Draft 10 May 2005

Background document

For

the PLA of the MST Cluster in Sweden on Maths Education

21-24 May 2007, Goteborg, Sweden

organised by
European Commission - Directorate General for Education and Culture
Directorate A - Lifelong Learning: Education and Training Policies Unit A4 - Innovation and Transversal policies DG Education and Culture
In cooperation with
NCM, the Swedish Recource Centre for Mathematics

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Promoting mathematics education through a PLA

All European countries agree that education and research are the key to the future. Every government is looking for the "smart solutions", that are based on knowledge and innovation and have clearly adapted skills and efficient organization as a prerequisite. The ambition of all countries is to be among the best. However, furthermore all countries want to have an educational system that furthers social equality and prevents exclusion. That is not merely a moral objective, but a prerequisite for optimal utilisation of the total knowledge-based resources of every European country. This is also in line with the Lisbon strategy.

Every country wants to create a positive society stimulating continued growth and prosperity. Today we can see that society and the labour sector's need for **mathematical and scientific expertise** are on the increase but that at the same time as maths and science have become less popular subjects among school pupils and university students. This means that our educational systems is not producing sufficient mathematical and scientific expertise. This is a serious problem. **Furthermore too often the link between maths and science and the interaction of the two is not enough closely focused upon.**

Strategies have to devised and implemented to develop the necessary expertise in the population that society and the labour and industrial sector need in the mathematic, scientific and technological areas . One of the crucial areas to succeed in achieving this, is reinforcing education in maths and science in the educational systems of many a European country. **To look at the strategies that reinforce maths education is the key objective of this PLA in Goteborg from 21 to 24 May 2007. Maths education has a key role as to science education and thus requires specific and very focused attention.**

The challenges linked to maths and science subjects in the school and educational systems of many European countries have been visible for a long time. There are reasons for concern when most Western countries are recording a noticeable downturn in recruitment to various scientific courses of study. In some countries it is even more seriuos than in others.
The decrease in recruitment points to a lack of interest in mathematical and scientific subjects, not just in the educational sector, but in society as a whole and perhaps to insufficient general understanding of the importance of the subjects. It is furthermore a particular challenge that girls choose maths and science to a considerably lesser extent than boys..

Several (if not all) European governments are going on the offensive in reinforcing mathematical and scientific subjects. Previously, the focus in several countries has largely been on improving the educational system itself. **A real effort to place emphasis on maths and science to meet society's needs can only be realized through strong and close collaboration between all of the relevant parties,** where both the education and labour sector cooperate to bring about positive results. This means that not only do we need new instruments and areas of collaboration, but that also many players in the societal and industrial sector must make a greater contribution. **All the stakeholders have to be involved actively** and have to contribute to every action to be taken.

If we are to meet these challenges, we must focus on many levels – total concentration and multilayered action. Thus the strategy should be to develop and strengthen a consistent chain of expertise stretching from the day care centre and the pre-primary school school, through primary and secondary school, higer education to the labour sector. The care for maths should begin at a very early stage!

Mathematical, scientific and technological expertise is necessary to solve problems and perform a number of projects in the community, from challenges to the environment to construction of buildings and maintaining the infrastructure of society. The foremost advantage and greatest value for european countries will be their expertise and their HR. We must look after that and develop it so that it is always appropriate for today's and tomorrow's society. We need science subjects for further development and renewal of our welfare state, but also as the source of personal development inherent in a sound knowledge of maths and science. Understanding more of the world around us is a source of increased awareness, understanding and pleasure in our surroundings.

One can say that two challenges have to be confronted:

- Recruitment to many courses of study in technological and scientific subjects is too low in severa&l countries;
- Too many pupils achieve far too low results in these subjects.

The first challenge concerns the fact that pupils and students in several countries do not choose mathematical and scientific subjects to a sufficient extent. The second one is linked to the fact that pupils in primary and lower secondary school in several countries have poor grades in maths and science. Too many pupils have too few lessons in science subjects at lower and upper secondary level, which means they achieve less in higher education. This is a cause for concern, not just because the labour market is looking for mathematical and scientific expertise, but also because a knowledge of mathematics and science is important to understand everyday issues.

Thus primary challenges as to mathetics and science education in the future are for most European countries:

- To encourage young people to choose further maths and science studies at upper secondary school.
- To adapt career choices based on scientific and technological courses of education .
- To strengthen maths and science in teacher training.
- To increase mathematical and scientific expertise in teachers.
- To increase the quality of the teaching of maths and science by developing and disseminating knowledge of good teaching methods.
- To increase collaboration between the education sector and the labour sector to ensure relevance and encourage recruitment.
- To increase research into maths and science education.

The objective of the Present PLA in Goteborg , Sweden is to focus on those issues and see how Sweden is trying to respond to the challenges mentioned above as to maths education. The several discussions and site-visits will focus on the elements mentioned above and should help to clarify some of those issues and the ways in which Sweden tries to solve the challenges. In this way the PLA will be a learning experience for all participants.

Draft Program for Peer Learning Activity of the MST Cluster
21-24 May 2007, Goteborg, Sweden

Monday 21
Morning Arrival, Hotel Gothia Tower

13.00 Welcome and introduction at NCM, Goteborg university
The Swedish school system – focusing on mathematics education

14.00 The work done by the Mathematics delegation and some other recent studies
and national commissions of inquiry. What has happened after the Mathematics delegation?

16.00 Time for discussion

17.00 Looking around – sightseeing in downtown Goteborg

20.00 Welcome Dinner

Tuesday 22
08.00 Departure – by bus (a 20 minutes drive)
Learning Study in Mathematics – Visiting a compulsory school participating in developmental work in mathematics classrooms in cooperation between teachers and researchers

10.30 Visiting an upper secondary school participating in activities for increasing the recruitment of minority students to higher education, creating interest for math and science. Started and run by students of engineering at Chalmers University of Technology

12.00 Lunch and departure to Boras, a city 60 km outside Goteborg

13.30 Visiting, "Navet" ("the Hub"), a Science Center focusing on mathematics

15.30 Back to Goteborg

16.30 Time for discussion and evaluation

Wednesday 23

09.00 The National Center for Mathematics Education, NCM
Background, organisation and the overall task.
– Journals, literature, websites and national conferences for teachers, National projects/initiatives for improving mathematics education
– Pre-Kindergarten mathematics – an in-service education project
– Hands-On Mathematics in classrooms and in-service education

12.00 Lunch

13.00 Continuing …
- ”Matematikutvecklare” – A network and initiative for supervisors of mathematics for in-service education and school development at local/municipality level
- Transitions from upper-secondary to university, a 3 year project
- Adults and mathematics, a vital subject

16.00 Time for discussion and evaluation

18.00 Dinner

Thursday 24

09.00 To be decided after reactions, requests and suggestions from the participants after looking at the draft program:
– The Swedish system for teacher training, including talking to teacher students
– The Swedish and Nordic graduate school of mathematics education
– Ongoing changes in National syllabi, assessment and tests in mathematics in the Swedish school system

12.00 Lunch

13.00 Discussions and reflections within the PLA Group
Presentations by some of the PLA participants?
Preparing for the final report
Evaluating of the PLA
Closing remarks, Farewell
Departure

Mathematics Education in Sweden

What's going on now?

NCM - The Swedish National Centre for Mathematics Education - regularly provides information about current and planned initiatives, studies and reforms i.a. under ”News” on its *web site* and in articles in the its journal *Nämnaren* (Denominator). Here is a short summary with links, background and information about what we consider to be the most strategic initiatives at the national level that are of particular importance for the development of mathematics education.

Studies and plans

In a Communication to the Riksdag from 2002 *Utbildning för kunskap och jämlikhet* (Education toPromote Knowledge and Equality) the former government gave prominence to mathematics education as a strategic development area. The background for this was i.a. NCM's final report from the government commission *Hög tid för matematik* (High Time for Mathematics), the National
Agency for Education's quality examination *Lusten att lära - med fokus på matematik* (Enjoyment of Learning - Focus on Mathematics) and major shortcomings in goal attainment, not least in the vocational programmes of the upper secondary school.

The Mathematics Delegation was appointed by the former government in Spring 2003 in order to draw up a national action plan with the task of i.a. increasing iterest in further studies in mathematics. The ambition was that the results of Swedish pupils in mathematics as measured by international comparisons should be at the very top. The goal should also be looked at in the light of the goals set up by the European Union for 2010, which i.a. cover basic proficiency in
mathematics and the goals in the MST area -- maths, science and technology. The Mathematics Delegation presented its final report in September 2004. Reactions to the Delegation's analyses, views and action plans from the various bodies consulted were very positive. The action plan covered four main proposals, 10 sub-proposals and more than 150 concrete implementation recommendations.
Most of the documentation can be found on the web site *Kollegieblocket* (Notebook) together with reports from the Delegation's working groups, studies and conferences. See also the article in Nämnaren 2004, No. 4: *Hög tid att lyfta matematiken* (High Time to give Prominence to Mathematics).
Evaluations and results

Since the delegation put forward its proposals, a large number of national and international evaluations and reports have described what amounts to nothing less than a crisis in the subject of mathematics.

Compulsory school

The national evaluation of the compulsory school carried out by the National Agency for Education in 2003, *NU*-03, which was presented in October 2004, showed that a disturbing deterioration in the mathematical knowledge of pupils had taken place since the beginning of the 1990s. The proportion of teachers with relevant qualifications teaching mathematics had also decreased.

The study confirmed the picture given in the report by the Mathematics Delegation. See also article in Nämnaren 2005, No 1: *Matematiken i den nationella utvärderingen* (Mathematics in the National Evaluation).
In the report from PISA 2003, Sweden was slightly above the OECD average in mathematics as was also the case in PISA 2000 - but was far from being "a leader in international comparisons".

When Swedish pupils in the 8th year were compared with pupils from other countries in TIMSS 1995, their outcomes were comparatively good. In a comparison between the same countries in TIMSS 2003, the average outcomes of Swedish pupils had decreased by more than in any other comparable country and to a level below the average in mathematics. The outcomes from 8th year pupils in mathematics did not reach the same level as the 7th year in 1995.

The report *Lusten och möjligheten - om lärarens betydelse, arbetssituation och förutsättningar* (Enjoyment and opportunity -- the importance of teachers, their working situation and conditions) found no simple relationship between teachers' training in mathematics and educational outcomes.
On the other hand, there was a positive correlation between teachers' explicit enthusiasm in teaching mathematics and the pupils' results on both tests and final grades. A t*eacher cannot share his enthusiasm when he has no enthusiasm to share*. (G Polya, 1981)
Results from another follow-up study - *Individ- och klassvariation i grundskolan* åk 9 (Individual and Class Variation in the 9th year of the Compulsory School) - also show that mathematics is the subject where streaming by ability most frequently occurs. A follow-up study by PISA 2003, shows that Swedish immigrant pupils (first-generation) have the lowest level of knowledge in mathematics of all the countries compared. See also *Northern Lights on PISA 2003*.
A recently published report by the National Agency for Education of pupils' results on tests in year 5 confirms the earlier picture of the results obtained by pupils with a foreign background.
In overall terms, the sub-tests in mathematics were those that pupils had most difficulty in managing in year 5.

Upper secondary school

No comparative international studies of mathematical knowledge of upper secondary school students have been carried out in recent years. But we can state that there has been a deterioration in the results achieved on the national tests in mathematics in spring 2006 compared with the same period the previous year. In total 28 % received IG (Fail) in Mathematics A if one looks at the results achieved in all programmes except for the Individual Program, the International baccalaureate (IB), the Specially Designed Programmes and "Others". In many programmes, the proportion receiving IG (Fail) in Mathematics A is around 50 %. By way of comparison it can be mentioned that corresponding figures for the subject test in Mathematics for year 9 are usually around 10-12 % and 7-8 % for the final grade.

Higher Education

Over many years students starting Master programs of engineering in higher education throughout the country have taken a diagnostic test in mathematics. In general all the studies carried out reveal a deterioration in their initial knowledge on the tests. The results appear now to have stabilised, but at a new low level, (pdf). Many students have serious shortcomings in basic areas, especially in arithmetic and algebra, areas which are normally

taught in the compulsory school, as well as in Mathematics A in upper secondary school. The current situation has been highlighted in many studies and reports over the years, most recently in the report by the National Agency for Higher Education *Nybörjarstudenter och matematik – matematikundervisningen under första året på tekniska och naturvetenskapliga utbildningar* (First year Students and Mathematics – Mathematics Teaching in the first Year in Technical and Natural Science Programmes) as well as in the KTH Report "*Gymnasiets mål och högskolans förväntningar i matematik*" (Goals of the Upper Secondary School and Expectations from Higher Education in Mathematics).

Numerous promises – ongoing and current initiatives

The situation in mathematics has been extensively debated in the Riksdag and the mass media in recent years, especially when the results from NU-03, PISA 2003 and TIMSS 2003 were published at the end of 2004. The promise of a major national initiative for mobilising energy for mathematics has been given by our politicians in the school area. What has happened as a result of this?
Amongst the assignments received by the Swedish National Agency for School Improvement and the National Agency for Education, the following can be mentioned:
– Local Development of Mathematics
– RUC, (Funds for Regional Development Centres
– Support for Development Work in Mathematics in the Compulsory School
– Support for Upper Secondary School to Coordinate with Higher Education
– The Burdock Project. A joint project between national resource centres in biology/ /bio technology, physics, chemistry, mathematics and technology
– Inspiration Material for Teachers, primarily Years 1-7
– New Diagnostic Material in Mathematics for Years 1-5).

Universities and university colleges have received support to improve the situation for new students in mathematics. At the same time the University of Göteborg has been commissioned to coordinate the work, develop a web-based bridging course, arrange regular national meetings between teachers in upper secondary school and higher education in mathematics, encourage local meetings between higher education centres and adjacent upper secondary schools, and also to coordinate the mathematics initiatives in higher education. This work can be viewed on the project's web site *Mattebron* (Mathematics Bridge).

In this context, we can also mention the initiative for postgraduate programmes in mathematics with a subject didactic orientation that is being implemented with funds from Riksbankens Jubileumsfond (Bank of Sweden Tercentenary Foundation) and Vetenskapsrådet (Science Research Council) and where many Ph.D. students have either presented or will present their theses in the near future. In connection with this initiative, a research centre has been established at the University of Umeå.

The Swedish Educational Broadcasting Company has also provided programmes on mathematics for several years. Currently a series on mathematics is being developed for years 4-6. At a number of the Science centres, mathematics is being given greater attention. The National

Mathematics Biennial was arranged recently for the 14th time and followed as is the tradition with a number of regional biennials. Exciting development work is underway in many parts of
our country.

Work at NCM

There are a number of initiatives underway at NCM, which are funded by the government and the Swedish National Agency for School Improvement and together with a number of different organisations and centres, with national, Nordic and international networks. These cover, amongst other things, commissioned activities, journals, literature for competence development, conferences, contributions to school development, links to research, advisory services, competitions, reference libraries, mathematics workshops, exhibitions of teaching materials and different types of web support.

The multiplicity of activities and players demonstrates the importance of coordination and cooperation so that different initiatives and measures are publicised and used in the best way – to increase awareness of teachers and pupils of the initiatives in order to develop better expertise in mathematics. The initiatives should also be related to and take advantage of the substantial involvement to be found everywhere in Sweden, as well as over the whole world in order to promote the development of mathematics education.

National mobilisation?

Despite the initiatives mentioned above, the comparisons show that current and planned activities only partially correspond to the comprehensive proposals and expectations put forward by the Mathematics Delegation in its report. It is our hope, However¸ that the initiatives decided on represent only the beginning of a more substantial and explicit long-term national initiative to provide support to promote the development of our mathematics education. The new government in its recent budget bill proposed an initiative for the in-serice training of teachers of slightly more than SEK 2 billion. We are currently awaiting a decision on how these funds could be used to improve the teaching of mathematics in our country.

Bengt Johansson

The Resource Centre for Mathematics, NCM

NCM is the Swedish national resource centre for mathematics. Its main task is to support the development of Swedish mathematics education in preschool, school, and adult education. It is one of a number of centres for different school subjects established by the government over the last 10 years. Recently a centre was also established for languages, development of reading and writing skills. In contrast to this centre, NCM does not come under the auspices of any state authority, but is an independent body at Göteborg University and runs its operations in conjunction with Chalmers.
The following is a short summary of our current activities. The web sites for NCM and Nämnaren (Denominator) are now located at a joint web site ncm.gu.se. Information on our resources and different activities can be accessed there.

Journals
A very important part of NCM's work is the journal *Nämnaren* (Denominator) and the related series of books *Nämnaren TEMA* with titles such as *Uppslagsboken* (Book of Ideas), *Matematik I förskolan* (Mathematics in Preschool) and *Algebra för alla* (Algebra for All). The editorial board for the journals is also responsible for the Kangaroo competition together with Kungl. Vetenskapsakademien
(Royal Swedish Academy of Sciences). Strävorna (Aims to strive for) is a part of Nämnaren on the net where we publish proposals for pupil activities and articles arranged by "goals to aim for" that are laid down in the syllabuses on mathematics. Information about "Kangaroo Hops" in mathematics competitions that have previously taken place can be downloaded from the web site -- together with examples of solutions, as well as ideas and proposals for further work.

The NCM also publishes the mathematics journal *Normat* (Journal of Nordic Mathematics) in conjunction with the society of mathematicians in the Nordic area and Institut Mittag-Leffler, in addition to the research journal *NOMAD* (Nordic Studies in Mathematics Education) together with Nordic research networks in mathematics education. Both journals have separate sections on the web site containing information on current contents etc. The latest issue of Normat contains i.a. an article which examines the arguments put forward by the anti-Darwinists from a mathematics perspective. The most recent issue of *NOMAD* contains an article on how mental arithmetic can play an expanding role in teaching.

Books and reports
In addition to these three journals and *Nämnaren-TEMA*, we publish reports, reviews of research and support material. Some of our new publications are the books *Matematikverkstad* (Mathematics Workshop) and *Små barns matematik* (Mathematics for Small Children) which together with *Nämnaren TEMA Matematik i förskolan* (Mathematics in the Preschool) are the result of a nationwide pilot project. A recent addition is the book *Lära och undervisa matematik – internationella perspektiv* (International Perspectives on Learning and Teaching Mathematics). It contains translations of articles and revised versions of articles previously published in the NCM book *International Perspectives on Learning and Teaching Mathematics*. Amongst our other titles, the following can be mentioned *Familjematematik* (Mathematics for the Family)

and *Läs- och skrivsvårigheter och lärande i matematik* (Reading and Writing Difficulties and Learning in Mathematics).

Conferences and courses
We take part in and contribute to exhibitions and lectures in biennial mathematics events at national and regional levels, as well as other conferences around the country. In the autumn we will be taking part in a number of national conferences on mathematics for small children and workshops on mathematics. We also participate in major school exhibitions during the autumn in Göteborg, Malmö and Stockholm. At Skolforum in Stockholm, we participate in the planning and implementation of exhibitions, mathematics workshops and lectures in a special section on mathematics. Information on current national, Nordic and international conferences is provided on our web site.

Adult learning
NCM's assignment from the government also covers initiatives for adults learning mathematics. On the web site, we provide information about the organisation of adult education, the players, steering documents and resources and about our cooperation with the City of Stockholm and Linköping University over courses in mathematics education. The work focuses on adults' learning of mathematics at the compulsory and upper secondary school levels in municipal adult education and in liberal arts education organisations. We also have great interest in learning that takes place in other environments, e.g. at the workplace.

Assignments for competence development
To the extent that time permits, we also undertake assignments if they are part of planned longterm development measures in schools and municipalities. One example is our participation in the mathematics initiative for the City of Stockholm. We share our experiences through our web site, in journals, literature, conferences and advisory services.

Investigatory and development work
As a result of assignments from the government and Swedish National Agency for School Improvement, NCM takes part in different national initiatives. For example, the Mathematics Delegation was established at NCM. The work of the Delegation resulted in a report which provides the foundation for a number of measures currently being implemented. Amongst the measures which NCM takes part in can be mentioned support to local supervisors of mathematics education, authoring of support material, the government's diversity initiative, the transition from upper secondary school to higher education, and coordination with school and business life.

National reference library
NCM's reference library on the literature of mathematics education contains more than 4 500 volumes and 60 journals. On the web site, there is a resource section where you can search for literature. Information is also provided on a regular basis about new acquisitions and journals with brief descriptions of the content of current articles.

Exhibition of teaching materials
The exhibition covers current Swedish teaching materials for mathematics and related support material- for example, instruction guides for teachers, games and puzzles -- covering preschool to upper secondary school and adult education. Publishers present their teaching materials and update
the contents regularly. The exhibition is well worth a visit if you're considering the adoption of new teaching materials.

Information on questions of direct or indirect interest in the teaching of mathematics, its conditions and development is regularly provided on our web site under the heading *Aktuellt* (What's new).
We monitor and report on debates and discussion in the media and about development work and initiatives, at local, national and international levels.
Advisory services and development support NCM provides advisory and development support for teachers, schools and municipalities. We often receive requests for teaching material and for persons who could contribute to different conferences and development projects -- most often via the Web. School heads and developers of mathematics in municipalities are increasingly visiting NCM to discuss planned development measures. At Kollegieblocket.se (Notebook) – a place of inspiration for teachers of mathematics - we gather information from development work around the country. This work has been categorised and can be quickly accessed. The material contains short descriptions and contact information. The ideas can cover everything from concrete approaches ideas for the classroom to development work throughout the municipality.

Workshops on mathematics
NCM's *Workshops on Mathematics* are a meeting forum for everyone interested in "hands on", innovative and experimental ways of working in the teaching of mathematics. As a result of numerous requests from teachers wanting to build a mathematics workshop in their own school, we have put together a manual for mathematics workshops, related study circle instruction material with substantial resources on the web to support this. As a result many workshops on mathematics have been built up at schools around the country. Moe and more groups of teachers are visiting the workshops.

Project activities
Amongst current projects at NCM can be mentioned mathematics terminology in school, the treasures /richness of mathematics and diagnostic material for numbers and arithmetical operations. One recently started project is *Kardborreprojektet* (Burdock Project) - an assignment from the Swedish National Agency for School Improvement - where NCM in conjunction with national resource centres in biology and biotechnology, physics, chemistry and technology have been commissioned to develop support material on how teaching in mathematics can contribute to better goal attainment in these subjects, how these subjects can enrich mathematics.

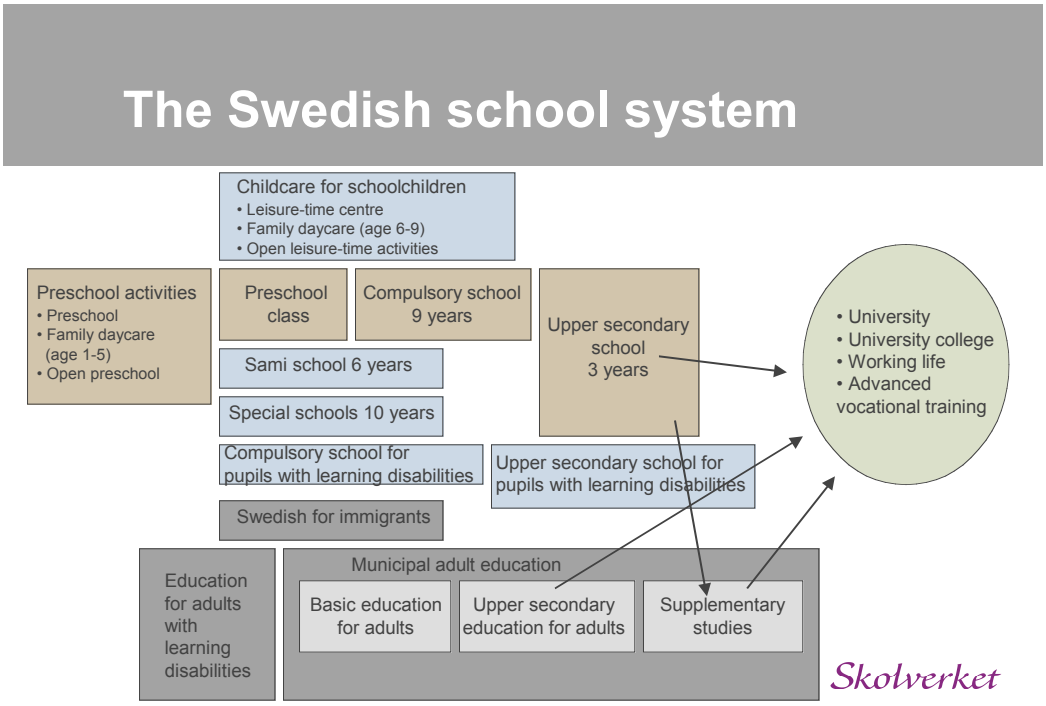
Research
A number of the staff at NCM take part in different research projects. One example is Lars Mouwitz who recently defended his thesis at KTH on mathematics and general education. Another example is that of Jesper Boesen

who in September presented his thesis at the University of Umeå on Assessing Mathematical Creativity.

Coordination and cooperation
As is evident from the descriptions above, NCM has extensive cooperation with various national and international organisations, associations, authorities, networks, environments, universities and university colleges. Visit our web site for further information.

Bengt Johansson

The Swedish education system



Useful websites and information in relation with Sweden and Swedish education

The Swedish National Center for Mathematics Education, NCM, Goteborg University
http://ncm.gu.se
Sweden.se - The official gateway to Sweden

http://www.sweden.se/
The Swedish National Agency for Education,
The Swedish School System and Steering documents

http://www.skolverket.se/sb/d/354
National Assessment and Grading in the Swedish School System

http://www.skolverket.se/publikationer?id=1524
The Swedish National Agency for School Improvement

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
Statistics Sweden, Education and Research

The ATTRAKTIVE SKOLA project in Sweden ([1])

The aim of the Attraktiv Skola Project (2001 – 2006) is to draw attention to the school sector as an attractive workplace by increasing the appeal of the teaching profession. Tangible work got started in March 2001, and is in 2005 in its last working year. The project is ending in June 2006. In 2005 there are 23 municipalities participating in the joint network of the Attraktiv Skola Project. The final phase of the project is the networking of organisations of the Attraktiv Skola Project which is greatly appreciated. The main focus of this Swedish project is not on science education but some of the partnerships and networking focuses on science and technology.

Five key elements have to be implemented in every partnership:

- Networks of local authorities, schools and universities;
- Document the activities of the partnership and networks;
- Exchange teachers between participating schools and universities (o.a. to stimulate transfer of research findings into school education);
- Give the opportunity to teachers to be involved in a variety of educational activities;
- To set up an exchange programme between schools and companies.

Useful initiatives on maths, science and technology education in Sweden

The SCI-TECH Basic Year in Sweden

One measure that has increased the recruitment of students into MST higher education is the establishment of the Sci Tech Basic year. The objective of the project is that youngsters who have completed their gymnasium studies in other fields than Sci Tech can study a supplementary year with that particular focus. The students study during this year the courses in which they lack qualification for continued studies in the Sci Tech field to go to university. The choice of courses to be taken by a student is adapted to the previous knowledge. This leads to the fact that for many students not a full year is necessary to upgrade their knowledge in the areas of Sci Tech. The initiative started in 1992 and has existed and expanded ever since. The Sci Tech year at a specific university is generally attached toa place in a programme in that university afterwards. The student is entitles to financial support during the basic Sci tech year but this doesn't mean that he will get support later on in the university studies. The basic years doesn't give any academic points or credits and can thus not be combined with a first year at university.
The SCI Tech year is a way to broaden the base of recruitment to MST education at the university. Thus students who have NOT followed an MST programme at the gymnasium (secondary school) level get the possibility to change their direction of studies to enter the Sci Tech field. Above all pupils who have attended the Social science Programme or more theoretical professional programmes as the electricity programme are recruited.

[1] Attraktiv Skola: for information in English see the following website: http://www.skola.se/ Click on 'in English' and the intermediate report of 2004 is available.

The Sci Tech Basic Year is regularly followed up , evaluated and reported upon; Special external evaluation of the initiative ahs also been set up. Every year around 7000 students from the social science programme or from different vocational programmes in upper secondary school have studied at the Sci Tech basic year. Most of them are entering higher MST education. About 50 per cent of those are female students. At the teacher training programmes in MST fields for lower secondary schools, about one third of the students have been recruited who came from the Sci tech Basic year.

The SCI-Tech Project "NOT projektet' [2]: creation of 5 Resource Centres.

The SCI-TECH project wants to develop teaching methods within MST so that young people and adults get the possibility to approach SCI-TECH in a stimulating and thought-provoking manner. Linking up MSTR with the reality of the learner is a key element. The project also want to raise the general interest and motivation for MST.
The work in the project has been organised in a number of activities: in-service training activities of teachers and teacher trainers, series of seminars for teacher trainers at the university institutes of education, evaluation of science education, in-set in science teachers for class teachers at lower and middle level, regional conferences concerning science education in cooperation with the National Resource Centres.
National resource Centres have been developed for Chemistry, Physics, Technology, Mathematics and for Biology and Biotech. Each of these centres is attached to a large university, thus ensuring a professional scientific expertise. All the centres focus on some form of support and cooperation with teachers to enhance MST but they each have their specific points of interest and attention. The help of the centres is greatly appreciated by teachers.

[2] NOT projektet: website: http with information:
http://www.ucer.umu.se/PDF/Utv%E4rderingsrapporter/Evaluationreport14.pdf#search=%22NOT-projektet%20Sweden%22
See also presentation: http://www.ntva.no/rapporter/Gago-2002/13-backlund.shtml

Useful initiatives in other European countries

The IMST2 and IMST3 initiatives of Austria ([3])

Most of the initiatives described for Austria in the GRID database are initiatives that are all linked to the IMST2 initiative of the University Of Klagenfurt. Dr. Konrad Krainer has set up for the Austrian ministry of Education this major innovation scheme in the field of Maths, science and technology called the IMST2 and which focuses on MST in the secondary school.

Subsequently the IMST3 pilot project is put in place which is also a **support system** put in place by the **Ministry of Education** in the areas of mathematics, science and technology as well as related subjects taught at Austrian schools. The support system comprises **seven core measure**s, with evaluation, gender sensitivity and gender mainstreaming as systematically integrated principles. These measures are implemented collaboratively by a wide **network of persons and institutions.**

The advantages of such a centralised system as for Austria are manifold. One is that a support and monitoring or follow-up structure is available to help the teachers involved; A second advantage is that financial means are available to support schools and/ or teachers involved. In this case the teachers who draft an action-research report get 1000 EURO. Experience in other countries shows that it is impossible to make teachers draft action-research reports if you do not pay them! Another advantage is the fact that there is a central database with detailed information about all the projects. This database is a key element in the dissemination of the innovation. Unfortunately the very rich and useful AT database is only available in German.

The SINUS and SINUS TRANSFER project of Germany

The SINUS and SINUS transfer projects are two excellent examples of national (in the case of Germany ‚federal') projects across the different Länder to promote maths and science. The advantages are gain manifold: a strong support structures through universities in terms of monitoring and evaluation; financial support to schools and universities involved and a detailed database with information on the projects. A website strengthens the dissemination and multiplier effect.

Important is that the first pilot project SINUS was at a later stage transferred into the SINUS TRANSFER project of which the objective is to 'transfer' the positive outcome of the first pilot project to many more schools. Pilot project should by nature lead to multiplier projects and be available to all schools.

Mathematics and the sciences are considered to be difficult subjects. In international comparison (e.g. TIMSS, PISA), the results of our pupils are

[3] A detailed description of the IMST2 and IMST3 initiatives is to be found in an issue of the Austrian Education News n° 44 of 2005 to be found on the following website: http://www.bmbwk.gv.at/medienpool/13059/aen44.pdf. The article is both in German and in English.

average, in mathematics in the bottom half. Yet, there are materials and models for good teaching. The Federal Government and the Länder have therefore launched a transfer programme to bring the results of the SINUS Programme for increasing the efficiency of teaching mathematics and the sciences into all schools nation-wide.

After five years (1998 - 2003), the BLK pilot project "Increasing Efficiency of Teaching Mathematics and the Sciences (SINUS)" was concluded on 29 April 2003 with a central final event in Berlin.

15 Länder had participated. Schleswig-Holstein had the lead, while the Leibniz Institute for Science Education (IPN) at Kiel University (head of project Prof. Dr. Manfred Prenzel) acted as project management agency. The State Institute of School Education and Educational Research in Munich (ISB) and the Chair of Mathematics and its Mathematics Education at Bayreuth University were subcontractors, especially for mathematic-didactical monitoring.

All in all, 180 schools participated. Six schools each cooperated in a local network (a school-set), while one of the schools had an outstanding position as 'pilot school'. 30 such school-sets were set up nation-wide. On average, about five teachers actively participated in the programme at each school.
The Steering Committee consisted of representatives of the participating Länder. Prof. Dr. Jürgen Baumert was chair of the scientific council.
The SINUS Transfer Programme was launched on 1 August 2003. 13 Länder participated with 734 schools in the first two-year cycle. The Federal Government and the Länder made available about €10 million.

Once again, Land Schleswig-Holstein shouldered the task of national programme coordination. Schleswig-Holstein charged a working unit of the Institute for Science Education (IPN) at Kiel University under the leadership of Prof. Dr. Prenzel with the programme management and the scientific monitoring (programme management agency). The ISB Munich and the Chair of Mathematics and its Mathematics Education at Bayreuth University will be involved in the programme management as subcontractors. The programme management agency establishes a body for programme management which is responsible for all participating Länder and schools.

The LUMA Joint National Action programme in Finland ([4])

Even if this programme was finished in 2002 it is important to mention it because it is more than a project as it is an integrated programme to enhance knowledge in maths and natural science. The LUMA programme is a good example of an 'integrated' approach in improving natural sciences and maths education involving all the key stakeholders.

In 1996, the Ministry of Education launched an extensive programme to develop knowledge in mathematics and the natural sciences (LUMA Joint National Action) for 1996–2002. Results are evident. The enrolment in science

[4] Full information about the LUMA Joint national Initiative and the evaluation report of 2002 is to be found on this webpage:
http://www.minedu.fi/minedu/education/luma/finn_knowhow.html

and technology in H. Ed. has increased beyond objectives, but the numbers of upper secondary school students studying advanced courses in mathematics and extensive syllabuses in the natural sciences have not risen enough to satisfy needs of H.Ed. Girls/women are still a minority among physics and technology students in H. ED. , even though their share is rising. On the other hand, university studies in biology and geography and the training of class and kindergarten teachers do need more men.

In basic education, the quality of learning results looks good in the light of international studies. In addition, equality of education appears to be implemented well both regionally and between schools and genders.

During the LUMA JNA teaching in VET has been developed to take better account of students with defects in their basic knowledge and skills. The extra hour of mathematics in the upper forms in the new division of lessons in basic education and the clarification of the position of physics and chemistry in the lower forms supports improvement in knowledge and skills in these subjects in future.
Different players were involved in JNA: the education administration, the municipalities, schools, educational establishments and H.ED as well as industry and other organisations. The most important work has been carried out at schools and educational establishments, where teachers have under-taken additional studies and developed teaching across subject boundaries. Teachers' IN-SET was the most visible of the projects in the LUMA JNA: 11,000 teachers took part in IN-SET.

Subject teacher organisations, other organisations and industry have supported the teachers' development work in a variety of ways. Schools, educational establishments and H. Ed. engaged in significant co-operation that transcends the boundaries between the various levels. H. ED. have provided schools with their equipment and expertise, given teachers supplementary training and carried out research and researcher training projects relating to the learning and teaching of mathematics and the natural sciences.

Raising standards in Mathematics and Science, Norway

The action plan focuses on FOUR primary goals

1) Improve the teaching of M & S in day care centres and primary and secondary school

The work done in day care centres linked to the subject areas of "Nature, the environment and technology" and "Number, space and form" will be increased.
The Norwegian University of Science and Technology implements a project up (similar to the Swedish "Head Start") within which university students will act as good examples and mentors for the pupils. (especially disadvantaged ones and girls).

Thematic evenings with speakers from business, universities and regional colleges, are set up to encourage pupils to believe in a future linked to M & S.

Students will also be connected to business to enhance collaboration education, business & industry and later career opportunities.
To meet the challenge of deficient knowledge in pupils of M & S, the Government seeks to increase the number of M & S hours at primary level. A charting test for numerical comprehension shall be introduced in the second or third grade. The aim is to find out what skills pupils actually acquire, so that teaching can be better adjusted to the needs.

2) To improve the competence of teachers and teacher training.

To increase recruitment of students in teacher training who choose M & S, to reinforce the proportion of M & S in their training and to increase the competence of teachers in M & S goal-oriented continuing and further education of teachers will be organised.
To strengthen partnerships and collaboration between businesses and education, opportunities will be given for personnel with an M & S educational background in enterprises and organizations to be given secondary senior teacher positions in schools
In order to increase the proportion of teachers with M & S in their portfolio of subjects, the Ministry will evaluate financial instruments for recruiting teachers/trainee teachers to take master's courses in M & S, and to recruit M & S students to the teaching profession.

3) To develop M & S subjects in higher education and research.

Recruitment of students to courses in M & S and engineering at universities and university colleges must be increased, as well as improvement of the quality of M & S teaching in higher education. The number of women choosing M & S in H. Ed. and research must be increased.

4) To reinforce expertise in M & S in the labour sector.

A national meeting-place between the Government, business / industry and education will be established to monitor developments in M & S, reinforce collaboration and propose schemes.

5) To improve communication with the general public

The aim is to increase awareness of the importance of M & S among decision-makers and in the media, and we wish to increase the opportunities for parents to motivate their children to study M & S. To achieve this t is important to develop M & S arenas outside schools with a view to creating interest in these subjects and the desire to study them.

Some useful initiatives and projects concerning MATHS

Lesson study: general information

'Lesson Study' and research lesson model (Japan, USA) - info by Bengt: About Lesson Study, Catherine Lewis from Mills College, CA (USA) gave a nice talk at a meeting in London in February - at NCM:s sistercenter in the UK. You can see and listen to here talk from a Video Clips:

http://www.ncetm.org.uk/Default.aspx?page=1&module=Feb_videogallery
http://lessonresearch.net/staff.html

PREMA project

"Promoting Equality in Maths Achievement" (Network of 100 members from 25 Member States)

PREMA aims at the deepening of understanding of the socio-cultural and pedagogical factors that impede upon girls' achievement / performance in mathematics (age cohort 14/15-18).

http://prema.iacm.forth.gr/main.php

EMMA Project

European Network for Motivational Mathematics for Adults (17 European partners, of which NCM Göteborg)
The EMMA Network intends to pay attention to difficulties with numeracy. Numeracy is the knowledge and skills required to effectively manage and respond to the mathematical demands of diverse situations.

http://www.statvoks.no/emma/
http://www.scb.se/templates/Amnesomrade___3930.asp

Some useful websites on MST

For several countries a website has been developed with innovative projects in the field of MST this is the case. Most of these websites are linked to a national policy on innovation in general or in science, maths and technology in particular. Herewith a list of websites with, in some cases, some comments.

Austria : a database specific to MST

For Austria: the IMST2 database: http://imst2.uni-klu.ac.at/innovationen/

This website gives full description of an important number of projects; it also gives details of the project coordinators and their schools. It also gives access to the action-research reports drafted by the teachers. This database can be put forward as the example of good practice in database in science education project. One element is the fact that it is only accessible in German.

Germany- a database specific to MST

For the German SINUS and SINUS Transfer projects.

Within the SINUS database: http://blk.mat.uni-bayreuth.de/search/modul.html, one can find all the schools that were involved in the project. They can be found according to the German Land (region!) they are located in according to the Module they were involved in and according to keywords.

The website also contains all sorts of materials and publications in relation with the SINUS project. For the SINUS Transfer project once has to access the website of the SINUS Transfer project and then go to the land one is interested in. Some of the Länder give full lists of all the projects; others not!

For the German BLK project KUBIM

Although the primary objective of KUBIM is not to promote science education but to promote links between ICT and culture, many of its activities have a direct or indirect links with the promotion of maths, science and e-technology. Hence it was thought to be useful to mention this website:
http://www.kubim.de/indexie.html
Click on 'Projekte'!

France: several websites with great use

A website for sciences in the primary school - For France the website of La Main à la Pâte : http://www.lamap.fr

It contains information on the initiative but no database with examples of good practice.

Innovative practices are also to be found on: the PASI website (Pôle Académique de Soutien à L'innovation): http://www.guyane-education.org/innovation/

A network of innovation centres is also available in general for the different Académies and is to be found on the following website:
http://innovalo.scola.ac-paris.fr/Innovalos_en_france/innovalo_en_france.htm
It has to be regretted that not all the sub websites of the different academies are no longer available!

Hungary

The main databases of innovative school-projects in the country are available in the website of TEMPUS Public Foundation, which administers EU cooperation programmes and more state-founded applications (www.tka.hu). Here can be found schools, participated/ing in Leonardo, Comenius and other European projects and also in national projects, scholarships (e.g. 'Road to science' (Út a tudományhoz). Besides a detailed set of information on usability of these projects is available here, the portal serves as an engine of networking.
Several websites serve electronic networking, e.g. the Hungarian research Student Movement (www.kutdiak.hu); the Neumann János Computer Society (**http://www.njszt.hu**) and others.

Italy: a general database with parts for MST education

For Italy the GOLD database: http://gold.indire.it/nazionale/
This is a database with good or best practice in Italian schools. There is a subdivision in the database for Maths and sciences and another subdivision for Applied sciences, technology and technique.

Apart from the GOLD database there is also the GOLD TRAIN project (2004-2006) for the ***dissemination of good practices in schools*** and more specifically the ***transferability of good practices*** to different school contexts:
http://gold.bdp.it/goldtrain/
When you click on the fifth icon on top from the left you find the area called: *La scienza amica - un amico di scienza* which refers to the first edition of the science education project "Physics On Show" – already subject of a GRID case study!

Netherlands: a variety of websites

The database of the Platform Bèta Techniek set up in the framework of the Delta Plan Bèta Techniek swill be accessible towards the end of 2006. Through this database examples of good practice will be available concerning the promotion of MST in the Netherlands. The databse will largely be in Dutch! See the website: http://www.deltapunt.nl

A database with a variety of good practice in schools!
For the Netherlands there is a general database with examples of good practice at school level. It is not a database specifically for maths, science and technology:

http://www.schoolvoorbeelden.nl/
On this database called 'Examples of schools' information is to be found for all innovative school projects and not only for the science area. However, the database is only accessible in Dutch.

Good practice in technology (plus a bit of Maths and science)
A Dutch database specialised in technology is to be found with the AXIS Foundation: http://www.platform-axis.nl/
Although most of the projects are focusing on the promotion of technology some may also touch upon sciences. There are many descriptions of good practice in schools (mainly VET schools) in Dutch but there is a selection of examples of good practice in English.

Projects in Sciences
The Dutch website of the Amstel institute of the University of Amsterdam mentions many projects in science education according to the level under:
http://www.science.uva.nl/amstelinstituut/vo.cfm
Click on 'Bestaande projecten'. Unfortunately the projects are only in Dutch. Some information about the Amstel Institute is given in English!

Projects focusing on the use of ICT in several disciplines; a.o. ICT in MST
Another Dutch website which mentions many project in ICT in general and on the use of ICT is science education is to be found under:
http://www.ictopschool.net/kennis
Unfortunately everything is also in Dutch!

Scotland

A section of the Science Education 3-18 website provides details of the wide range of projects and initiatives which have been funded by the Scottish Executive Education Department (SEED) in line with the school science education commitments of the Science Strategy. See the website:
http://www.scienceeducation3-18.com/projects.htm

The Lisbon strategy of the European Union as to Maths, Science and Technology

The organisation of the present PLA in Sweden has to be seen in the light of the activities of the European Union as to Maths, Science and Technology.
A first PLA on MST was held in The Netherlands in November 2006 with the major focus on science and technology.

Maths, Science and technology a key challenge for Europe

Europe's future competitiveness in the global economy will depend to a great extent on its supply of scientific specialists and on ensuring that they are put to good use. Mathematics, science and technology (MST), including computer sciences and engineering are vital for the development of the knowledge-based and increasingly digital economy. The EU has a higher proportion and larger absolute numbers of tertiary graduates in these areas than the USA or Japan. However, it does not fully capitalise on this potential, as it has fewer active researchers (both in absolute and relative terms) in the labour force than the US or Japan. Europe needs to develop and increase the attractiveness of its research labour market, in order both to retain and make use of its own talent and to attract researchers and scientists from outside Europe.

In 2003 the EU had 755 000 maths, science and technology graduates compared to about 430.000 in the USA, 230 000 in Japan and over 800 000 in China. The share of MST graduates (as a % of all graduates) was at 24% slightly higher in the EU compared to the USA (19%) and Japan (23%). However, measured per 1000 inhabitants aged 20-29 Japan (13.2) has more graduates than the EU (12.2) or the USA (10.9). EU countries with a high ratio of graduates in the population 20-29 included France, Ireland and the UK. While the European growth rates are impressing they might be overstated by double-counting of graduates in the move to a BA/MA structure (not considering short programmes/BA growth would reduce the growth rate 2000-03 by about 1%). Growth in the number of MST graduates is moreover even stronger in new competitors like India and China.

The development of Europe towards a knowledge society implies the need of a scientific culture with all its citizens so as to be active citizens also in the field of scientific and technological choices. Hence a high quality science education is vital on the one hand to see to it that the citizens can acquire the competences needed by the knowledge society and on the other hand to train enough scientists and researchers. To invest in knowledge and in innovation contributes to prepare the citizens especially as to their scientific and technological competencies and their potential scientific careers.

However, the interest for studies in scientific areas and the number of scientists, researchers and engineers is decreasing in the labour market. Moreover, the effect of the ageing population will only add a cumulative effect to this lack of human resources. To increase the recruitment in scientific studies, the motivation of the youngsters for sciences is the major factor together with better information about scientific studies and

the creation of a scientific country within the different countries. The participation in MST studies and jobs is another key issue.

The crisis concerning sciences is not limited to the problem of ill-paid and ill-loved scientists. The teaching (learning!) methods of sciences are put forward by the pupils themselves as one of the key reasons why the interest for science is lacking or disappearing.

Sciences suffer also from the fact that they are perceived as abstract. This lack of popularity is very often attributed in different countries to the shortages in terms of the programs and the manuals (used in the classroom) that may lead to a purely mechanical learning or teaching process without enabling a real comprehension of the notions and concepts used.

To promote enthusiasm of young children for science requires an important effort of the teachers who are usually badly trained to do this and who themselves have not studied or appreciated those subjects when they were at school. Teachers are confronted in their classroom with pupils who very often know more about information and communication technology than themselves while the teachers have no idea of the laws of physics that support them and have no interest in knowing them.

Hence some key questions are asked :

- How to make maths, sciences and technology more attractive for youngsters and how to promote the teaching and learning of sciences?
- How to encourage or incite young people and pupils to stake up or study MST?
- Which pedagogical tools , changes in the curricula, extracurricular activities etc. are necessary to improve the quality of the teaching (and learning of MST)
- How to improve the perspectives of scientific and research careers and how to avoid that people drop out of those areas during their professional career?
- How to increase and strengthen links between research, the world of work (companies and industry) and society?

The ministers of Education and Research meeting in Uppsala in March 2001, have reflected on those questions. This event in Uppsala has had an impact on later debates in this area and has introduced the concern to strengthen the scientific context in relation with the interest of youngsters and the present challenges of society. The initiatives taken successively at the European level illustrate this approach. We mention, amongst others:

- The Resolution of the Council « Women and science » (June 2001),
- The « Action Plan Science et Société » (Dec. 2001)
- The « Report on the concrete future objectives of the education and training systems» (Feb. 2002)
- The putting in place of the Working Group on Maths, Sciences and Technology in the framework of the working programme Education & training 2010.

Within this context the European Union has intensified its efforts in the fields of research, innovation , education and training and is putting in place this European knowledge space. This has also translated itself in the development of ambitious projects either as to the development of European networks and centres of excellence in the fields of research and education but also by putting in place working groups of which the objective is to implement the work programme « Education and Training 2010 » which is part and parcel of the Lisbon strategy.

The MST group set up by the Commission within the Education & training 2010 Workprogramme

A synthetic analysis of the activities carried out since 2003 by the WG Maths, Science and Technology put in place in the framework of the work programme « Education and Training 2010 » shows clear evidence of a certain number of specific elements.

The following different aspects are especially pointed out:

- The importance to be given to under-representation of women in the study areas of maths, science and technology.
- The putting in place at the level of the Lisbon strategy of 5 key indicators (benchmark) one of which focuses directly on maths, science and technology as the objective by 2010 is to increase the number of graduates in those disciplines by 15% giving furthermore a special attention to reduce the imbalance between men and women.
- The importance to be given to the development of new pedagogical approaches for the teaching (and learning) of maths, science and technology.
- The need to reflect on the profile of the teachers of those disciplines and on the decisive role they have to play (at all levels of education) to do something about the increasing lack of interest and dropping out of science, maths and technology studies.
- The necessary re-enforcement of the relations between educational institutions (in the largest sense) and companies (school-industry links) which should contribute to give, inter alia, another image of science and technology.
- The involvement of the parents in this process.
- The need to develop new links and new mechanisms of cooperation between primary and secondary schools on the one hand and with higher education on the other hand.
- The diversity of approaches as to the practices used in different countries.
- It is imperative to be able to identify and bring together good practice concerning the different challenges mentioned earlier.

Within the framework of the Working group Maths, Science and Technology (Group MST), an important number of good practices have already been identified. One of the challenges is to share good pracice through databses, study-visits and peer learning activities, or PLAs, that address key decision-makers in the field of MST.

Activities and results of the WG MST

Since its creation, the WG MST has been very active by drafting reports with recommendations, by iorganising study-vists and a first PLA in November 2006 In the Netherlands

Interim recommendations of the progress report of 2003

The MST Group has identified 'compulsory education' as the top priority sector for action, since it has the central role in the education systems.

- Mathematics, scientific and technology education should be an entitlement for every child and introduced at an early age. It should be mandatory at all levels of compulsory education.
- More effective and attractive teaching methods should be introduced by linking learning to real life experiences, working life and society, and by combining classroom-based teaching with appropriate extra-curricular activities
- The professional profile and practice of MST teachers should be further enhanced. Initial , induction and in-servoce training of teachers has to receive special attention.
- The needs of special groups (both high and low achievers and young people from different ethnic backgrounds) should be addressed, and the appropriate measures taken to respond to gender-specific attitudes to mathematics, scientific and technical subjects.
- Strong and effective partnerships between schools, universities, research institutions, enterprises, parents and other actors should be strongly encouraged and supported at all levels.

Recommendations of the progress report of 2004

The 2004 recommendations are the following ones:

- Curricula should clearly take into account the important role of Technology education, which should be addressed as a field in its own right within MST.
- The needs of low-achieving pupils in MST should be addressed specifically by implementing MST curricula that are appropriate to their needs, abilities and interests, by providing more opportunities for practical activities and by introducing initiatives such as special classes, inclusion measures, appropriate textbooks and materials, etc.
- It is essential that policies tackle the problem of gender imbalance in MST.
- Pedagogy is a crucial area for decision-makers to address if MST subjects are to improve in effectiveness and attractiveness.
- Policies should address the perceived reluctance of teachers to adopt new didactics in the field of MST and find ways and means, in particular through the dissemination of good practices, to change the situation.
- Pupils' assessment procedures should give importance to both theoretical and practical work and promote new teaching methodology.
- Any measure taken to increase interest and participation of pupils in MST, and in particular girls, should foster the participation of parents.

- Partnerships/initiatives aimed at providing "second chance" opportunities for those who did not opt for MST subjects should be developed.
- Partnerships between schools and universities to increase interest and participation in MST should be made more frequent.

Recommendations of a sub group - cooperation between schools and universities

- Efforts should be made 'to promote the creation of new positions for MST education in higher education institutions'.
- Governments should encourage schools to liase with universities, parents associations, and industry on MST subject development.
- Second-chance opportunities" were considered as good potential methods for inspiration in establishing partnerships and should therefore be supported.
- Member States should promote and/or update 'school development plans' for MST.
- Partnerships should be seen as 'equal opportunities and reciprocal partnerships' – universities should be able to learn from school partners and school partners from universities.
- Alliances should be formed between stakeholders so as to ensure equitable access pathways to training programmes and employment in the field of MST.

The evaluation form for the Goteborg PLA, 21 - 24 May 2007

1= I disagree
2= I agree more or less
3= I agree
4= I fully agree

	1	2	3	4
1.The programme was very well balanced as to the contents giving a full overview of the different parts and issues related to the Delta Plan for science and technology				
2. The programme enabled the participants to meet all the key actors or beneficiaries at all levels: senior officials, decision-makers, teachers, heads, inspectors, universities, students etc.				
3. The colleagues of the host country were available to answer any question at any time				
4. There was enough time for discussions within the group of participants of the PLA				
5. Clear information on the objectives of the PLA were available before the PLA itself				
6. The information sent to participants in advance proved to be very useful in preparing oneself for participation				
7. The presentation made by participants of the PLA were complementary to the core topic and issues of the PLA				
8. The discussions within the PLA group were well organised and fruitful				
9. The PLA was very well organised and smoothly implemented				
10. The PLA has proved / will prove to be useful for policy development and implementation in my country				

Please add comments for any of the topics or issues mentioned above
Take as much space as you like!

1.
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7.
8.
9.
10.

Please send back by e-mail to Yves Beernaert by 15 June 07
yves.beernaert@educonsult.be
Educonsult
00 32 474 987411