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WORK PROGRAMME**

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PEER LEARNING ACTIVITY (PLA)

organised by

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REPORT

Theme: Increased recruitment and better quality instruction in MST.
A joint promotion of MST in Norway

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Report, PPT presentations and documents: see website: <http://ncm.gu.se/node/1959>

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Executive summary

The general objective of the PLA was to show how Norway is addressing several of the challenges as to MST especially as to the lack of recruitment of students in the field of MST in higher education and subsequently the lack of MST competencies in industry, business and research. Norway is currently facing a situation where the needs of the society and working life for expertise in mathematics and a number of natural science and technological fields are not being met. This is serious and will be a barrier to a positive trend for innovation and for working life and the society in general. A sub-objective of this PLA was to show to the European experts, members of the MST cluster, how the Norwegian government is addressing the problems and implementing solutions. Another sub-objective was also to allow time for exchanges of ideas and expertise between the participating experts on these questions. This confrontation lead to useful cross-fertilisation.

Representatives of CY, DK, FR, IS, LV, NO, PT and SE participated in this PLA.

The general introduction about the Norwegian education system stressed the **key challenges**:

- One out of four 15 year-olds leaves compulsory school without adequate basic skills.
- One out of four pupils discontinues upper secondary education / training and leaves without formal qualifications. One hypothesis is that there is plenty of work available, but the reason is probably more related to inadequate basic skills and lack of motivation.
- More than 400,000 adults have poor skills in reading and numeracy.
- The poor PISA results with Norway scoring below average in Scandinavian countries.
- Low expectations of pupils' achievements in subjects and low motivation for efforts in school subjects.

In opposition to those challenges a positive element revealed by an annual official inquiry with students shows that students are 'happy' at school and like to go school.

The PISA results of 2003 were expanded upon showing Norway was doing below the average compared to the Nordic countries in Europe. It was stressed that the lack of competency of primary school teachers in the field of MST is one of the main causes of this poor performance of pupils. A white paper is expected on the role of the teacher in 2008 proposing different reforms in initial teacher education. One of those will be that teachers will only be able to teach a subject if they have spent 60 ECTS credits on it. It is also expected to introduce a subject "professional studies" which will introduce teachers in a.o. hands-on and inquiry-based science teaching approaches.

Two national strategies as to MST have been implemented over the last 6 years in Norway.

In 2002 the first Norwegian strategy for the strengthening of math, science and technology (2002-2007) was launched. The National Centre for Mathematics in Education and National Centre for Science in Education were established in 2002 and 2003. These events contributed to putting focus on the problems among the actors in the field. Lack of necessary financial support was a problem, and still is. One of the main features that have been constructed is The National Forum for MST including participants from the Industry, trade unions, the educational establishments and other stakeholders. This forum launched several initiatives such as informing all youngsters at the end of the lower secondary school of what certain jobs in science and technology stand for.

In 2006 the second strategy (2006 – 2009), "A Joint Promotion of Mathematics, Science and Technology" was launched with the following objectives:

- encourage young people, and especially girls, to choose depth study in MST in upper secondary education and to make career choices based on natural sciences and technological areas of study;
- strengthen MST in teacher training and raise the MST qualifications of existing teachers;
- improve the quality of teaching in MST by developing and spreading good teaching practices;

- increase the cooperation between education and working life in order to create a greater sense of relevance and to encourage recruitment.

These challenges were translated into goals to be reached with the second strategy:

- Strengthen MST in kindergartens and primary and secondary education
- Improve teachers' qualifications and teacher training
- Development of MST in higher education and research
- Provide Norwegian working life with the MST competence that is needed
- Increase the MST competence and improve the communication to the general public

For each of the five goals **indicators** have been developed to see whether the goals have been achieved!

The second strategy was developed taking into account some of the preliminary conclusions and recommendations of the **evaluation of the first strategy** carried out by an external independent consultancy company.

This evaluation looked at the following elements: the impact, the relevance, the way in which the 1st strategy had been implemented and the utility and the sustainability of that strategy.

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. The main general recommendation was to focus on more measurable goals and to have less goals overall. 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 visits to two schools (one upper secondary school and one school with primary and lower secondary) enabled the participants to understand better the Norwegian education system and the way it works through the large autonomy given to the schools. The visits also showed how the motivation and interest for and quality of MST teaching and learning were promoted. Different organisation of timetables in large blocks of up to half a day or even one-day per week focusing on key subjects such as MST combined with hands-on and inquiry-based approaches plus a creative and stimulating use of ICT are implemented to have a major effect on the interest and motivation of MST. The vision and mission of the school supported through the head, is a key element in this area!

The participants had the opportunity to see **different innovative measures to promote MST concretely at work**. The implementation of the **(new) 'Technology and research' subject** in the curriculum of the upper secondary school stimulating the interest for MST is one of those. Another one is the new subject focusing on 'Earth sciences'.

The inquiry-based approach applied in the 'Nysgjerriger project' (Making youngsters more curious!) in the primary school and lower secondary school is another IBST (Inquiry-Based Science Teaching) approach that seems to pay off. Finally the participants could attend lessons showing how **ICT was used in maths education** at the level of the compulsory school. The visits also enabled the participants to witness how schools implement an inclusive and social inclusion policy for all children with learning difficulties or other disadvantages.

The schools and other stakeholders are supported in their MST work through various structures such as the Norwegian **Centre of Science Education, the Norwegian Centre for Mathematics Education and the seven science centres** that have been set up across the different regions in Norway.

The recently set up Norwegian Centre of Science Education implements initiatives focusing on the curriculum, equality and outreach activities with periodicals, websites, annual conferences and seminars for teachers and a network of ambassadors in science that are involved in in-service training of science teachers. This centre also has a major focus on **research in science education** with several key European projects focusing on IBST, on the relevance of science education – **ROSE** -, on the pedagogical processes in the science classroom - **PISA+** - etc. It is important to strongly stress that there is a clear link between the research and the in-service training and support offered by this centre to teachers and schools. The Norwegian Centre for Mathematics Education is also involved in various activities such as conferences, a magazine and in-set of teachers organised by a network of resource teachers active across Norway.

Schools, teachers, parents and pupils get a lot of support through **various websites** run by the Norwegian Centre for Science education and the website for mathematics, **matematikk.org**, which is to be integrated into the work of the Norwegian Centre for Mathematics Education mentioned above. Furthermore, information was also given about the creation of seven science centres across Norway that in close cooperation with science museums support the implementation of the MST strategy set out by the Ministry of Education and Research.

Two of the research projects of the Norwegian Centre for Science Education were extensively reported upon. **The ROSE project (Relevance Of Science Education)** addresses the issue of how youth culture has an impact on the choice the youngsters make or do not make for MST. Youngsters can also be subdivided into profiles such as idealistic or creative ones which have an impact on their choice of studies and career. Thus the issue was raised how MST and MST related careers have to be presented to girls and boys and how MST subjects have to be taught.

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.

Finally the PLA was a unique opportunity to have lengthy and **in-depth discussions** with the participating colleagues on the following issues:

- The competency-based MST curriculum and the way it is assessed
- The use of ICT in MST: advantages, limits, cost efficiency
- The advantages of, problems with or limits of hands-on and investigation approaches (IBST)
- The role of initial teacher education in promoting and strengthening MST
- The autonomy of the schools in enhancing creative learning environments
- The gender issues in MST; how to address the participation of girls in MST
- The cooperation with industry and other stakeholders
- The evaluation of policies and action plans to enhance MST learning and teaching.
- The contribution of MST to promoting equity, equal opportunities and social inclusion

The participants to the PLA stressed the following strengths of the Norwegian education system

which they would highlight in their reports for their respective ministries:

- The overall quality of the education system, by the autonomy the schools have and which they translate into the flexible organisation of the school time to the benefit of learning.
- The different concepts that lay at the basis of the Norwegian education system such as autonomy to be given to the pupils, the promotion of the sense of innovation, respect for diversity, active participation of all stakeholders, inclusive education.
- The strong focus on competence-based education and learning outcomes to be achieved

- The fact that there is a clear link between the development of the national strategy for MST and the results of the research carried out. The research carried out by the Norwegian Centre for Science Education is indeed closely linked to classroom and school practice and to in-service training of teachers. The strong focus on action research or action-oriented research in science education in general and in teacher training in particular is definitely a strength.
- The focus on peer learning activities so that teachers can learn from one another in teams.
- The supportive structures such as the 7 science centres, the Norwegian Science Education Centre (with its science ambassadors) and the National Centre for Maths Education (with its regional maths resource persons).
- The way in which the first strategy for MST had been evaluated and how the results of it had been taken into account to develop the second strategy for SMT
- The various efforts, made within the framework of the MST strategy to promote interest for MST and the fact that those efforts also received adequate financial support seemed to be a major reason of the results reached so far.
- The role of the teachers in contributing to enhancing innovation
- The commitment of the schools and the teachers to focus on the quality of education and learning, on the welfare and well-being of every child to optimise its talents in a lifelong learning perspective. The lack of pressure on the pupils.
- The knowledge of English of all pupils and teachers met was of a very high quality.

Large autonomy, concern for quality, constant promotion of innovation, active citizenship through participation of youngsters to school life, inclusive education, a caring school, involvement in European and international cooperation and cooperation between school and the local community all seem to be key elements of the Norwegian education system.

Participants raised some concern as to:

- the large autonomy of the schools wondering how the ministry of education and science could influence, stimulate, monitor and evaluate innovation in the education system.
- external quality assurance mechanisms that are limited to the national exams. This surprised somewhat the participants.
- the quality of initial teacher education especially for teachers in the primary and lower secondary schools. The recruitment of new teachers. These are major concerns of the Norwegian colleagues themselves.
- the lack of detailed content as to the curriculum.

All the participants stressed that the PLA had been very useful and that it has given them **evidence-based information** which they could use at the level of their education systems. They also stressed that the involvement in several of the PLA on MST proved to be particularly fruitful to policy development in their countries. Countries that had been involved with two participants stressed that this enhanced reflection within the country even more.

Special thanks were expressed by all participants to the Ministry of Education and Research of Norway for setting up this very useful PLA and to DG EAC for its synergetic and catalytic role in the MST cluster.

Part 1: The MST Cluster and the organisation of PLAs

1.1. The Cluster and its priorities

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 LLL.

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.

Three PLAs have been organized so far. The first PLA was organized in the Netherlands from 13 to 17 November 2006. The key topic was the Delta Plan, Science and Technology with specific focus on the development and the implementation of a holistic / systemic policy to promote MST at all levels of the education system.

The second PLA was organised in Sweden from 21 to 24 May 2007. The key topic was mathematics education and it focused on the different strategies and activities developed to enhance maths education.

The third PLA was organised in France from 8 to 12 October 2007 focusing on: "Renovation in science education: an INQUIRY-BASED APPROACH". It focus especially on the innovations brought about by the large Initiative "La Main à la Pâte" set up since 1996.

1.2. Challenges as to MST and the Objectives of the PLA in Norway

1.2.1. Challenges as to MST in Europe

The primary challenges as to maths, science and technology education in the future are for most European countries the following ones:

- To encourage and motivate pupils to choose further maths & 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.

1.2.2. Overall objective of Oslo PLA

The overall objective of the Oslo PLA was to show how Norway is addressing several of the challenges mentioned above especially in the area of addressing the problems of lacking recruitment of students in the field of higher education and subsequently the lack of MST competencies in industry, business and research. Norway is currently facing a situation where the needs of the society and working life for expertise in mathematics and a number of natural science and technological fields are not being met. This means that the education system is not providing sufficient competence in the sciences. This is serious and will be a barrier to a positive trend for innovation and for working life and the society in general. The objective of this PLA is to show to the European experts, members of the MST cluster, how the Norwegian government is addressing the problems and implementing solutions. The objective is also to allow time for exchanges of ideas and expertise between the participating experts of the Member States on these questions. This confrontation usually leads to cross-fertilisation.

In 2002 the first Norwegian strategy for the strengthening of math, science and technology (2002-2007) was launched. The same year the National Centre for Mathematics in Education was established. The establishment of the National Centre for Science in Education was established in 2003. These events contributed to putting focus on the problems among the actors in the field. Lack of necessary financial support was a problem, and still is. In 2006 the second strategy (2006 – 2009), A Joint Promotion of Mathematics, Science and Technology was launched. One of the main features that has been constructed is The National Forum for MST, led by the minister, including participants from the Industry, trade unions, the educational establishments, among others.

Some of the main problems that can be mentioned is a very low fraction of students in MST studies in higher education. Norway is doing very badly compared to the other countries in Europe. The latest PISA results also shows that norwegian pupils are performing badly compared to nations we usually wish to compare us with. The competency of primary school teachers in the field of mathematics and science is lacking to a large degree. We therefore have grave and pressing problems and we wish to discuss possible solutions with our colleagues in the MST PLA.

At the same time, this PLA was the occasion to present to the European participants some examples of projects that were felt to be stimulating and successful. Among others the use of national science centres in personal development and development of learning resources, the Norwegian Centre for Science Education, the Norwegian Centre for Mathematics Education and the science work in classroom activities a.o. through the Nysgerrigper project (Make young people curious about MST).

1.3. The Norwegian education system , the National Curriculum, Teacher education

1.3.1. The Norwegian education System ¹

By Gunnar Mandt, Ministry of Education and Research

The introduction highlighted the responsibilities of the different official bodies:

- The Ministry of Education in charge of policy , legislation and budget; it is subdivided into 6 departments;
- The Norwegian directorate for education and Training; the executive agency implementing the policy and the development of 1ary and 2ary education & training
- The Counties and Municipalities as school owners in charge of follow-up and assessment.

The general introduction about the Norwegian education system stressed the **key challenges**:

- One out of four 15 year-olds leaves compulsory school without inadequate basic skills.
- One out of four pupils discontinues upper secondary education / training and leaves without formal qualifications. One hypothesis is that there is plenty of work available, but the reason is probably more related to inadequate basic skills and lack of motivation.
- More than 400,000 adults have poor skills in reading and numeracy.
- The Poor PISA results with Norway scoring below average in Scandinavian countries.
- Low expectations of pupils' achievements in subjects
- Low motivation for efforts in school subjects.
- Unrest and disturbances in classes and groups.
-

In opposition to those challenges a positive element revealed by an annual official inquiry with students shows that students are 'happy' at school and like to go school.

Education for all is a basic precept of Norwegian educational policy. Children and young people must have an equal right to education, regardless of where they live, gender, social and cultural background or any special needs. All public education in Norway is free of charge, while kindergartens have relatively small parental fees. Education must be organised in a lifelong learning perspective if we are to meet changes in society constructively.

The Norwegian Parliament (the Storting) and the Government define the goals and decide the framework for the education sector. The Ministry of Education and Research is responsible for carrying out national educational policy. National standards are ensured through legislation, regulations, curricula and framework plans. Children and young people must have an equal right to education, regardless of where they live, gender, social and cultural background or any special needs.

Kindergartens

The Government has the overall responsibility for quality development, management and financing of the kindergarten sector, and allocates earmarked funds for the running of kindergartens.

¹ This is an abridged version of the brochure "Education: From Kindergarten to Adult Education" to be found on the website of the Norwegian Ministry of Education and Research:
http://www.regjeringen.no/upload/KD/Vedlegg/Veiledninger%20og%20brosjyrer/Education_in_Norway_f-4133e.pdf

The County Governors act as links between the Ministry of Education and Research and the kindergarten sector. The County Governors implement kindergarten policy through development work, administrative tasks, supervision and guidance for municipalities.

The municipalities are responsible for providing and running municipal kindergartens, as well as for approving and supervising both public and private kindergartens in the municipality. The municipalities must also ensure that the kindergartens are operated within their approval framework and that the content complies with legislation, regulations and the framework plan. In addition the municipalities have an active responsibility for providing guidance.

Municipal authorities must ensure that public subsidies are paid on an equal basis to all the approved kindergartens in their municipality. Kindergarten owners are responsible for the contents of the individual kindergarten. The Parents' Council for each kindergarten determines a year plan ensuring the participation of parents and staff in the framing of the educational contents. Kindergarten owners are responsible for employing adequate and qualified staff.

Primary and Secondary Education and training

The state bears the overall responsibility for the Education Act with regulations, contents and financing of primary and secondary education and training. The County Governors are to act as links between the Ministry of Education and Research and the Directorate for Education and Training on the one hand and the education sector in municipalities and counties on the other. The County Governors are responsible for supervision and dealing with complaints related to regulations, participation in quality development, information, guidance and various administrative matters. The municipalities are responsible for operating and administering primary and lower secondary schools, whereas the county authorities are responsible for upper secondary education and training. Legislation and regulations, including the National Curriculum, form a binding framework, but within this framework the municipal and county authorities, schools and teachers can influence the implementation of the education and training. Each school has a head teacher and various boards, councils and committees. The Norwegian Directorate for Education and Training is an executive subordinate agency for the Ministry of Education and Research. The Directorate's main tasks are to promote quality development, quality assessment, analysis and documentation in primary and secondary education and training, and to perform administrative tasks connected with primary and secondary education and training, in addition to bearing the overall national responsibility for supervision of primary and secondary education and training.

Tertiary Vocational Education

Tertiary vocational education is a short vocational alternative to higher education. It is regulated by national legislation and is offered partly by county authorities and partly by private parties.

Higher Education

The state is responsible for universities and university colleges, which are directly subordinate to the Ministry of Education and Research. Each institution has a board which is responsible for the direction and organisation of operations. Accredited institutions have been awarded extensive academic powers and may establish and terminate their own courses of study. University colleges decide for themselves which studies and topics they are to offer at first degree level. Universities determine for themselves which subjects and topics they wish to offer at all levels, including doctoral programmes. The Norwegian Agency for Quality Assurance in Education and the Norwegian Centre for International Cooperation in Higher Education are also instrumental in the governance of the universities and university colleges.

1.3.2. National Curriculum, challenges and implementation

by Kari Berg, Ministry of Education and Research

Two white papers were the basis for reforms that were implemented: “The knowledge promotion” (2003-2004)² .and “...No-one was left behind: Early measures for lifelong learning” (2006-2007)³. These white papers advocated more and improved learning for all. The latter stressed that nobody should complete compulsory education without having acquired basic skills. It also stressed that everyone should have documented qualifications at the end of upper secondary education and training. It was also highlighted that those who need it must be allowed a new chance to acquire basic skills as adults.

The white paper n° 30 (2003-2004) “Culture for Learning / Knowledge promotion” focused on competence based curricula and on competence objectives expressed as learning outcomes stating clearly what the learner should be able to master / demonstrate after completing education and training. It also focused on national objectives for basic skills and subject / area competencies. Finally it stressed the establishment of a quality framework for the schools and workplaces.

In the autumn of 2006 the school reform called “The Knowledge Promotion” was introduced. The objectives and quality framework for primary and secondary education and training are laid down in The National Curriculum for the Knowledge Promotion which applies to all levels of primary and secondary education and training and comprises:

- The Core Curriculum
- Quality Framework
- Subject Curricula
- Distribution of teaching hours per subject
- Individual Assessment

The subject curricula include competence aims for the pupils after certain grades. All the subjects have competence aims after grades 4, 7 and 10 and after each level in upper secondary education and training. Some subjects also have competence aims after grade 2.

In the subject curricula the five basic skills are integrated in a way that is adapted to each subject. These skills are: Being able to read, being able to express oneself orally, being able to express oneself in writing, being able to develop numeracy and being able to use digital tools.

The Subjects of Primary and Lower Secondary Education

Norwegian	Mathematics
Social Science	Foreign Languages/ Language In-depth Studies
Christianity, Religion and Ethics Education	Arts and Crafts
Natural Science	English
Food and Health	Music
Physical Education	Student Council Work
Optional Programme Subject	

² **White Paper No. 30** (2004-05) Norway “Culture for Learning” (*Kultur for læring*).

³ **White Paper:** Early intervention for lifelong learning:

http://www.regjeringen.no/nb/dep/kd/aktuelt/taler_artikler/Kunnskapsministerens-taler-og-artikler/Djupedal/2007/Fair-and-Inclusive-education.html?id=472840

English is a compulsory foreign language from grade 1. In the lower secondary school pupils can in addition choose between another foreign language and in-depth studies in Norwegian or English or Sami. At the lower secondary level there are specially designated periods for student council work. For deaf pupils there are curricula for Sign Language as first language, Sign Language In-depth Studies and adapted curricula in Norwegian, English and Drama and Rhythm.

New national tests are in application in reading and numeracy since the autumn of 2007. The test results will determine whether pupils' skills are consistent with the learning outcomes for the basic skills. The results of the tests are to be made available to those who are involved with qualitative developments in the schools. The objective is not to make a ranking between the Norwegian schools.

Education according to the Sami National Curriculum for the Knowledge Promotion

In collaboration with the Sami Parliament (the Sameting), a separate curriculum for primary and secondary education and training in Sami districts has been developed. The subject curricula are partly separate curricula, such as for the Sami language and for duodji, and partly adapted parallel curricula, such as for natural science, music etc. As well as this curriculum is ensuring that pupils in primary and secondary education and training in Sami districts receive their education in Sami, it also gives Sami pupils an individual right to learn the Sami language wherever they live.

1.3.3. Teacher education in Norway, challenges and questions about new structure ⁴

by Hanna Marit Jahr, Ministry of Education and Research

Basic training

Pre-primary teachers follow a three-year pre-school teacher education programme leading to a pre-primary teaching certificate. There are several ways to qualify for teaching at the various stages of the primary and lower secondary education. Most teachers at this level (ISCED 5) have a four-year course in general teacher education at tertiary level of education. Some have a four-year university degree with an extra one-year course in educational theory and practice.

Teachers at the pre-primary and primary stages are most commonly generalists. At the lower secondary stage, there are some subject specialists, but most teachers are trained as generalists. Teachers at upper secondary stage are all subject specialists, either from university with a one-year course in educational theory and practice in addition to their three-year to five-year degree, or from vocational training in combination with a teaching qualification.

All teachers receive introductory courses in special education and support services in their initial training. Half a year of special education is required in the initial teacher training. There are also mainstream in-service training programmes on special education issues

Competences for all teachers

- *subject competence*: familiarity with the content, theories and methods associated with the various basic subjects, knowledge of children, childhood and child education and knowledge of theories and working methods in and across subjects

⁴ This contribution is based on the following sources of information :

http://www.regjeringen.no/Upload/KD/Vedlegg/UH/Rammeplaner/Lærer/Rammeplan_laerer_eng.pdf
<http://www.eurydice.org/portal/page/portal/Eurydice>.

The OECD publication Teachers matter.

- *didactic competence*: ability to analyse curricula and reflect over content and working methods and make provisions for learning and development processes for all pupils
- *social competence*: ability to observe, listen, understand and respect the views and actions of others, ability to cooperate with pupils, colleagues and parents and guardians and ability to function as a leader in a community of learners
- *adaptive and developmental competence*: ability to assess one's own activities and those of the school, contribute to development of the teaching profession, take part in local development work and strengthen one's own competence
- *professional ethics competence*: insight into one's own attitudes and the ethical challenges of the profession and ability to assess learning situations in the light of basic educational values

Specialist teacher training

All initial teaching qualifications include elements of study in the field of special education. Teachers may also take additional in-service courses. Special education is offered as an upgrading course. Many colleges offer one or two years of training in special education on a full-time or part-time basis. The Institute for Special Education at the University of Oslo offers training at masters and doctorate levels. Nearly 18% of the teachers in compulsory schools have studied special education one year or more in addition to their initial training. The focus in the training for special education teachers is upon different special educational topics and on preventive work and counselling. There are no special programmes focused on inclusion. Municipalities employ teachers of pre-primary level and primary and secondary school, while counties employ teachers at upper secondary school.

Objectives of the practical training in teacher training

- become familiar with the diversity of professional tasks
- encounter the practice field as an arena for study of the subjects and as an arena for exploration
- develop knowledge of the interaction between pupils and between pupil and teacher and knowledge of school management, class management and teamwork
- reflect over and develop didactic knowledge relating to the subjects and across the subjects
- work in a multicultural learning environment and make provisions for adapted education for all pupils
- experience cooperation with parents and guardians and persons who share responsibility for the environment in which the children are growing up
- analyse experience of practice in the light of theory, curricula for the primary and lower secondary school and own experience with pupils
- gain experience of working methods that promote entrepreneurship

The teacher education system is characterised by the following challenges and ensuing discussions

The status and the recruitment to the teaching profession is a problem. Only 1,5 candidates apply for every post available. In Finland it is 10 to One!

Furthermore there is a high drop-out rate of those starting the studies of teachers.

There is a lack of teachers of sciences and of languages

There is a major problem as to the quality of the primary school teachers teaching MST.

The quality of the practical training has to be improved. New forms of cooperation have to be developed and implemented between schools and higher education institutions.

Systematic and targeted work has to be developed to improve the competence of teaching staff.

More R & D activities have to be developed oriented towards topics relating to teaching, teacher education and early childhood education.

New school-relevant programmes have to be developed at MA-level. Lack of PH.D is a problem to organise those MA programmes.

Quality assurance

Institutions of H.Ed. organising initial teacher education and training are subject to QA through the independent Norwegian Agency for QA in Education (NOKUT). This NOKUT also has the power of accreditation in H.Ed.

1.3.4. Norway and PISA results 2003 and 2006 ⁵

By Rolf Vegar Olsen, EKVA, University of Oslo

Information was given as to how the results were for scientific literacy. This item includes how scientific knowledge is used in everyday situations such as interpreting information in newspapers and journals. The test demands of the students that they have scientific knowledge and that they are able to relate and reason in concrete situations which are described in the text. Scientific literacy in PISA gives priority to three scientific competencies. Explaining phenomena scientifically is about knowing and applying appropriate knowledge of science, such as facts, concepts and laws, especially in regards to interpreting phenomena and predicting changes in a given situation. The students have to use their knowledge of science or about science, in a given situation, or they have to explain phenomena scientifically. Identifying science issues requires that students show knowledge of science and what is regarded as key features of science. Students are also expected to be able to recognize what kind of issues can be investigated scientifically, and show that they are familiar with the main procedures of scientific enquiry. Using scientific evidence, requires students to make conclusions base upon the evidence, give reasons and produce arguments for or against a given conclusion and show that they are able to communicate their reasoning and evidence which they rely upon.

The PISA results of 2003 for science were expanded upon showing Norway was doing below the average compared to the Nordic countries in Europe. The Finnish students' score best of all the participating countries on the science items in PISA, but otherwise the Nordic countries do not perform particularly well. Only Sweden performs over the OECD average, but the difference is not statistically significant. Norwegian students have the lowest score among the Nordic countries, and only six OECD countries have a lower score than Norway. The average deviation from the average value (distribution) is similar to the OECD average, but after Iceland, it is the highest among the Nordic countries. The Norwegian results in science are definitely worrisome.

The Norwegian students achievements are considerably lower in competence 3, Using scientific evidence, than the two other competence classes, Explaining phenomena scientifically and Identifying science issues. The same profile is seen in Denmark and Sweden. The Norwegian students show their strengths in Knowledge in Science, less in Knowledge of Science. They also achieve relatively better in subjects of geology and biology then subjects in physics and chemistry, even if the difference is not very large.

It is also a general characteristic of Norwegian students to report less than average interest for science, just like students from the other Nordic countries. The Norwegian students appear in an international perspective with quite average awareness to the environmental problems, but they seem to be less worried and more optimistic about the future and the possibility to solve these problems.

⁵ See also the website: <http://www.pisa.no/pdf/Chapter1and11PISA2006.pdf>

The Norwegian mathematics results show a weak but continuing decline in the period from 2000 – 2006. As to mathematics Finland outperforms all the Nordic countries. The students from Iceland, Denmark and Sweden performed higher than the OECD average, but only the Swedish students score significantly better. The Norwegian results is disappointing, since the Norwegian students score significantly lower than the OECD average for the first time in PISA. When looking at the variation, it is also highest among the Nordic countries and at the same level as the OECD average when it comes to mathematics.

Norwegian students do well on tasks regarding practical probability and statistics, while they are performing weaker in the other areas included in PISA. There is particular concern about the Norwegian students' weak performance regarding basic arithmetic.

In regards to the stress in working for equity and equal opportunities, these results are more than problematic for Norway. According to these results, the Norwegian schools are NOT able to reduce the differences between the students.

The analysis of the PISA results as to MST pointed at challenges regarding changing student- and teacher roles, especially related to student centred learning and unclear learning goals. In this relation there is a need for teachers with more subject knowledge and who can be the leaders of the learning activity. It is also clear new 'active' learning activities demands much more of the teacher when it comes to subject knowledge and subject didactics reflection.

A careful analysis had been made of the PISA results as to MST for Norwegian schools. These showed that more attention had to be given to the following approaches in MST:

- Interactive teaching methods which focus on pupils explaining phenomena, giving their opinion, debating about issues in formal and informal discussions.
- Hands on teaching and learning methods such as practical laboratory exercises and experiments; the pupils drawing themselves conclusions;
- Inquiry-based (investigative) approach for learning; the pupils design the questions themselves, they also design the (open-ended) experiment themselves, they choose the investigation method to be used; they debate about their investigations and the outcomes and write subsequently reports.
- Applications; youngsters are invited to apply what they learn to real life contexts.

The weak pedagogical leading in classrooms is one main concern for interpreting the decline in the subject achievement level. Student active learning processes are important but they demand a stronger didactic leader who helps the students to guide towards their learning goals and also hold high expectations and check their work and learning outcome. It was strongly stressed that in all interactive approaches the role of the teachers was very important. Interactive methods require special competences and skills of the teacher to manage the process, to coach the pupils and to organise the scaffolding of the pupils during the learning process.

It was stressed that the lack of competency of primary school teachers in the field of MST is one of the main causes of this poor performance of pupils. A white paper is expected on the role of the teacher in 2008 proposing different reforms in initial teacher education. One of those will be that teachers will only be able to teach a subject if they have spent 60 ECTS credits on it. It is also expected to introduce a subject "professional studies" which will introduce teachers in a.o. active learning methods such as hands-on and inquiry-based science teaching / learning approaches. It is also hoped that the full implementation of the white paper "Culture for Learning: the knowledge promotion" and the white paper "...and no-one was left behind: Early measures for lifelong learning with focus on competence-based curricula, learning outcomes and a quality framework will change the situation for the better towards the future.

PART 2: The national strategies as to MST in Norway

By Thorvald Astrup, Ministry of Education and Research

2.1. Introduction

Two national strategies as to MST have been implemented over the last 6 years in Norway. **In 2002 the first Norwegian strategy** for the strengthening of math, science and technology (2002-2007) was launched. The National Centre for Mathematics in Education and National Centre for Science in Education were established in 2002 and 2003. These events contributed to putting focus on the problems among the actors in the field. Lack of necessary financial support was a problem, and still is. One of the main features that have been constructed is The National Forum for MST including participants from the Industry, trade unions, the educational establishments and other stakeholders. This forum launched several initiatives such as informing all youngsters at the end of the lower secondary school of what certain jobs in science and technology stand for.

In 2006 the second strategy (2006 – 2009), “A Joint Promotion of Mathematics, Science and Technology” was launched

2.2. The 2006 – 2009 MST Strategy, principles, priorities and activities⁶

2.2.1. Motivation for the strategy “A Joint Promotion of MST”

MST competence is a necessary condition for being able to function in a modern society and to participate in democratic processes. Norway needs the competence in order to keep its own private economic affairs in order, to be able to form qualified opinions in the public debate on key matters such as the ethical aspects of gene technology, or to take a position on important matters that are based on economic and social priorities. Solid knowledge in MST is a source of self-realisation. Understanding more of the world around us is a source of increased awareness, understanding and enjoyment of our surroundings. In addition Norway must have sufficient insight to understand environmental challenges and take correct actions and also take part in the international cooperation on these challenges as a highly qualified party. One of the current challenges is that many young people do not see how or for what purpose knowledge in MST shall be used. The significance and application of MST must therefore be made more apparent and more relevant.

2.2.2. Main constituents of the strategy

In order to succeed in the effort to give the society necessary MST competence, there are two main challenges that have to be met:

- The recruitment to many programmes of study with a technological and natural science orientation is too low.
- The performance in MST of Norwegian students is too low.

The first challenge deals with the fact that an insufficient number of students in Norway choose MST areas of study. The second challenge is associated with the fact that Norwegian pupils in primary and lower secondary education do not have a good enough performance in mathematics and the natural

⁶ 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%20realfa_g_engelsk.pdf

sciences, and their performance is becoming steadily poorer. This is a cause for concern not only from the perspective of recruitment, but also because a knowledge of mathematics and the natural sciences is essential for mastering the challenges of everyday life.

In order to provide the 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 depth study in MST in upper secondary education and to make career choices based on natural science and technological areas of study
- strengthen MST in teacher training and raise the MST qualifications of existing teachers
- improve the quality of teaching in MST by developing and spreading good teaching practices
- increase the cooperation between education and working life in order to create a greater sense of relevance and to encourage recruitment.

2.2.3. Main priorities and measures

Quality of teaching

The quality of the teaching must be improved. Efforts will have to be made so that Norwegian teachers are given better qualifications for teaching MST, e.g. through continuing education and training. The number of qualified MST teachers must be increased at all levels of education. In addition, efforts will have to be made so that good methods of presentation and teaching are developed and spread. The framework conditions for teaching must be good, e.g. the equipment situation must be good enough.

Recruitment

In order to improve both performance and recruitment, certain parts of the instruction must be made more relevant to students. A closer collaboration between education and working life must be developed in order to make the subjects' applications and significance more apparent and to increase the motivation to study MST. There is a need for good role models who can inspire students.

It is especially important to improve girls' motivation to study MST. Girls are less likely to choose higher education and careers in these subjects. Reversing this trend will be important for the girls themselves, for equal status in general and for recruitment for working life. Up-to-date knowledge, good role models, closer contact with working life, targeted recruitment measures and positive activities in the society can combine to give increased recruitment.

That students apply to study MST is a necessary condition for further recruitment to research. The challenges to research are associated with recruitment enough good candidates for education as a researcher and to give them an education as a researcher that paves the way for activities in research institutions, trade and industry, and society in general. In order to help bring about increased innovation in business and society in general, interaction and cooperation with the research institutions must continue to be strengthened.

There is a national forum for interaction between working life and the educational sector (in which the Minister participates) in a joint effort to promote MST. Cooperative forums between education and working life will be further developed as it is necessary to have forums both for policy-related cooperation and for more technically-oriented cooperation. The mandate for these forums is to develop good initiatives to strengthen MST in a collaboration between education and working life and help see that these measures are put into practice.

Working life and business must help facilitate these processes and play an active supporting role. It is essential that these players think in the long-term in order to develop and maintain good research, development and centres of excellence in this country, even during economic recessions.

Continuing education and training programmes

Continuing education and training programmes will be important in order to provide working life and trade and industry with enough expertise. This applies to both basic skills in mathematics, which has been shown to be a big challenge in many areas of working life¹⁵, and updating professional competence and further development in certain disciplines. The most effective way this can occur is through closer cooperation between education and working life than that which exists at present, and by associating the teaching more closely with workplaces.

The media

The media also play an important role in conveying relevant material and being a channel for spreading information about new knowledge and interesting events that may help increase our knowledge about and understanding of the importance of MST in our practical everyday lives.

2.2.4. Short and long term activities and goals

Many of these steps cannot be taken overnight, and for a majority of the initiatives it will take a long time before their impacts become apparent. It is necessary to institute initiatives that have both short-term and long-term effects.

- In the long run, it is necessary to improve the situation regarding MST in the primary and secondary education in Norway. This will require 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 run, it will be necessary to make an effort in several areas. The Recruit be strengthened. The career opportunities must be made more apparent, we must succeed in influencing more young people to study MST, and the contact between education and working life must be strengthened.

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 and its 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 the 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!

2.3. Evaluation of the first strategy

By Allan J; Christensen, Ramboll Mgt

The second strategy 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 1st 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 highly 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 1st 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 that 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 the 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.

PART 3: Specific initiatives or projects that support the Norwegian MST strategies

3.1. Visits to schools

The visits to two schools (The Nesbru upper secondary school and The Vevelstådasen School with primary and lower secondary) enabled the participants to understand better the Norwegian education system and the way it works through the **large autonomy given to the schools**. The visits also showed how the motivation and interest for and quality of MST teaching and learning were promoted. Different organisation of timetables in large blocks of up to half a day or even one-day per week focusing on key subjects such as MST combined with hands-on and inquiry-based approaches plus a creative and stimulating use of ICT are implemented to have a major effect on the interest and motivation of MST. The vision and mission of the school supported through the head, proved to be a key element in this area!

The participants had the opportunity to see **different innovative measures to promote MST concretely at work**. The implementation of the **(new) 'Technology and research' subject** in the curriculum of the upper secondary school stimulating the interest for MST is one of those. Another one is the new subject focusing on 'Earth sciences'.

The inquiry-based approach applied in the 'Nysgjerrigper project' (Making youngsters more curious!) in the primary school and lower secondary school is another IBST (Inquiry-Based Science Teaching) approach that seems to pay off. The participants could attend lessons showing how **ICT was used in maths education** at the level of the compulsory school. The visits also enabled the participants to witness how schools implement an inclusive and social inclusion policy for all children with learning difficulties or other disadvantages.

During the visits the participants could also see the efforts schools make to implement **inclusive education** both at the level of children with various learning difficulties such as physical handicaps or learning problem due to the fact that are children of parents that have just migrated to Norway. Special computers were available for pupils with sight problems.

The special efforts to help children of migrant parents were also thought to be particularly interesting. Special lessons were given in the native language of the children (Somali, Arabic, Kurdish) by people who themselves had emigrated earlier to Norway as it is clear that a good knowledge of the mother tongue also has a positive impact on the learning of the Norwegian language and on learning in general. It was also particularly interesting to see that every Wednesday a tandem of children – one child of migrant origin together with one of its Norwegian friends- prepared together with a teacher a meal for the teachers so as to get acquainted with the Norwegian food and the way of living in Norway;

The Nysgjerrigper project (Inquiry-based science teaching method)

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.

The Nysgjerrigper Science Knowledge Project for children in primary school has been administrated under the auspices of the Research Council of Norway for more than 15 years. In Norwegian the name

Nysgjerrigper is the equivalent to the English curious George. In other words, a person who wants to know about everything that is going on, and questions every topic. 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 also participates in international conferences and gatherings.

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 problems. 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 patterns 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 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 teachers' guide to scientific methods of the Nysgjerrigper project describes this method and it is a very useful tool designed to help primary school teachers and pupils. The objective is to inspire educators and communicators to put scientific working methods on the agenda.

The Nysgjerrigper magazine is published four times a year, with lots of interesting articles on famous explorers, archaeology, space, strange animals and much, much more.

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.

Drawings children sent to Nysgjerrigper in the 1990s generally depicted male scientists in laboratory situations. None of the drawings showed female scientists at work. The project is trying to raise interest for science with girls and to promote the image that women also have to be scientists and researchers.

3.2. Research in science education

3.2.1. THE ROSE project and recruitment to MST, attitudes and gender issues

By Camilla Schreiner, Norwegian Centre for Science Education

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. Industrialized countries cover their own expenses, while some funding for data collection has been provided for developing countries and countries with less available resources.

Two other studies were briefly presented; On the one hand the **Project "Liljekonvall" (Lilly of the Valley)** focusing on the girls' and boys' choice to study or not to study MST. The objective is to find out if different recruitment efforts for boys and girls have an effect. Next to this the **IRIS study "Interest**

and Recruitment in Science” is under development. It will focus on factors influencing recruitment and retention into MST in higher Education. It will also focus on gender equity in H.Ed.

3.2.2. The PISA+ project

By Marianne Ødegaard, Norwegian Centre for Science Education

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.

As a conclusion the following elements of the PISA+ project can be highlighted:

- The overall results of the research through videoing the teachers are a starting point for discussion in in-service training of teachers;
- There is no individual follow-up of the teachers but there is an open seminar for all teachers when the videoing activities of the PISA+ are over;
- The main idea is to make teachers reflect on their teaching and classroom activities so as to come to improvements as to learning and teaching of MST; it is to show which teaching strategies are efficient and effective and which ones should better not be used;

Several websites were mentioned during the PISA + presentation which in a combined way, can promote active learning in the MST classroom. They are mentioned as a footnote just for information⁷.

3.2.3. The National Research School for doctoral students in MST of Norway

By Doris Jorde, Norwegian Centre for Science Education, University of Oslo

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.

Dr. Doris Jorde expanded on the efforts that have been made to develop the National Research School for doctoral students in MST in Norway 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 be allowed to the National Research School of Norway which is located at the University of Oslo.

3.2.4. Mind the gap, 7FP project

By Doris Jorde, Norwegian Centre for Science Education, University of Oslo

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 that 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.

⁷ Some websites to be combined into MST teaching and learning:

<http://www.sesam.no>

<http://www.netvibes.no>

<http://www.diigo.com>

<http://www.viten.no>

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 will be 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

Participants of the Mind the Gap project are : University of Oslo (NO), Centre National de la Recherche Scientifique (FR), University of Copenhagen (DK), University of Bristol (UK), Université Rennes2- Haute Bretagne (FR), University of Kiel (DE), Hungarian Research Teacher's Association (HU), Universidade de Santiago de Compostela (ES), Friedrich Schiller University of Jena (DE).

3.3. The Norwegian Centre for Science education

By Anders Isnes, NCSE

3.3.1. General information about the NCSE

Vision, mission and values

The centre is built on a clear vision and mission statement. The vision can be summarised in the following key word KIMEN (seed)

- Kompetense (Competences)
- Inspirasjon (Inspiration)
- Engasjement ' Engagement / commitment)
- Naturfag (sciences)

The word KIMEN also stands for the 'Budding' scientists which can be supported at different levels of the education system.

As to the values, the NCSE intends to challenge the intellect, attitudes and feelings; it intends to establish science literacy as part of our culture; science is to be learned by the individual in social processes; science is the basis for our living standard.

The centre is a national resource centre for science education (kindergarten, primary and secondary school, adult education and teacher training). Its main objective is to enable pupils and teachers to consolidate competence and motivate interest in natural science. This is achieved by developing and improving content and methods through research, experiment and development projects. Furthermore, the centre contributes to actions aimed at increasing the recruitment to scientific and

technical studies. The centre seeks contact with societies of science education on a national, Nordic and international level. The NCSE 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. Collaborators of current interest are milieus of universities and university colleges, museums, primary and secondary education and industry.

The centre leads and coordinates, in collaboration with other milieus of relevant specialized fields, the work 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. Among other things the centre shall contribute to the development and the testing of computer based learning materials and the organization of web based learning environments in natural science.

The centre contributes to the information and dissemination of results from research, experiment and development projects in those areas which are the tasks of the National Centre of Science Education. This can be accomplished through courses, seminars, visits at the centre, material development, written material and web based solutions. The outreach activities are especially promoted through periodicals, websites⁸, annual conferences and seminars of teachers, science ambassadors that disseminate innovation in science education across Norway.

The centre assists actions to develop in-service training and further education for teachers of natural science in primary and secondary education and teacher training. It contributes to develop positive attitudes and a thoughtful view of natural sciences in society.

The centre 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. Especially, the centre contributes to ensure a good progression and continuity throughout education with regard to natural science education.

The centre develops contacts and collaboration with national, Nordic and international networks, organisations and milieus of research and development in natural science didactics. The centre builds up an overview of relevant projects/experiences/materials.

The centre collaborates with other national centres and advisory councils of current interest such that the work to promote science is coordinated in a good and functional way.

The centre contributes to promote equal opportunities in natural science education, when it comes to gender, socio-economic differences and multicultural milieus.

The centre is localized at the Faculty of Mathematics and Natural Sciences, at the University of Oslo.

The director relates to the Ministry of Education and Research in specialized questions and to the Faculty of Mathematics and Natural Sciences in administrative questions. The Ministry approves yearly plans, budgets and economy and follow up the activities.

Website: http://www.naturfagsenteret.no/mandat_en.html

⁸ Websites mentioned:

<http://www.viten.no>

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

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

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

<http://www.sutain.no> (to create partnerships with other schools at Eur. / internat. Level)

3.3.2. Research activities at the NCSE

To implement all the activities involved as to the improvement of science education has the NCSE had major research activities. Its major research activities were expanded upon earlier in this report.

The following are some of the key projects explained earlier:

- the ROSE project: Relevance in Science Education
- the PISA + project looking at teachers and pupils behaviour in MST class activities
- The Mind the gap project

3.4. The 7 Norwegian Science Centres

By Merethe Frøyland , Norwegian Centre for Science Education

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.

Research has shown out that in the past there was a weak link with the visit of pupils and schools to the science centres and the curriculum. The visit was not integrated in the programme of the pupils. There was no pre-visit activity and no post visit activity. Furthermore the science centres rarely evaluated their work and the impact they may have on teaching and learning sciences. In fact this research showed that the science centres tended to forget about the role they could play towards the pupils as to enhancing their motivation and interest for sciences.

This has led to new approaches by which the visit to the science centre has to be closely integrated in the normal curriculum activity at school. Thus efforts are made to analyse where the visit to the science centre best fits into the curriculum. In some cases more than one visits. Pre-test and post-test are introduced. There is on-going assessment of what the pupils have learned and of what the science centres do with the pupils. Thus the focus is now fully on the pupils and the contribution of the visit to the science centre to the learning and teaching of sciences.

The cooperation between the school and the science centre is decided by the two parties and attention is paid to it that the work which is done in the science centre is complementary to what happens at school. The science centre is a different learning environment and thus activities have to

be done at the science centre which cannot be done at school. Hence it should be avoided to do activities at the science centre that can be done at school.

Finally information was also given on the Museum project BRUDD (Breach) which focuses on combining in museums and science centres activities of a controversial natures. Exhibitions were thus developed in a science centre to focus on homosexuality with animals, on whaling etc. This approach proves to be very stimulating in generating positive dialogues and reflections.

3.5. The Norwegian Centre for Mathematics Education

By Tor Andersen, NCME

The Norwegian Centre for Mathematics Education was established August 1, 2002 and it's primary is task to lead and coordinate the development of new and improved working methods and learning strategies in the mathematics education, from kindergartens through teacher education in Norway. The Centre shall also contribute to a close and good Nordic cooperation.

The Centre's primary targets are first and foremost teachers teaching mathematics in schools and teacher education, teacher students at Colleges and Universities and teaching aids developers. In order to build a general positive view at mathematics, parents, media and the public are also important targets for our 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 developed to help teachers
- Outdoor activities for maths are developed
- 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>

3.6. The website *matematikk.org* website: <http://www.matematikk.org>

By Hege Kaarstein, Institute of Maths, University of Oslo

The information on this website is only available in Norwegian.

Lessons plans can be sent in by teachers are , after evaluation, put on the website so that other teachers can access them. The lesson plans are presented under the heading of the curriculum programme where they belong so that teachers only have to search under the objectives of the programme to find the appropriate lessons. All the lessons are composed of a part of instructions and information for the teachers and another part focusing on exercises for the pupils.

A selection of games is also available on the website for pupils such as Sudoku and Kakuro. The maths calendar also raises a lot of interest. The website is funded by the Norwegian Research Council on the one hand and by a BP related company on the other hand. So far it has been operating more or less independently but in the near future its activities are closely linked to the activities of the Norwegian Centre for Mathematics Education.

Part 4: Strengths, areas of concern, outcomes of the PLA discussions

Here below are first mentioned the different strengths of the Norwegian which the participants to the PLA mentioned during the different discussions and during the final meeting of the PLA. The strengths concern both the Norwegian education system as a whole and the strategy for MST in particular. Next to this there are concerns that seem to be common to several if not to all countries involved in the PLA. Finally some elements are mentioned which were debated during the various discussions moments of the PLA.

4.1. Strengths of the Norwegian education system and of the national MST policy

Several elements struck the participants as being strengths of the Norwegian education system in general and the national strategy for MST which is implemented at the moment. These strengths became apparent during the numerous presentations, visits and discussions held during this PLA.

Strengths as to the Norwegian education system in general :

- The overall **concern at all levels to work on the quality** of the education system constantly taking into account a.o. outcomes of national exams plus the findings of the PISA studies;
- The **autonomy** the schools have and which they translate into the flexible organisation of the school time and the time table to the benefit of learning and to the benefit of the organisation of creative learning environments;
- The different **key concepts** that lay at the basis of the Norwegian education system such as autonomy to be given to the pupils, the promotion of the sense of innovation, respect for diversity, active participation of all stakeholders, inclusive education.
- The fact that the education seems to promote more **creativity, teamwork** and the sense of **initiative** with children
- The strong focus on competence-based education and **learning outcomes** to be achieved. The whole system seems to be clearly focused on the output-based approach;
- The strong stress put on **key competences for lifelong learning** to be acquired by all children which is translated into creative pedagogical approaches;
- The strong focus on **in-service training and professional development** of teachers and other members of staff;
- The clear focus on the **caring school and equal opportunities** for all youngsters, boys and girls, native Norwegians and all youngsters of migrant origin, children with various learning difficulties and/or handicaps;
- The interest and **active promotion of European and international cooperation** as to schools as highlighted during the visits;
- The **commitment** of all the services and people involved in the development and implementation of education across Norway;
- The **close cooperation** between the different services (the Ministry of Education and Research, the directorate for Education and training, the schools, the universities, the NCSE, the NCME, the national science centres, science museums, The Norwegian Research Council etc)
- The commitment of the schools and the teachers to focus on the quality of education and learning, on the **welfare and well-being of every child** to optimise its talents in a lifelong learning perspective. The lack of pressure put by the education system on the pupils.
- The **knowledge of English of all pupils and teachers** met was of a very high quality.;
- The **openness** with which all issues and topics were addressed during the PLA.

Strengths as to the 2nd MST strategy in particular:

- The clear **and realistic structure of the national MST strategy** with goals and sub goals linked to indicators for each of the goals and sub goals;
- The fact that **all stakeholders are well informed** about the strategy and know clearly what their roles are plus which objectives they have to reach through the indicators;
- The **strong interaction between the different key stakeholders** involved in the development and the implementation of the strategy: the Ministry of Education and Research, the directorate for Education and training, the schools, the universities, the NCSE, the NCME, the national science centres, science museums, The Norwegian Research Council etc.
- **The key role of the NCSE** as to the development and the implementation of the second national MST strategy;
- The fact that there is a clear **link between the development of the national strategy for MST and the results of the research** carried out. The research seems to be a major pillar of the strategy for innovation in MST.
- The research as to **gender specific issues** linked to youth cultures was particularly appreciated as it linked up with raising the interest for MST teaching and learning and careers in that area
- The **research** carried out by the Norwegian Centre for Science Education and possibly by other stakeholders) is **closely linked to classroom and school practice and to in-service training** of teachers so that it has a direct impact on the quality of learning and teaching of MST;
- The fact that the 2nd strategy for MST has clearly taken into account the **recommendations and conclusions of the evaluation of the 1st strategy**;
- The **quality of the evaluation of the 1st strategy** was also greatly appreciated and thought to be useful to many cluster countries;
- The introduction of **a new subject** “Technology and research” which was tested in several schools at the moment; focusing on the budding scientist or researcher in every child, as suggested in the Norwegian strategy, was thought to be particularly important;
- The **supportive structures** such as the 7 science centres, the Norwegian Science Education Centre (with its science ambassadors) and the National Centre for Mathematics Education (with its regional maths resource persons), The website for Mathematics etc.
- The **strong cooperation** between some of those actors such as the science centres, the museums and the schools to come to real complementarity in their activities;
- The **several examples of IBST** (Inquiry-based science teaching) shown in practice
- The use of IBST was facilitated by the **flexible organisation** of the timetable and assignments within the job of a teacher
- The fact that the introduction of a **subject “professional studies’** is envisaged in initial teacher education to train teachers in hands-on and inquiry-based approaches and the use of ICT based tools in the different curriculum activities;
- The various efforts, made within the framework of the MST strategy to promote interest for MST and the fact that those efforts also received **adequate financial support** seemed to be a major reason of the results reached so far.
- The **role of the teachers** in contributing to enhancing innovation;
- The different initiatives that seem to promote the **teacher as a reflective professional**;
- The strong focus on **action research** or action-oriented research in science education in general and in teacher training in particular;
- The focus on **peer learning activities** so that teachers can learn from one another in teams was thought to be an important element in creating schools as learning organisations.

4.2. Concerns for the participating cluster members

Participants raised some concern as to:

- The large autonomy of the schools wondering how the ministry of education and science could influence, stimulate, monitor and evaluate innovation in the education system as a lot of the responsibility was with the municipalities and the counties. As autonomy in schools across Europe was a concern, one of the latest publications of Eurydice is referred to.⁹
- External quality assurance mechanisms that are limited to the national exams. This surprised somewhat the participants. It was not clear how self evaluation tools and other external mechanisms were applied in the schools.
- The quality of initial teacher education especially for teachers in the primary and lower secondary schools . Some elements for solving this problem were mentioned but deepening this issue would be appreciated as it concerns many countries. These are major concerns of the Norwegian colleagues themselves.
- The recruitment of new teachers. Several countries lack a.o; teachers of science Also here further investigation is needed across several countries as it concerns many countries. the lack of detailed content as to the curriculum;
- Further information on how the second national strategy for MST is being evaluated; which mechanisms are set up to see that all the indicators are reached and which action is taken if the indicators are not reached. It would also be useful to know about how progress as to the different goals and sub goals of the national strategy is documented.
- The integration of various teaching techniques in one lessons or block of lessons to facilitate the full implementation of the IBST method (combined with ICT based tools and techniques) was thought to be essential. Teachers do not have the skills to do this. It should be looked into how initial and in-service teacher education can help promote this.
- The use of ICT as a supportive tool to the teaching and learning of MST seems to be major concern for all the members of the MST cluster. The participants to the PLA had very different and diverging opinions on how and to which extent to use ICT in MST. It was suggested to possibly look into this issue in close cooperation with the cluster dealing with ICT in education.
- The role of companies / industry was not explicitly addressed in the Oslo PLA but it requires the particular attention of all ministries promoting MST across Europe. It was suggested to follow very closely the initiative which was being set up by The ERT (European Round Table of Industrialists) as to maths in the primary school.
- The competency-base curriculum focusing on learning outcomes was an issue of interest to all participants. However, key questions were raised as to how the assessment has to be organised in a system focusing on the acquisition of competences and on the learning outcomes achieved.

⁹ Eurydice publication on autonomy of schools:
School autonomy in Europe: policies and measures, Eurydice, December 2007, Brussels
http://www.eurydice.org/ressources/eurydice/pdf/0_integral/090EN.pdf

4.3. Issues addressed during the discussions within the group

The PLA was a unique opportunity to have lengthy and **in-depth discussions** with the participating colleagues on various issues. Several of those were already mentioned in the items here above that focus on the strengths of the Norwegian education in general and of the MST strategy in particular on one hand and on the other hand on the concerns raised by the participants. Some further issues addressed are mentioned here below. There are not expanded upon as some were merely touched upon or were not discussed at length.

- The competency-based MST curriculum and the way it is assessed
- The assessment of pupils with particular interest for national assessment
- The development of indicators to assess education policies
- The national curriculum and the way it is developed and/or upgraded
- The use of ICT in MST: advantages, limits, cost efficiency
- The advantages of, problems with or limits of hands-on and investigation approaches (IBST)
- The role of initial teacher education in promoting and strengthening MST
- The autonomy of the schools in enhancing creative learning environments
- The gender issues in MST; how to address the participation of girls to in MST
- The cooperation with industry and other stakeholders
- The evaluation of policies and action plans to enhance MST learning and teaching.
- The contribution of MST to promoting equity, equal opportunities and social inclusion
- The quality assessment schools and ranking of schools
- The problem of how to deal with differences in the PISA results related to the social and/or ethnic background of the children

4.4. Some conclusions

During the final discussions all the participants stressed that they had been strongly impressed by the Norwegian education system for several of the reasons that were expanded upon above under the headings of 'strengths' of the system. All the participants stressed again the importance of the organisation of PLAs as a major contribution of policy development in the field of MST. It was repeated that PLAs are an excellent contribution to evidence-based policy development. It was also stressed that the coherence in the cluster had grown over the three years that PLAs have been organised. One can now see how the PLAs have stimulated cross-fertilisation across the member countries of the MST Cluster.

Part 5: Evaluation of the Norwegian PLA

Some quotes from participants

The PLA had been very useful: new ideas for MST curriculum development, scientific inquiry-based approach, use of ICT. The information about the Centre of Science Education and Norwegian Centre for Mathematics Education will be very useful for explanation of necessity to establish similar Centers in Latvia too.

I have got confirmation that educational reform what we have started in our country according to MST in general education is very similar to the activities what we have seen in Norwegian schools, only our economic situation is different and our educational system is more centralized.

As conclusions from PLA for the future policy development some key words: research on MST education, cooperation between different stakeholders, evaluation of policy documents by different experts, methodological support for teachers.

La visite de l'école élémentaire m'a paru très intéressante. Elle montre bien combien la Norvège met l'accent sur l'autonomie des élèves et le développement de l'esprit d'initiative. Le statut, l'implication des professeurs apparaissent comme des éléments clés de cette politique. Je m'interroge par contre sur l'équilibre entre développement des attitudes et acquisition des savoirs. Autre point qui m'amène à m'interroger et à proposer cette réflexion à mon ministère: le travail sur l'inclusion sociale et l'intégration, avec la mise en place de l'enseignement des langues maternelles non norvégiennes: kurde, arabe, etc.

La visite du lycée m'a paru également intéressante sur les points suivants: construction d'un projet spécifique innovant (regroupement des cours par blocs), autonomie de l'établissement, nouveau programme de technologie et recherche; j'ai cependant regretté de ne voir essentiellement que des classes "d'élite" préparant le bac international, et non des classes de sciences plus usuelles même innovantes.

J'ai beaucoup apprécié les présentations recherche de Doris Jorde et Camilla Schroder. Le développement d'une formation des enseignants "research-based" et d'une recherche "active", basée sur les observations de terrain, me paraît être un axe très prometteur

In Denmark we have a system which is very similar to the Norwegian. Therefore it was very useful to hear of the Norwegian experiences – especially on topics as gender problems, national strategy, inquiry based science teaching (Nysgerrigper-metoden) and resource centers for the support of science education.

Summary of the evaluation forms

All the participants strongly agreed that the programme of the PLA was well balanced as to the contents giving a full overview of the different activities and issues related to the development and the implementation of the MST strategy.

The participants also strongly agreed that the programme enabled them to meet all the key actors or beneficiaries at all levels concerning the promotion of maths, science and technology. They indeed had the opportunity to meet the decision-makers, the representatives of the Ministry of Education and Research, of the University of Oslo, of the Norwegian Centre for Science Education, of the Norwegian Centre for Mathematics Education etc. The visits to the schools were also greatly appreciated as there was ample opportunity to see concrete work and lessons in the schools and to exchange ideas with several teachers and the heads.

The participants also thought it very useful that several colleagues of the ministry of education and Research and of other official bodies and organisations were always present during formal and informal moments (such as dinners) so that there was ample opportunity to exchange ideas with them and to ask for further information.

Most of the participants thought that there had been enough time to discuss and reflect with the other participants of the PLA of what they had seen, heard and/or experienced. A few thought that more time could be spent to this reflection and exchange. However, overall participants are happy with the opportunity to confront the policy in their country with what they see in the host country. Hence the discussions were thought to be very fruitful and well organised. The information given by the other participants is thought to be useful and confronting. The fact that participants to the PLA chair the discussion sessions is definitely appreciated.

The participants agreed that clear information was available on the objectives of the PLA and that useful information had been sent to them –such as the background paper – in advance.

All the participants, except one, thought that the PLA was well organised and that everything went about very smoothly.

As a conclusion the participants mentioned that the PLA prove to be very useful and fruitful for policy development in their own countries. They also stressed that the fact that most of them have been involved in several PLA strengthens the cooperation, the exchange and the interaction between the participants. The cross-fertilisation effect of PLAs is greatly appreciated.

Part 6: Annexes

6.1. The evaluation form for the PLA in Norway 14 – 17 April 2008

- 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 activities and issues related to the promotion of MST in Norway				
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.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Please send back by e-mail to Yves Beernaert by 30 April 2008

Yves.beernaert@educonsult.be

Educonsult

00 32 474 987411

6.2. Programme



NORWEGIAN MINISTRY OF EDUCATION AND RESEARCH

Programme for the PLA in Oslo, 2008

Monday 14.april

1200 Lunch The Ministry of Education and Research

1300 – 1800 The Ministry of Education and Research

Education in Norway: Overview

- Principles, structure and facts about education in Norway
- National Curriculum, challenges and implementation
- Teacher education in Norway, challenges and questions about new structure
- Nordic perspective on PISA; The PISA results for Norway and Comparative studies between the Nordic countries.
- Discussion

1900 Dinner Royal Christiania Hotel

Tuesday 15.april

0845 Bus leaves Royal Christiania hotel

0930 Visit to Nesbru upper secondary school

- Introduction by the principal
- Half of the group in Biology, the other part in Technology,
- The groups change
- Observing a Math lesson – with special focus on use of ICT

1115 Lunch at school

1200-1400 Walk and talk in the [Vigeland park](#)

1430-1630 Ministry of Education and Research

The MST Strategy,

- Principles, priorities and activities
- Evaluation of the Strategy (by external consultant)

1630-1800 Reflections within the PLA group

Wednesday 16.april

0830 Bus leaves Royal Christiania hotel

0900 Visit to Vevelstadåsen school, 5.-7.grade (primary school)

- Introduction to the "Nysgjerrigpermetoden", (inquiry based method in science)
- Focus on learning strategies, math and using digital tools
- Lunch

1300-1630 The National Centre for Science in Education

Recruitment. Science centers in Norway

- [ROSE](#) project and recruitment to MST, attitudes and gender issues. What we know, what we are doing
- About Science Centres in Norway
- The website matematikk.org

1630-1730 Reflections within the PLA group

1800 Bus leaves the Centre

1900 Dinner Frognerseteren Restaurant in the Holmenkollen skiing area

Thursday 17.april

0830-1200 The Ministry of Education and Research

Research in Science education. National Centres for Mathematics and Science Education

- National research school for doctoral students in MST
- Mind the Gap; EU supported coordination activity to examine the use of inquiry based learning in science teaching
- About the [Norwegian Centre for Science Education](#)
- About the [Norwegian Centre for Mathematics Education](#)

1200 Lunch

1230-1430 -Reflections within the PLA group

6.3. List of participants



NORWEGIAN MINISTRY
OF EDUCATION AND RESEARCH

PARTICIPANTS, PLA 14.- 17. APRIL 2008

Zena Poulli	Cyprus	
Brian Krog Christensen	Denmark	
Florence Robine	France	
Björg Petursdottir	Iceland	
Allyson MacDonald	Iceland	
Velga Kakse	Latvia	
Rui Durao	Portugal	
Eric Hendriks	Sweden	
Ana Serrador	EU Commission	
Yves Beernaert	GHK (rapporteur)	
Trond Bergene	Norway	
Thorvald Astrup	Norway	
Randi Schiøll Heneide	Norway	

Special presentation + film crew

Stella Adabugday (Intize)	Sweden	
Ismail Pelaseyed (Intize)	Sweden	
Farid Nolen (Intize)	Sweden	
Anthony Bruno (Film crew)	France	
Clemence Dibout (Film crew)	France	
Stephanie Durant (Film crew)	France	

Keynote speakers, representatives of schools visited

Gunnar Mandt	Norway	Norwegian Ministry of Education and Research
Kari Berg	Norway	Norwegian Ministry of Education and Research
Lene Karin Wiberg	Norway	Norwegian Ministry of Education and Research

Camilla Vibe Lindgaard	Norway	Norwegian Ministry of Education and Research
Torunn Riise	Norway	Norwegian Ministry of Education and Research
Hanna Marit Jahr	Norway	Norwegian Ministry of Education and Research
Rolf Vegar Olsen	Norway	EKVA, University of Oslo
Anders Isnes	Norway	Norwegian Centre for Science Education
Marianne Ødegaard	Norway	Norwegian Centre for Science Education
Camilla Schreiner	Norway	Norwegian Centre for Science Education
Wenche Erlien	Norway	Norwegian Centre for Science Education
Merethe Frøyland	Norway	Norwegian Centre for Science Education
Lise Faafeng	Norway	Norwegian Centre for Science Education
Allan J, Christensen	Norway	Ramboll Management
Tor Andersen	Norway	Norwegian Center for Mathematics Education
Hege Kaarstein	Norway	Institute of Mathematics, University of Oslo
Doris Jorde	Norway	Department of Teacher Education and School development, University of Oslo
John Amundsen	Norway	Vevestadåsen primary school
Gro Wollebæk	Norway	Vevestadåsen primary school
Inger-Marit Øymo	Norway	Nesbru upper secondary school
Dag Brustad	Norway	Nesbru upper secondary school