic guides to teachers for the development of the practical experimental science work;
- The methodology used as it improves the knowledge of real situations in which experiments can be carried out;
- The usefulness of the national criteria given to assess the science teaching as they enhance critical reflection on science teaching;
- The project has a positive impact on the quality and the number of experimental activities they carry out in the science classroom.

The following weaknesses were revealed by the evaluation

- The difficulty to build groups of teachers' mobility of teachers across schools is too high;
- Poor help given to the schools and teachers by the regional directions of Education (DRE)
- Delays in the distribution of the didactic guides, resources and the didactic equipment
- The difficulty to organise the plenary sessions with the teachers due to the incompatibility of timetables and the places where the meetings are organised;
- The implementation of the assessment process; particularly the constitution of the portfolio which is considered to be heavy by teachers;
- The limited financial support the institutions of H. Ed. get for their involvement.

Suggestions have been made to the Minister of education subsequent to the evaluation:

- Extend the programme to all the Portuguese regions;
- Re-conduct the programme over the next three years to enhance continuity in innovation;
- Develop more didactic guides on other curriculum subject;
- Implement a national standardization of the science curriculum;
- Evaluate the effect of this experimental science programme at national level;
- Create an on-line platform for all teachers interested;
- Accredite the teacher education network involved.

## **Evaluation of Ciência Viva and science centres in Portugal (PT)**

All the separate activities of Ciência Viva are evaluated but there is no external evaluation of the organisation itself so far. The 17 science centres have been externally assessed and separate projects are assessed external or internally. In fact all project funded have to fill in an evaluation form

and have to ask participants in their activities to fill in an evaluation form. In the case of the summer placements in research labs an annual review is held to guarantee the quality of the placements.

The question whether the activities and the work of *Ciência Viva* have an impact on enrolment in science education is difficult to answer for several reasons. The overall population is decreasing and the number of youngsters starting at the universities and the politechnicos is increasing. Some people speak of a *Ciência Viva* – effect but there is no real evidence and data to support this. A thorough study would have to be made to have hard evidence of the impact. However in some cases there is an effect. After having organised geology summer activities, the interest for those studies (which was low in higher education) has definitely increased.

### **Internal and external evaluation of the science centres**

All the science centres have their activities evaluated by the participants or beneficiaries. Evaluation sheets are developed to this effect. In the near future these internal evaluation activities will be computerised so as to have access centrally and nationally for the number of participants and possible effects of the activities of the centres. Each centre produces an annual report which can also function as an internal evaluation report. The findings of this annual report are taken into account for the organisation of the future activities.

An external evaluation has been carried out during the past two years and the external evaluation report is expected to be presented to and discussed with the science centres in the near future. The external evaluation has made use of different tools such as interviews, questionnaires, visiting the science centres and participating in a normal visit organised by the science centre. Special attention was also given to the quality of the exhibition (the scientific quality!) in each science centre and the quality of the network across the 17 science centres. The evaluation team was composed of two mathematicians and one engineer. A general report is drafted covering the activities and function of the network of centres plus a separate report for each of the 17 centres.

The written report is to be published in 2008 and will be discussed during a meeting with all the science centres. The report will especially focus on how to strengthen the networks of the 17 centres, how to better manage the resources of the centres and how to guarantee the quality of the modules and the exhibitions offered by the centres.

### **3.13. Research in science education**

#### **Research studies, projects and support**

##### **The ROSE project and recruitment to MST, attitudes and gender issues**

ROSE, The Relevance of Science Education, is an international comparative project shedding light on affective factors of importance to the learning of science and technology. Key international research institutions and individuals have worked jointly on the development of theoretical perspectives, research instruments, data collection and analysis. The target population is students towards the end of secondary school (age 15). The research instrument is a questionnaire mostly consisting of closed questions with four-point Likert scales. The rationale behind the project, including the questionnaire development, theoretical background, procedures for data collection, etc. is described in a publication available in pdf or print format: *Sowing the seeds of ROSE*.

<http://www.ils.uio.no/english/rose/key-documents/key-docs/ad0404-sowing-rose.pdf>

The lack of relevance of the S&T curriculum is probably one of the greatest barriers for good learning as well as for interest in the subject. The outcome of the project are empirical findings and theoretical perspectives that provide a base for informed discussions on how to improve curricula

and enhance the interest in S&T in a way that it respects cultural diversity and gender equity, that it promotes personal and social relevance and that it empowers the learner for democratic participation and citizenship.

The key feature of ROSE was to gather and analyse information from the learners about several factors that have a bearing on their attitudes to S&T and their motivation to learn S&T. Examples are: A variety of S&T-related out-of-school experiences, their interests in learning different S&T topics in different contexts, their prior experiences with and views on school science, their views and attitudes to science and scientists in society, their future hopes, priorities and aspirations, their feeling of empowerment with regards to environmental challenges, etc.

Particularly interesting are the findings that girls have a more idealistic profile. This means that they want to improve the world, to work in the reality of the world and to care for people. They thus are less interested in money and prestige. This shows that idealistic values should be integrated in the teaching of MST so as to create more interest with girls. More efforts should be invested in showing how the diversity of values can be integrated in MST careers. MST and related careers and jobs should be more presented as exciting and cool, as important to the sustainable development of society and as enabling women to develop themselves fully. At the moment there is still too strong a link between MST and the nerds, people interested in abstract things, disconnect from society and from the social context. To attract more girls in MST efforts have to be made to connect SMT to society and to link it closely up with the social context and societal issues that our present-day world has to face. Women in scientific careers have to be presented differently focusing on feminine characteristics.

ROSE is supported by The Research Council of Norway, The Ministry of Education in Norway, The University of Oslo and the Norwegian Centre for Science Education.

### **The PISA+ project (Norway)**

**The PISA+ project** addresses how teachers organise teaching and learning in their science class by making and analysing videos of science classrooms. The objectives are to enhance the reflection on the organisation of teaching of learning in the science classes and the improvement of those activities. The concern to link up research with classroom practice is always clearly present.

The research project was established to pursue and enlighten problematic PISA findings in the Norwegian context in mathematics, science and reading. The PISA+ project is organised as an integrated collaborative research project between junior and senior scholars at the Faculty of Education. The projects group is cross disciplinary and involves scholars from maths education, science education, language arts and general education/ didactics. The PISA+ project is based on two different sources of funding from the Norwegian Research Council.

The data is collected by video, observations and interviews. Three cameras are used: one following the teacher; one over-viewing the classroom; and one focusing on a small group of students. In addition, focused and purposive interviews with students and the observed teachers have been conducted. The informants are given opportunity to comment on the lesson videos. Each lesson is followed by a students' interview, with different students for each lesson. The teachers are interviewed about one selected lesson a week.

There are three main categories used in the general analysis with a focus on the teacher:

- the whole class instruction;
- teachers' activities during individual seatwork;
- teachers' activities during group work.

Each category is subdivided into several codes.

In this way it is possible to compare science, math and Norwegian lessons, see whether special profiles of teaching strategies for the different subjects can be found. It is also possible to give an overview of teaching strategies at the activity and organisational level in ninth grade classrooms.

After the quantitative analysis this information is used together with other observations, information from earlier studies and educational insight to do qualitative analysis closer related to each subject; science, math, and reading. Also teachers' mode of guiding students and new teaching tools; as work plans and work sessions, are explored. Both the teachers' and the students' perspective are given attention.

The analysis as to the teaching activities showed that teachers use very often dialogue instruction, questions and answer sessions and task management in a whole class instruction model. They worked less with groups within a class. The analysis also shows that teachers spend little time on summing up the knowledge acquired at the end of a learning period. They also spend little time on going over homework. The analysis also showed that there little science talk between pupils.

### **Mind the gap, 7FP project, coordination: Norway**

The starting point of the drafting of the 'Mind the Gap' project was the Rocard report "Science education now: a renewed pedagogy for the future of Europe" published in 2007. At the moment there are different gaps in science teaching and learning: the gap between theory and practice, the gap between teaching and learning, the gap between research policy and practice, the gap between educational policy and in-service teacher training and the gap between cognitive demands and available resources.

The project will gather, exchange, develop and disseminate good practices in inquiry-based science teaching (IBST). IBST wants to promote authentic and problem-based learning attitudes, hands-on activities, self-regulated learning sequences emphasizing student autonomy and discursive argumentation and communication with peers talking science.

IBST refers to learning and instruction design that engages students in authentic problem-solving activities that pay attention to diagnosing problems, integrating experiments, distinguishing activities, planning investigations, researching conjectures, searching for information, constructing models, debating with peers and formulating coherent arguments.

The overall aim is to stimulate a more engaging and interesting science teaching based on principles of IBST so that more young people in general, and girls in particular, wish to pursue education and careers in science and technology.

The following aspects are addressed in the different work packages:

- Frameworks for IBST: national educational policy and IBST, scientific literacy, the role of teachers, students and curricula as to IBST;
- Scientific literacy in IBST: bridging the gap between policy and teachers; focus groups involving parents, teachers and politicians will be involved;
- Communication and argumentation in IBST in the classroom; good practice in some countries; the use of socio-scientific issues in science teaching;
- Investigating ICT tools for IBST;
- Dissemination of the outcomes and professional development of teachers; models for teacher professional development at work.

## **Research support structures**

### **The National Research School for doctoral students in MST of Norway**

The activities of this recently created National school or research are a.o. contributing to goal C of the MST strategy in Norway: viz. The development of MST in higher education and in research.

The National Research School for doctoral students in MST in Norway has been set up at the University of Oslo in close cooperation with the national Norwegian research network.

One of the reasons for creating this National research centre was the fact that many MST teachers that teach at teacher training colleges of the university colleges do not have a PH.D. As mentioned earlier the absence of PH.D. makes it impossible to set up Master courses in those institutions of higher education. Measures have already been taken to do something about this as the government has made available scholarships to university college lecturers to get a PH.D. at the University of Oslo. Through the activities of the National Research School of Norway it is hoped to increase the interest for and the quality of MST teaching and learning

The National Research School intends to bring expertise together available in different universities in faculties of education and in faculties of sciences. Candidates from across Norway are able to take a PH.D. at this national research school. They are brought together for courses and other networking activities. The students can get funding for three years. At the moment there are 10 PH.D. students in science and 10 PH.D. students in maths. There is definitely a potential to have more students as some 30 students – mostly teachers or teacher trainers – are interesting in studying at the National Research School. They would leave their teaching jobs for the three years of the PH.D. in special circumstances it can be extended to a four-year period. The students do not have to be necessarily involved in the doctoral programme of the university of Oslo to be allowed to the National Research School of Norway which is located at the University of Oslo.

### **3.14. Science promotion initiatives for the large public**

#### **Science in summer. in Portugal (PT)**

The organisation of Science in summer activities is part of the National Scientific Awareness Campaigns to stimulate and provide the opportunity for personal contact with science specialists and institutions in the different fields. These initiatives are free and open to all, with a focus on practical activities, providing active observation and interaction with specialists from relevant fields. Ciência Viva (see separate information) is in charge of it! Initiatives are run during the summer from the 15th of July to the 15th of September across different regions of Portugal in close cooperation with NGOs, local authorities, institutions of H.Ed etc. The only thing to do is that participants are invited to register in advance so that the organisers know how many people will turn up.

These initiatives focus on various topics:

- Astronomy: 35 institutions are involved organising all together some 292 activities annually ; these are mainly night observations and solar observations during the day;
- Geology: 37 institutions are involved in 181 activities annually; these may take the forms of geology in the city, field trips; they have had an effect on more students taking geology in higher education;
- Biology,: 49 institutions are involved in 169 activities annually; activities maybe fieldtrips, sea trips, sea observations, bird counting etc.
- Engineering: 18 institutions are involved in 51 activities annually; the activities consist of visits to dams, telecommunication installations and antennas, shipyards etc.
- Visits to lighthouses in cooperation with the Portuguese Navy.

### 3.15. Support structures

#### The Netherlands

##### **The Platform Bèta Techniek (Science and Technology) (NL)**

The implementation of the Delta Plan Bèta Techniek is the responsibility of the Platform Bèta Techniek since 2004. The Platform was commissioned by the government, education and business sectors to ensure sufficient availability of people who have a background in scientific or technical education. It is in its structure a Foundation which is a non profit organisation implementing the policy decided by the government. The aim of the activities of the Platform is to achieve a structural increase of 15 per cent more pupils and students in scientific and technical education and to use existing talent more effectively in businesses and research institutes. The aim is not just to make careers in science more appealing, but also to introduce educational innovations that inspire and challenge young people. The Platform therefore targets schools, universities, businesses, ministries, municipalities, regions and sectors. The objective is to ensure that the future supply of knowledge workers will meet the future demand. It will exist from 2004 to 2009.

It is not simply about 15% more beta technicians. It is about working to create talent for the future: more beta technicians who have broader competencies, and increased affinity with science and technology in the entire population. It is also about more effective deployment of the talented professionals already in the job market. Particular attention is paid to women and ethnic minorities. A broad approach is needed. The approach is divided into the 5 subprogrammes outlined in the compendium: see the description of the Delta Plan Science and technology (NL)

<http://www.deltapunt.nl/>

The focal point are the clearly targeted agreements with different kinds of institutions: with primary schools (1930 involved in April 2007 ; 2500 in 2008), 250 general secondary schools (Universum- en Jet-Net schools) 47 lower secondary vocational / technical schools (target 100-150 in 2008); 10 upper secondary vocational / technical schools (target 30) and all universities and universities of applied sciences with science and technology departments. Agreements are also target an increasing number of industrial sectors and companies. All of them have to integrate the strategy of the Delta Plan on Science and technology in their institutional policy. For 2007 the Deltaplan Bèta Techniek could dispose of 58,3 MIO EURO. Partly ESF funds. 60 MIO EURO are also available (2006-2009) for the professional development of teachers and for improving facilities in secondary education.

To reach its objectives the Platform builds on a well structured cooperation between the government (o.a. Ministry of education and science), education & training and the world of industry. The platform is the 'middleman' the spider in the middle of the web, the stimulator and catalyst to see that the objectives of the Delta Plan are reached.

A midterm review was carried out by independent audit commissions for each sub programme . This showed the strategies applied to be successful. Based on this review new key elements are focused upon for the final two year of the plan. The professional development of present and future teachers; the mobility of science teachers from secondary schools to higher education., research possibilities for teachers; attracting more girls into science and technology studies / jobs and promoting science and technology with students of migrant / disadvantaged origin.

The Platform is investing in the final phase in enhancing the sustainability of what has been set up once the Delta Plan comes to an end (2008-2009). A final review is scheduled also at the end of the Delta Plan Science and technology.

## France

### A support team and 15 resource centres for La Main à la Pâte

In order to realize this objective, the Academicians have also the support of a team of around **fifteen full time persons** (Lamap team), of a Scientific Council composed of outstanding persons of research and education, and of a Committee of partners which is intended to give ideas and financial support to the action of the Académie.

From the beginning, a number of partners were sought, **actions** were initiated and tools created. At the same time, stimulating relations have been established with foreign colleagues working in the same vein, thus leading to collaborations and enriching comparisons. On all these points the Académie has contributed greatly to the progression of these ideas and to the facilitation of contacts between the partners in the operation.

The creation, development and implementation of **15 pilot resource centres** is very important for the support which is given to schools in implementing La Main à la Pâte. They organise training, they go into schools to help teachers, they can welcome teachers and their pupils in the resource centre to do experiments. They can also cooperate with the pilot schools to disseminate the innovative inquiry-based pedagogy towards other schools.

The representatives of the 15 centres also meet on different occasion to share experiences and strengthen their work the schools. The resource centres are also strongly cooperating with the local authorities that in some cases support the centres by giving them financial support for the equipment; All of them are linked to other local partners such as institutions of higher education, research centres etc. to strengthen their activities.

### Cité de la Science et de l'Industrie, la Villette, Paris ;

The activities of the Cité de la Science et de l'Industrie are a good example of scientific cultural mediation. The objective of scientific cultural mediation is to make science and scientific culture more accessible to all layers of the public ranging from pupils, youngsters to all groups of adult learners. It organises different activities. <http://www.cite-sciences.fr>

*The Villette classes*, allow a primary or secondary class to spend a week devoted to the study of a scientific or technical topic in Paris. The stay is spent mainly in La Cité des Sciences (min. 4 half-days) and also enables the classes to make use of the scientific and cultural resources of the Paris area.

*The international classes La Villette « Sciences in French »* are organised for foreign pupils (15 - 19 years) who have learned at least for 3 years French at school. The four day event enables pupils to implement a pedagogical project, in French and to work in an interdisciplinary way. Such classes give the opportunity to pupils to meet other pupils from other countries and to set up a real linguistic and cultural exchange focusing on scientific themes .

The teacher of the visiting pupils attends a four-day preparatory session and builds the programme of pedagogical activities with the mediator in charge of the specific theme to be addressed. This visit enables the teacher to discover the permanent and temporary / special exhibitions on various themes. Teacher can chose the way in which work will be done with their pupils so that they can well prepare and follow-up the work of the pupils during their four-day stay at the Cité La Villette.

The objective of the Villette discovery classes is to have pupils learn in an environment where plenty of resources, information and support are available. It contributes to the development of the autonomy of the pupils and it stimulates their interest and curiosity. Experience shows that motivation is largely increased for science and technology when they are confronted with science and technology in a creative and very often playful way.

**The Villette project class** enable teachers to work on a theme of their choice or on an experimental topic proposed by the Cité des Sciences. A project class requires a special commitment of the teachers and is a particularly rich teaching adventure. The project classes last four days: two days are standard for all pupils and the other two days take into account the wishes of the teachers. The teacher attends a preparatory session to build the programme with the mediator. Thus the class links up with the pedagogical project the pupils are working on at school.

**The project Cité en alternance (City in alternation)** targets pupils and their teachers of classes of the lower secondary schools (colleges) in an education priority area (ZEP- disadvantaged schools) near to the Museum. Alternating work in the museum and work at school pupils acquire knowledge, skills and attitudes while getting acquainted with a place of scientific and technical culture. Teachers discover the resources, try out pilot activities and acquire varied methodological tools to build their own project. The project has extended successfully gradually since 1997. The pupils registered benefit from an individual subscription to the City of sciences and of industry: they come either with their professors during school time, or on an individual basis out of school time.

## Sweden

### **The National Centre for Mathematics Education, NCM**

NCM of the Göteborg University, is the Swedish national resource centre for mathematics education. Its main task is to support the development of Swedish mathematics education in pre-school, school, and adult education. Its major target groups are thus practising teachers and teacher trainers in mathematics education at all ages including adult education.

It has a major website <http://ncm.gu.se> of which the aim is to make available valuable resource for teachers, teacher trainers, researchers and young students to enable them to provide concrete and continual support that can be a tool in the day to day work

An important part of NCM's work is the journal **Nämnamnaren** (Denominator) and the related series of books *Nämnamnaren TEMA*). *Nämnamnaren* is a gigantic virtual staff meeting where teachers can exchange ideas, good practice, reflect on maths teaching and learning etc. Everybody can contribute to this journal based on his or her practice or research. The NCM also publishes the mathematics journal *Normat* (Journal of Nordic Mathematics). In addition to these journals the NCM publishes reports, reviews of research and support material. The NCM runs the Kangaroo competition to promote maths.

NCM takes part in planning and contributes to exhibitions and lectures, especially in the **biennial mathematics events at national level**, as well as other conferences. Biennials are arenas where teachers meet, discuss, exchange ideas and good practice and listen to researchers. In between the Biennials involving 3500 to 5000 teachers smaller biennettes are held at regional level. NCM's assignment from the government also covers initiatives for adults learning mathematics.

NCM undertakes assignments if they are part of planned long-term development measures in schools and municipalities. It cooperates with the National Agency for School Improvement, universities, university colleges, the municipalities and individual schools is intense and developed continually. NCM is strengthening collaboration with and between the national network, organizations,

associations, committees and those concerned with the environment who can contribute to the development of Swedish maths education

The NCM is cooperating with top representatives of the Swedish industry about the support and cooperation on the development of mathematics education in Sweden. The activities are linked to the ERI, the European Round Table of Industrialists.

NCM also has a very extensive international network of researchers and institutions in mathematics education around the world.

NCM's reference library on the literature of mathematics education contains more than 5 000 volumes and 80 journals. Information is also provided on a regular basis about new acquisitions and journals with brief descriptions of the content of current articles.

### **Nordic Graduate School in Mathematics Education (NoGSME),**

NoGSME is an independent organisation that works in close cooperation with other organisations such as NCM to improve maths education.

Its aims are:

- To support and develop education of researchers in maths education in Nordic and Baltic countries;
- To create constructive cooperation to raise the scientific quality of research in maths education;
- To give doctoral students in maths education access to the activities of the Graduate School;
- To create cooperation among a greater group of doctoral students and supervisors in order to share experiences and opportunities to improve the education of researchers. This even after the five years of the Graduate School.

The Nordic Graduate School in Mathematics Education is involved in the following activities:

- Common courses created with the added competence from all researchers in the Nordic countries and international partners;
- Summer schools building on earlier good experience from similar arrangements;
- Seminar-series in specific research areas as a complement to local series and workshops on subjects or issues of main importance;
- Competence development for maths supervisors and exchange of experience;
- Partnership and collaboration with distinguished international scholars;
- Creating a database for ongoing work, theses and greater development work in maths education;
- Granting mobility stipends and special financial support for doctoral students.

It is also cooperating with the other National Graduate Schools as the Finnish Graduate School in mathematics and science education, the Swedish Graduate School in mathematics didactics 2000-2006, 21 doctoral students were taken up, 8 has finished so far, the Danish Graduate School in mathematics and science education started 2004.

The Nordic Graduate School is situated at Agder University College in Kristiansand, Norway and financed by NordForsk 2004-2008

### **NAVET (The Hub) or Science Centre in Borås**

The NAVET centre shows how a science centre can contribute actively to increase the interest in and motivation for mathematics with children in compulsory education.

Navet is the natural science centre of Borås - an inspirational place containing masses of enjoyable experiment stations that are both instructive and exciting for adults and children alike!

Within the NAVET (HUB) Science Centre a special area - Bagdad - is dedicated to maths. The visit of school children is composed of a pre-assignment given to the pupils before they come to the centre, when they arrive there is a drama played by the staff and then during the visit there is all sorts of mathematical games in which they are the active players. The variety of games is very large to stimulate the interest and the use of various skills with pupils.

The schools can also take back to the school boxes with further pedagogical material related to maths and science which then they can use once they are back in their classroom. The Centre also works with The initial teacher training department of the regional university college, Högskolan Borås, and with in-service teacher training centres. NAVET also has a travelling exhibition that can go to schools.

[http://www.navet.com/information\\_english.html](http://www.navet.com/information_english.html)

### **Norway**

#### **The Norwegian Centre for Science Education**

The centre is a national resource centre for science education (SE) (kindergarten, primary and secondary school, adult education and teacher training). The vision can be summarised in the following key word IMEN (seed): Kompetense (Competences), Inspirasjon (Inspiration), Engasjement (Engagement / commitment) and naturfag (sciences). The word KIMEN also stands for the 'Budding' scientists which can be supported at different levels of the education system.

Its main objective is to enable pupils and teachers to consolidate competence and motivate interest in natural science by developing and improving content and methods through research, experiment and development projects. The centre contributes to actions aimed at increasing the recruitment to scientific and technical studies. It seeks contact with societies of science education on a national, Nordic and international level and has an important research group focusing on MST issues.

Its target groups are teachers of natural science in primary and secondary education and teacher training, students, researchers, and developers of teaching material in topical fields.

It cooperates with universities, university colleges, museums, primary and secondary schools and industry. It leads and coordinates activities to develop working methods, content and examples of teaching material which contribute to make natural science education diversified, exciting and alive to pupils and students. It contributes a.o. to developing and testing computer based learning materials and to organizing web based learning environments in natural science.

The centre contributes to disseminating results from research, experiment and development projects through periodicals, websites, annual conferences and seminars of teachers, science ambassadors that disseminate innovation in science education. The centre is involved in the development of in-service training and further education. It helps to develop positive attitudes and a thoughtful view of natural sciences in society. It assists the Ministry of Education and Research and the Directorate for Education and Training with advice when it comes to curriculum development and pupil assessment in natural science. It collaborates with other national centres and advisory councils to see to it that

science work is coordinated in a good and functional way. It promotes equal opportunities in natural science education.

The centre is localized at the Faculty of Mathematics and Natural Sciences, at the University of Oslo. Website: [http://www.naturfagsenteret.no/mandat\\_en.html](http://www.naturfagsenteret.no/mandat_en.html)

### **The Norwegian Science Centres**

Seven science centres have been or are being developed across the different regions of Norway to support science learning and teaching. They are an explicit element of the strategy to promote MST across Norway especially as to goal E of that strategy: Increase the MST competence and improve the communication to the general public. The science centres are to work locally and to cooperate and network nationally.

The main objective of the science centres is to make science more accessible not only to young people but also to the large public. The focus is on communication about science through exhibition that can be visited by various target audiences. More and more the science centres cooperate with museums so as to put science in a cultural and historical perspective. All the seven science centres also run in-service training courses for teachers to support them in the teaching and learning of sciences.

As the science centres are part of the overall strategy for the promotion of MST a clear indicator has been worked out stating how during the strategy for MST the numbers of visitors to those centres have to be increased. The visitors should have been increased by 20% over the period 2006 – 2009 but already after one year the increase of visitors had reached 30% which was beyond expectations.

They are funded by the local government and private companies and get support from the Ministry of Education and Research and the Ministry of Culture and Church Affairs. The contribution of the Ministries is limited so that other activities have to be developed to generate extra income.

### **The Norwegian Centre for Mathematics Education (NCME)**

The NCME primary task is to lead and coordinate the development of new and improved working methods and learning strategies in the maths education, from kindergartens through teacher education in Norway. It also contributes to a Nordic cooperation.

Its primary targets are first and foremost teachers teaching maths in schools and teacher education, teacher students at Colleges and Universities and teaching aids developers. In order to build a general positive view at maths, parents, media and the public are also important targets for its activities. It addresses itself to children and adults of all ages.

The NCME develops various activities to promote maths learning and teaching:

- Maths clubs for small children;
- Evening classes of maths for parents;
- Public and media activities / events to draw the attention of the large public to the importance of maths in society;
- Laboratory exercises are to help teachers;
- Outdoor activities for maths;
- National test development;

- Guest lecturers are invited to the centre for one term; during their stay that are involved in various training and support activities.

The NCME works with maths resource persons that can help teachers across the country to developing new approaches to maths education. Those resource teachers are very experienced maths teachers who are not paid to do the job and who are no exempted of any classroom activities to do this supplementary job.

Website: <http://www.matematikkcenteret.no/english>

## Portugal

### The Network of 17 science centres in Portugal

A national network of Ciência Viva Centres - interactive science centres - provide the opportunity for scientific, cultural and economic regional involvement. The main aim of the science centres is the promotion of scientific culture and awareness and interest in and motivation for sciences with children and with adults at all ages.

More specific objectives are: Enable the public to talk to scientists who can act as role models; Stimulate young people's interest and motivation for science; Raise the awareness of the general public about contemporary science; Bridge the gap between science and society and Promote the choice of scientific and technological careers.

Presently there are 17 Ciência Viva Centres. Some of them already existed as museums, planetaria or science centres and have joined the network, while others are newly created centres. The development of each of the science centres in the present network has gone through three movements. A first movement was from Ciência Viva to the science centres: creating a building, developing an exhibition, establishing a programme, training their own human resources. A second movement was the creation of an identity for each science centre: their themes, their unique exhibition and their own programme. The third movement was the networking process of the 17 science centres.

**Each Science centre has a specific theme**, in accordance with the region's history, economic activity or natural characteristics. There are science centres dedicated to the forest, to astronomy, to water and energy, to geology or to the sun to blood etc.

Along with the interactive exhibitions, each science centre develops several activities aimed at schools and also several different workshops that meet their communities' interests. The exhibits and activities are developed with the scientific support of universities or research institutions that are normally partners of each Science centre, along with the local authorities. The centres really contribute to strengthening the promotion of maths and science education.

#### The 17 centres have the following common characteristics:

- A scientific board involving researchers' and scientists; the centres are based on the trilogy: Ciência Viva, universities, local authorities;
- A team composed of scientists and/or 3 science teachers paid by the ministry of education;
- The autonomy of each centre;
- Partnerships with local, regional authorities,
- Partnerships with higher education, in particular teacher training departments
- Partnerships with companies;
- Partnerships with schools (local or other schools)

- Partnerships with NGOs, associations;
- Activities open to all sorts of publics: seminars, colloquia;
- Infrastructure: an exhibition area, a cybercafé and media library accessible free of charge;
- Promotion of science centres with teachers;

The major concern is that the teachers use the science centre as a valuable support to their science lessons and to increase the interest and motivation for maths, science and technology. In no way the centres want the teachers to bring their students to the centre and leave them, so to speak, behind to be taken care of by the science centre. There must be real cooperation with the centre in which both the centre and the teacher play an active role.

In-service training courses are organised to show teachers how they can use the science centres to support the teaching of science and technology. Teachers can also visit the science centres any time as part of the preparation of a visit. At the moment the science centres do not yet work with the teacher training institutions in higher education so that future teachers are not yet made aware of the potential of the science centres.

## **Latvia**

### **VISC or the State Education Centre in Latvia**

The State Education Centre or Valsts Izglītības Satura Centrs (VISC) is a public administration institution directly subordinated to the Minister of Education and Science. The VISC has three departments: the curriculum development department (CDD), the state examination department (SED) and the Interest related and Teacher In-Service Training department (SINSET).

The functions of the CDD are : to coordinate curriculum development for basic education and for general secondary education, to provide all levels of education with in-service training, to coordinate the validation of textbooks (conformity to the standards, no gender bias in textbooks, humanitarian aspects) in secondary education and to coordinate the implementation of support systems for special needs students.

The functions of the SED are to organise and implement the state examination and test system in general education, to develop the curriculum of state examinations and organize examinations in vocational education and to organize the testing of state language proficiency which is linked to the Common European Framework of References for Languages.

The functions of the SINSET are to coordinate and provide support for the activities and development of in-service training of teachers, to coordinate the activities which are of interest to the education system and which promote the development of students' personality and talents. Every teacher is expected to attend some in-set every three years. This department also deals with out-of-school activities such as heritage activities. It thus prepares e.g. the 10th Latvian School Youth Song and Dance celebration.

The two ESF projects implemented since 2005 to promote the quality of maths and science in the basic school and in the upper secondary school are run by a special project management unit situated within the State Education Centre or VISC. In this way there is a very close interaction with the three VISC departments dealing with all the other aspects of school education.

## **The Natural History Museum of Latvia and its contribution to the MST reform**

The NHML has some 100000 visitors a year of which  $\frac{3}{4}$  are school children/students.

The Natural History Museum of Latvia (NHML) has various permanent exhibitions and several temporary exhibitions. The permanent exhibitions cover: Dynamic geology, Palaeontology, Botany, Life in the sea and Entomology.

The temporary exhibitions cover various topics and all of them have great potential to support science education on the one hand or cross-curricular topics such as environmental education in particular.

The pedagogical activities of the NHML for schools intend to support the school curriculum in close cooperation with the Ministry of Education, the State education Centre and the schools themselves. 75% of all visitors to the museum are school groups for which appropriate and adapted guided tours are developed in close cooperation with the teachers. 40 types of school guided tours have been developed. Activities are developed for children with disabilities (hearing or visually impaired).

Guided tours for children are characterised by the fact that the children are invited to be actively involved. They focus on hands-on activities, include role-playing, simulations, debated or practical research activities carried out by the students. All senses are involved inviting as children to use their eyes, taste, smell and touch.

The activities in the museum may have some follow-up session in the schools.

Exhibitions are open to school groups and to families that are invited to visit the museum during the weekends or family days.

Special trails are also created within the museum such as presently one trail about Darwin. Furthermore birthday celebrations for children can be organised in the museum during which a child and its friends visit the museum.

The students do not only come to the museum but the museum also goes to the school with the initiative "The Museum in our luggage". Museum educators go to the schools with luggage containing various elements to be used in specific lessons.

In the future the NHML wants to make educational resources even more relevant for teachers by enhancing cooperation with various agents and linking up with specific events. Thus more activities are scheduled similar to those already taking place such as bird watching, cooperation with the mycological association, activities related to Ramsar convention as to the protection of wetlands, an international day on biological diversity, bat days, the international day of the Baltic harbour porpoise, work in relation with the international trade in endangered species in fauna and flora, the animal of the year, the protection of swans etc.

Next to the activities for children there are, of course, also various activities focusing on scientific literacy of adults. Thus there are visits for adults to the storage rooms of the museum, days dedicated to mushroom as mushroom picking is a national traditional activity in Latvia, a visit "The earth, the sun and" for adults, etc. Lectures and courses are also held.

A special service within the museum is the VITILA or Latvian Environmental Interpretation Service. The objective of this service is to improve the understanding of environmental processes, to raise public awareness and to change attitudes as to the environment; To this effect VITILA has trained already 98 environmental interpreters or specialists through a specially devised training programme.

Finally some team members of the NHML also carry out scientific work in the museum.

The finances of the NHML come from the state (the Ministry of Environment), the income of the museum mainly through the tickets and the involvement in various projects such as the EU Interreg projects mentioned above.

### **3.16 Other specific issues**

#### **Authorisation of textbooks in Latvia**

There is a clear official regulation as to the assessment and approval of textbooks in Latvia. Once the new subject standards and syllabi have been developed textbooks can be developed by publishers. When the textbooks are developed they are given to two reviewers for comments. The reviewers look especially at the compliance of the textbooks with the educational standards of the subject concerned. They also use specific criteria such as the compliance of the textbooks with human rights' issues or the compliance of the textbooks with gender equality etc. When the comments are integrated by the publishers they are then submitted for the official approval. When textbooks have been officially approved they can be printed. The textbooks are valid as long as the subject standards do not change.

A special part is available in the state budget for the purchase of textbooks by the schools. In many cases the textbooks are bought by the schools and given on loan to the students. Whether the textbooks are bought or not by the school depends also upon the extra funds that the municipality is willing to give as the financial support of the state is limited for textbooks. In some cases the textbooks are bought by the parents.

Textbooks are usually approved for relatively long periods. Sixty textbooks have been approved so far for the primary or basic schools while 67 have been approved so far for the secondary school. It is important to be aware of the fact that all textbooks used from grades 1 to 9 are translated into Russian as Russian is also used as the language of education in an important number of schools in Latvia.

The Ministry of Education and Science hopes to get the financial support of the publishers when the next phase of the reform of maths and science will have to be developed and implemented. As this phase will probably have to take place without ESF funding and as Latvia is also severely hit by the present financial crises, it is hoped that publishers will be willing to invest money into the reform of maths and science from grades 1 to 6. It was also added that, without any doubt, publishers try to lobby and put some pressure on the state as to the approval of their textbooks.

#### **Assessment of student in the national state exams in Latvia**

##### **The procedure for developing the centralised state exams**

The procedure to develop the centralised state exams is composed of 7 phases: 4 to 5 experts prepare a first draft of the state exam in one subject the year before it will be used; some tasks of the central exam are piloted at schools with specialists from the state examination department; experts prepare a second version taking; other experts review the new version of the central exam; a teacher is invited to do the test of the national exam as if he / she was a student; one person makes a layout of the final version ; the central exam papers are printed one person; the central exam papers are distributed to school boards

The copies of the test of central exams are corrected by special evaluators, school teachers or university lecturers, at national level (called methodologists); 1300 in all. They get a special certificate from the VISC, the State Education Centre. This is different from the local exams which are assessed by local teachers. Each test is corrected by two evaluators. A third one may evaluate it when the difference between the two other evaluators is very large.

In the centralized examinations the educational achievements are evaluated at six levels (A, B, C, D, E, F levels, where A is the top level and F is the lowest level. The evaluation levels of the foreign languages are determined according to the reference framework of the Council of Europe. In other subjects the Ministry of Education and Science works out the levels of evaluation.

All copies of the previous tests of the centralised exam are available on the website of VISC and are definitely used by teachers to prepare the students for the state exams at the end of secondary school.

Discussions are held at the moment within the Ministry of Education and Science and within the State Education Centre (VISC) about the future of the centralised state exam. One of the possibilities is the development of a database with all possible tests accessible to all teachers and students. To this effect contacts have been made with Scotland which has already developed such a database with tests and assignments to assess students.

#### 4. Some useful websites

The websites mentioned below are directly linked to the four PLAs organised so far. They have been mentioned or referred during the different activities of the PLA.

##### Netherlands

Website Ministry of Education, Culture and Science, Netherlands (English!)

<http://www.minocw.nl/english/index.html>

Platform Bèta Techniek

<http://www.deltapunt.nl/>

Website Axis Foundation (predecessor of Delta Plan & Platform)

<http://www.platform-axis.nl/>

Jet-Net

<http://www.jet-net.nl/start.html>

Junior College Utrecht

<http://www.uu.nl/uupublish/homeuu/onderwijs/overigonderwijs/juniorcollegeutr/30984main.html>

(Dutch information)

<http://www.nnv.nl/NNV/DATA/Downloads/FYSICA2006/Ton%20vd%20Valk%20-%20paper.doc>

(Article in English)

VHTO

National expert organisation on girls/women and science/technology

<http://www.vhto.nl/>

WITEC

Women in Science, Engineering and Technology

<http://www.witec-eu.net/>

Freudenthal Institute for science and mathematics education

<http://www.fi.uu.nl/fisme/en/>

Stichting Techniekpromotie (students of TU Eindhoven promoting MST)

<http://www.techniekpromotie.nl/>

Amstel Instituut (University of Amsterdam)

Faculty of natural sciences, Maths and Informatics

<http://www.science.uva.nl/amstelinstituut/english.cfm>

Next generation Science (cooperation in sciences between UK-NL)

<http://www.britishcouncil.org/netherlands-cf-ngs-rotterdam-report.pdf>

Durven, Delen, Doen (Programme Dare, Share, Do: to support Innovation in secondary education)

<http://www.durvendelendoen.nl/>

Casimir programme (NWO) Mobility of researchers

<http://www.nwo.nl/> (Nederlandse Organisatie voor Wetenschappelijk Onderzoek) see:  
subsidiewijzer

NEMO: Science Centre Amsterdam

[http://www.e-nemo.nl/print\\_detail.php?id=5&s=85&d=551](http://www.e-nemo.nl/print_detail.php?id=5&s=85&d=551)

ESERO project of ESA

[http://www.esa.int/esaED/SEME3W59CLE\\_teachers\\_2.html](http://www.esa.int/esaED/SEME3W59CLE_teachers_2.html)

Kookdroom Foundation / Fifteen Amsterdam Restaurant

<http://www.fifteen.nl/index.php?onderdeel=fifteen&menu=82>

A Joint promotion of Mathematics, Science and Technology (MST) Strategy 2006-2009, Norwegian  
Ministry of Education and Research

[http://www.naturfagsenteret.no/Strategiplan2006\\_eng.pdf](http://www.naturfagsenteret.no/Strategiplan2006_eng.pdf)

## Sweden

The Swedish National Centre for Mathematics Education, NCM, Göteborg University  
<http://ncm.gu.se>

The official gateway to Sweden  
<http://www.sweden.se/>

The Swedish National Agency for Education,  
<http://www.skolverket.se/sb/d/354>

National Assessment and Grading in the Swedish School System  
The Swedish School System and Steering documents  
<http://www.skolverket.se/publikationer?id=1524>

The Swedish National Agency for School Improvement  
[http://www.skolutveckling.se/in\\_english/](http://www.skolutveckling.se/in_english/)

The Swedish National Agency for Higher Education  
<http://www.hsv.se/2.539a949110f3d5914ec800056285.html>

The Ministry of Education and Research  
<http://www.sweden.gov.se/sb/d/2063>

The Government and the Government Offices  
<http://www.sweden.gov.se/>

The Riksdag  
[http://www.riksdagen.se/default\\_\\_\\_56.aspx](http://www.riksdagen.se/default___56.aspx)  
Statistics Sweden, Education and Research

Webmaths  
<http://www.webmaths.com.au>

European Round Table of Industrialists  
Working group societal changes: focus on sciences and maths  
[http://www.ert.be/working\\_group.aspx?wg=102](http://www.ert.be/working_group.aspx?wg=102)

## France

The French Ministry of education:

<http://www.education.gouv.fr/>

La Main à la Pâte main website

<http://www.lamap.fr>

The PRESTE plan for renovation in science teaching and learning

<http://www.education.gouv.fr/bo/2000/23/ensel.htm>

EIST : Enseignement Intégré des Sciences et de la Technologie

[http://www.academie-sciences.fr/enseignement/guide\\_06.pdf](http://www.academie-sciences.fr/enseignement/guide_06.pdf)

The common base of knowledge and skills in France

<http://www.education.gouv.fr/bo/2007/hs6/default.htm>

Detailed information on the common base for knowledge and skills in ENGLISH:

<http://media.education.gouv.fr/file/46/8/5468.pdf>:

More information in FRENCH can be found on the following website:

<http://www.education.gouv.fr/cid2770/le-socle-commun-connaissances-competences.html><http://www.education.gouv.fr/cid2770/le-socle-commun-connaissances-competences.html>

The High Council of Science and of Technology and its opinions on the young people's disaffection for the scientific studies can be found on the following websites:

<http://www.enseignementsup-recherche.gouv.fr/conseil/hcst/index.htm>

<http://www.enseignementsup-recherche.gouv.fr/conseil/hcst/avis.htm>.

National Centre Of Pedagogical Documentation (CNDP).

<http://www.cndp.fr/ecole/programmes/accueil.htm>

The science programmes of the primary school :

<http://eduscol.education.fr/D0048/primprog.htm>

Cité de la science et de l'industrie de la Villette

Website: <http://www.cite-sciences.fr> ;

Then go to "éducation"

## **Norway**

The Ministry of Education and Research:

[www.kunnskapsdepartementet.no](http://www.kunnskapsdepartementet.no)

The Education Mirror: 2006

Analysis of primary and lower and upper secondary education in Norway

[http://www.udir.no/upload/Rapporter/Utdanningsspeilet\\_2006/The\\_Education\\_Mirror\\_2006.pdf](http://www.udir.no/upload/Rapporter/Utdanningsspeilet_2006/The_Education_Mirror_2006.pdf)

The Internet Gateway for Education : [www.utdanning.no](http://www.utdanning.no)

The Directorate for Education and Training: [www.utdanningsdirektoratet.no](http://www.utdanningsdirektoratet.no)

The School Web: [www.skolenettet.no](http://www.skolenettet.no)

The Internet Gateway for applicants to upper secondary education:

[www.vilbli.no](http://www.vilbli.no)

Mathematics

<http://www.matematikk.org>

Natural sciences (in Norwegian)

<http://www.viten.no>

Northern lights

<http://www.northernlights.viten.no>

Global warming

<http://www.globalwarming.viten.no>

Gen Technology

<http://www.genetechnology.viten.no>

Sustainable development (partnerships between schools)

<http://www.sustain.no>

## Portugal

All the Powerpoint Presentations from the PLA in Portugal can be downloaded from  
[http://www.cienciaviva.pt/download/PLA\\_PT\\_presentations.zip](http://www.cienciaviva.pt/download/PLA_PT_presentations.zip)

Education and Training in Portugal

A publication of the Ministry of Education, Lisbon, 2007

[http://www.gepe.min-edu.pt/np4/?newsId=7&fileName=education\\_and\\_training.pdf](http://www.gepe.min-edu.pt/np4/?newsId=7&fileName=education_and_training.pdf)

The general website of the Portuguese Ministry of Education (in Portuguese!)

<http://www.min-edu.pt/>

The website of the DGIDC (Direcção-Geral de Inovação e de Desenvolvimento Curricular or General Directorate for Innovation and Curriculum Development) of the Ministry of Education where specific information can be found on mathematics and sciences (in Portuguese):

<http://sitio.dgdc.min-edu.pt/Paginas/default.aspx>

Eurydice: The National summary sheet on education systems in Europe and ongoing reforms: Portugal, April 2008

[http://eacea.ec.europa.eu/ressources/eurydice/pdf/047DN/047\\_PT\\_EN.pdf](http://eacea.ec.europa.eu/ressources/eurydice/pdf/047DN/047_PT_EN.pdf)

Eurybase: The Information Database on Education Systems in Europe: Portugal

[http://eacea.ec.europa.eu/ressources/eurydice/eurybase/pdf/0\\_integral/PT\\_EN.pdf](http://eacea.ec.europa.eu/ressources/eurydice/eurybase/pdf/0_integral/PT_EN.pdf)

ALEA - A place to understand the numbers: a programme used in Portuguese schools

<http://www.alea.pt>

Ciência Viva website

<http://www.cienciaviva.pt/home/>

National call for projects

<http://www.cienciaviva.pt/concurso/>

Science Centre

<http://www.centroscienciaviva.pt>

Summer science activities

<http://www.cienciaviva.pt/veraocv/>

Census Vivo

[www.mct.uminho.pt/censusvivo](http://www.mct.uminho.pt/censusvivo)

IPATIMUP

<http://www.ipatimup.pt>

Longeva project results

[http://en.wikipedia.org/wiki/Life\\_extension](http://en.wikipedia.org/wiki/Life_extension)

and

[http://en.wikipedia.org/wiki/Elixir\\_of\\_life](http://en.wikipedia.org/wiki/Elixir_of_life)

The LUDUS project: maths games

<http://ludicum.org/>

ORION NGO: astronomy activities  
<http://www.orion.gualtar.com>

Portuguese Robotics Open  
<http://www.spr.ua.pt/fnr/>

Teacher Education Programme for experimental science teaching in the first cycle  
The six didactic Guides  
[http://sitio.dgidc.min-edu.pt/experimentais/Paginas/Recursos\\_Didacticos.aspx](http://sitio.dgidc.min-edu.pt/experimentais/Paginas/Recursos_Didacticos.aspx)

Vila do Conde Science Centre  
<http://viladoconde.cienciaviva.pt>

## Latvia

Ministry of Education and Science of the Republic of Latvia: <http://www.izm.gov.lv/>

National Education Centre (Curriculum Development and Examination Centre), Latvia: <http://www.isec.gov.lv/>

Project „Science and Mathematics” <http://dzm.lv/>

Central Statistical Bureau, Latvia: <http://www.csb.lv/>

Higher Education Quality Evaluation Centre, Latvia: <http://www.aiknc.lv/>

Museum of Nature <http://www.dabasmuzejs.gov.lv/>

National summary sheets of education systems in Europe and ongoing reforms: Latvia (Eurydice)  
[http://eacea.ec.europa.eu/education/eurydice/documents/eurybase/national\\_summary\\_sheets/047\\_LV\\_EN.pdf](http://eacea.ec.europa.eu/education/eurydice/documents/eurybase/national_summary_sheets/047_LV_EN.pdf)

Information about Latvia in the Eurydice EURYBASE  
[http://eacea.ec.europa.eu/education/eurydice/documents/eurybase/eurybase\\_full\\_reports/LV\\_EN.pdf](http://eacea.ec.europa.eu/education/eurydice/documents/eurybase/eurybase_full_reports/LV_EN.pdf)

## Action plans or initiatives per country to be found in this compendium

### Netherlands

<b>The Netherlands</b>	<b>Title</b>	<b>Nature</b>
	The Delta Plan Science and Technology	National action plan
	VTB (Verbreiding Techniek Basisonderwijs)	Primary school initiative; part of Delta Plan
	The UNIVERSUM programme: Better off with science	Secondary school initiative; part of Delta Plan
	The AMBITION programme: Backbone of the knowledge-based economy	Secondary school initiative; part of Delta Plan
	The SPRINT programme: Science and technology at top speed	Cooperation across different levels of education; part of Delta Plan
	The ACT Programme: Appealing careers, innovative businesses	Involvement of/ partnerships with companies; part of Delta Plan
	Jet-Net	Involvement of/ partnerships with companies; part of Delta Plan
	The students of the Stichting Techniekpromotie of TU Delft	Students as mentors or tutors of teachers or pupils to promote MST
	Junior College Utrecht (NL): Motivating gifted secondary kids for scientific careers	Students as mentors or tutors of teachers or pupils to promote MST
	Women in scientific jobs: Promoting girls in MST , VHTO	Girls in MST
	The Platform Bèta Techniek (Science and Technology)	Support structures

### Sweden

<b>Sweden</b>	<b>Title</b>	<b>Nature</b>
	The Swedish action plan for the promotion of mathematics education	National action plan
	Pilot project in pre-school maths (1-5 years old)	Primary school initiative
	Attracting more students in maths education in higher education	Higher education initiative
	The learning study: professional development of maths teachers	Qualified teachers initiative
	Hand-on maths / Matematikverkstad	Creative learning environments initiative
	The INTIZE initiative:	Students as mentors or tutors

	Engineering students mentoring secondary school pupils	of teachers or pupils to promote MST
	The Swedish Network Women and Mathematics	Girls / women in mathematics
	Municipal Maths education supervisors (ambassadors)	Projects involving cities, regions etc.
	The National Centre for Mathematics Education, NCM	Support structures

### France

France	Title	Nature
	La main à la pâte Innovation in MST in France	National action plan
	PRESTE , the Plan for the renovation of the teaching and learning of sciences in the primary school (abbreviated in French to PRESTE)	National action Plan
	EIST, Integrated teaching and learning of sciences in lower secondary schools	National action plan
	The MECHATRONICS project : engineering students helping VET pupils	Students as mentors or tutors of teachers or pupils to promote MST
	Scientific coaching of teachers by engineering students	Students as mentors or tutors of teachers or pupils to promote MST
	The Ariane cities project	Projects involving cities, regions etc.
	Cité de la Science et de l'Industrie, la Villette, Paris	Support structures

### Norway

Norway	Title	Nature
	The MST Strategy: "A Joint Promotion of MST" in Norway 2006-2009"	National action plan
	The Nysgjerrigerper project (Inquiry-based science teaching method)	Primary school initiative
	Nordic Graduate School in Mathematics Education (NoGSME),(SE, NO)	Support structure
	The Norwegian Centre for Science Education	Support structure

	The Norwegian Science Centres	Support structure
	The Norwegian Centre for Mathematics Education (NCME)	Support structure
	The ROSE project and recruitment to MST, attitudes and gender issues	Research in science education
	The PISA+ project	Research in science education
	Mind the gap, 7FP project	Research in science education
	The National Research School for doctoral students in MST	Research in science education

### Portugal

<b>Portugal</b>	<b>Title</b>	<b>Nature</b>
	The Portuguese Plan of action for mathematics	National action plan
	Ciência Viva , the National Initiative for Scientific and Technological Culture	National action plan / initiative
	Teacher education programme for experimental science teaching	Primary school initiative
	Scientific work with youngsters at school of IPATIMUP	Secondary school initiative
	Scientific work with youngsters in summer holidays at IPATIMUP	Higher education initiative
	The Robotics Open project in Portugal (and beyond)	Creative learning environments
	CENSUS VIVO: a different way to teach statistics in schools	Creative learning environments
	Ethno-Mathematics	Creative learning environments
	Science in summer in Portugal	Science promotion initiative for the large public

**Latvia**

<b>Latvia</b>	<b>Title</b>	<b>Nature</b>
	The Maths and Science Reform	National Action Plan
	Curriculum in mathematics and science	Part of the National Action Plan
	The development of Teacher Support Materials	Part of the National Action Plan
	In-service training of the project "Mathematics and Science"	Part of the National Action Plan
	Work with talented students: Olympiads	Related to the National Action Plan
	The authorisation of textbooks	Related to the National Action Plan
	The assessment of student in the national final state exams	Related to the National action plan
	Cooperation with universities	Part of the National Action Plan
	Cooperation with companies	Part of the National Action Plan
	Cooperation with science museum	Related to the National Action Plan
	The ESF Pilot project Implementation unit within VISC the State Education Centre	Support structures of the national action Plan