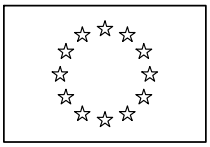

EUROPEAN COMMISSION
Directorate-General for Education and Culture

Directorate B Lifelong Learning: policies and programme,
Unit B2 - School Education - Comenius

Cluster
Maths, Science & Technology

PEER LEARNING ACTIVITY (PLA)

Organised by
the Latvian Ministry of Education and Science and the State Education Centre
in cooperation with
the European Commission - Directorate General for Education and Culture (EAC)
Directorate B Lifelong Learning: policies and programme,
Unit B2 - School Education - Comenius

REPORT

Theme: The Science and Mathematics reform in Latvia (2005 – 2011)
The new curriculum in Biology, Chemistry, Physics and Mathematics for general secondary education and basic education

Date: 1 – 4 December 2009,

Place: Riga, Latvia

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Ana Serrador (DG EAC European Commission).

Rapporteur: Yves Beernaert, GHK, BE

A very special thanks has to be expressed to the Latvian Ministry of Education and Science in general and to the State Education Centre, Valsts Izglitibas Satura Centrs, in particular for their outstanding support in the preparation, the organisation and the implementation of the PLA in Latvia from 1 to 4 December 2009.
A warm thanks also to all the representatives of the Ministry of Education and of the State Education Centre and within the VISC to the ESF pilot implementation Unit and to all other organisations and bodies (schools, university, companies etc.) that facilitated the discussions and the exchanges thanks to their stimulating and enriching inputs. Finally, also a sincere thanks to all the participants to the PLA for the active participation and contributions.

Contents

Executive summary

Representatives of CY, DE, LV, NL, PT and SE participated in the sixth PLA of the Cluster MST (Maths, Science and Technology). The PLA was organized in Riga by the Ministry of Education and Science State Education Centre from 1st to 4th December 2009 in cooperation with DG EAC of the Commission of the EU.

The overall objective of the PLA was to show the education reforms in basic and secondary education as to mathematics and science which the Ministry of Education and Science is implementing to enhance the quality of the teaching and learning of MST in general and the interest in and the motivation for physics, chemistry, biology, natural sciences and mathematics of students in particular.
The specific objectives of the PLA were to give detailed information on the one hand about the development and implementation of new curricula in natural sciences, biology, chemistry, physics and mathematics from grade 7 to grade 12 and on the other hand on the piloting of the new curricula and the In-Service Training of MST teachers in this innovation process.

The PLA was composed of various activities blended together into a rich and unique learning experience. There were presentations focusing on key aspects of the education system and of the reforms by representatives of the ministry and of the State Education Centre (VISC) in charge of developing and implementing the reform as to MST. Furthermore there was a visit to a school to attend lessons and meet teachers and pupils. There were presentations by, and discussions with representatives of other stakeholders from universities, companies and science museums that are directly involved in the MST reform. Finally, there were extensive discussions amongst the participants of the MST Cluster.

The key focus of the MST PLA in Riga was the reform as to Maths and Science in the basic / secondary school from grade 7 (14 yrs) to grade 12 (19 yrs) over the past five years. The Maths and Science reform was implemented through two major ESF projects. The 2008 – 2011 project is the second largest building block of the reforms as to Maths and Science focusing on grades 7 to 9. From 2005 to 2008 a first ESF project focused on the grades 10 to 12.

It was made very clear that the reforms as to Maths and Science are based on a clear vision and policy as to education in general to rebuild education after the Soviet era and to reform Maths and Science education in particular to respond to the challenges of the present-day society and economy. The Science and Maths reform is based on a holistic vision involving, at all levels of the development, the implementation and the evaluation, the different stakeholders: the ministry, schools, teachers, universities

(with particular attention to initial teacher education for maths and science), private companies and other organisations such as the Natural science museum.

The State Education Centre (VISC) (approx. 60 – 100 people according to 1st or 2nd project) was set up by the Ministry to coordinate all the activities of the Maths and Science reform. The whole reform is largely based on recent research findings in education and made use of the input of key specialists across Europe and the world through visits and conferences.

First VISC coordinated the development and drafting of the new standards for maths, biology, physics, chemistry and natural sciences which had to take into account the general standards approved by the Cabinet of Ministers of the Republic of Latvia. The VISC then developed the curricula focusing on learning outcomes reflecting the needs of the present-day society and the Latvian economy. The new curricula were then translated into syllabi (programme contents for the various subjects) for which simultaneously extensive high quality teacher support materials were developed, tested and finalised by experienced teachers, university professors and other experts. This resulted in five sets of documents and materials to be used to implement the MST reform. An in-service training programme for teachers was developed integrating all the aspects of the MST reform with specific attention to new forms of active learning and teaching.
In the 1st project 50 pilot schools were involved (12 school 3 years tested new standards, syllabi and teacher support materials, but 38 schools 2 years tested teacher support materials and a new equipment). In the 2nd project 26 schools are involved (12 from ~~in~~ the 1st project and 14 is a new schools). They tested the new standards, curricula, syllabi and teacher support materials for the grades 7-9.

The VISC organised the training of heads and deputy heads of schools, of school coordinators (helping MST teachers) leading the reform and of the subject teachers of MST implementing the innovation at classroom level. Extensive in-service training has been developed not only for all the stakeholders involved in the pilot schools but also for all science and maths teachers of Latvia. The in-service training (4 key modules) forms a strong basis to support MST innovation. In total some 2950 teachers (math, biology, chemistry, physics and nature science) were trained and further training is organised. Universities have also been involved using the teacher support materials in training future MST teachers. These activities combined piloting the innovation and mainstreaming it simultaneously.

The PLA participants stressed that the Maths and Science reform in Latvia was an outstanding example of a thorough in-depth, efficient and comprehensive reform as to Science and Maths education with clear results and impact over a period after 5 to 6 years. All PLA participants agreed very strongly that the Latvian government had made a key political decision to use the structural funds to improve Latvian Human

Resources by supporting on the one hand the reform of Maths and Science and on the other hand by launching up from 2010 another national programme project (with ESF support) focusing on the creation of the methodological network and the provision for the further education of pedagogues and teachers.

At the conclusion of the PLA the participants stressed that the Maths and Science reform was very well thought of with a clear policy vision and with a clear implementation strategy. The implementation was said to be very efficient and effective, transparent, pragmatic and well-steered leading to self-corrections (through evaluation) whenever required. The successful MST reform was thought to be really addressing all key issues and stakeholders from top to bottom. It was emphasized that what had been achieved was impressive, of high quality and with great potential for sustainability. The enthusiasm, the motivation and the professionalism of all the stakeholders involved was definitely a key factor the success of this reform. It was suggested that a research-based meta-evaluation should be set up of similar reforms in different European countries to outline the key success factors and pitfalls to the benefit of all European ministries concerned.

The Commission and the participants thanked the organisers of the PLA for the perfect organisation and the rich contents of this PLA during which some 50 key stakeholders of the reform were met. The PLA members stressed the contribution of the PLAs to the development of innovative policies in their respective countries and they explicitly hoped that the work of the MST cluster with a.o. PLAs would be continued in the future.

Part I. Introduction

Introduction by the DG EAC

Ana Serrador, DG EAC of the Commission, welcomed the participants and thanked the Latvian Ministry of Education and Training for all the work and efforts they had put in the preparation of the 6th PLA of the Cluster Maths, Science and Technology.
She stressed the importance of the PLAs or Peer Learning Activities as they have proved to be an excellent means to support policy development in MST by comparing experiences and expertise present in all the countries visited.
She informed the participants that the Cluster MST will be finalising a document with recommendations and conclusions after three years of activities and 6 PLAs organised so far.

Introduction from the Secretary of State for Education and Science

Mareks Gruskevics, Secretary of state of the Latvian Ministry of Education and Science, welcomed the participants and hoped they would enjoy their stay in Latvia.
He especially emphasized the efforts Latvia has invested in rebuilding a democratic education system after the soviet period which responded to the present-day needs of the Latvian and global society and economy. To this effect three major changes had to be made: develop new contents (standards, curricula or programmes), make new equipment available to schools and to train teachers to be able to implement the two changes mentioned just before. A key challenge was to reach a consensus with all stakeholders as to the way which education should take. The ESF projects focusing on maths and science were a unique opportunity to show that in Latvia a common perspective could be reached that brought about synergy between all the stakeholders in education concerned. He congratulated to this effect the project management unit of the State education centre that had implemented over the past years successfully the two ESF projects as to MST.

Part II. Education in Latvia

The Latvian Education system

Objectives and national development plan

Guntis Vasilevskis, Director of the State Education Centre (VISC) expanded upon the structure and the key issues of the Latvian education system. Starting from the 1 September 2002 pre-school education is compulsory for 5 and 6-year olds. Basic compulsory education lasts 9 years from age 7 till 16. Acquirement of basic education is mandatory until age 18.

He stressed that the key future objectives of the Latvian education system were: to increase education quality of all stages and types of education, to provide education quality in line with the development needs of the Latvian society and economy, to facilitate access to education for everyone within the context of lifelong learning and to strengthen the capacity of education management.

One of the key challenges after the political changes in the 90ties was to develop a 'new' education system moving away from the centralised model that had been imposed upon Latvia for decades by the soviet regime. This explains the fact that the system is presently more decentralised with much autonomy for the municipalities and for the schools as explained further on.

A key element in reaching those objectives was the National Development Plan 2007-2013 which was adopted in 2006. It is a national mid-term planning document conveying the main directions of development and the main tasks of the state and society. Education and knowledge for the growth of economics and technological excellence is defined as the main strategic aim with the following priorities: a well-educated and creative individual, technological distinction and flexibility of enterprises, and research development. During this period it is necessary to achieve an important turn in education, science and industry, in order to establish a stable intellectual and material basis for gradual improvement of life quality in Latvia.

Governance at national, municipal and institutional level

He expanded upon the governance of the education system as this was a key element in understanding it. He stressed that the administration of education is organised at three levels: national, municipal and institutional.

At *national* level the main decision-making bodies are *Saeima* (Parliament), Cabinet of Ministers and the Ministry of Education and Science. The state is responsible to adopt legislation, to develop normative documents on the organisation of educational services, to determine the standards for education, the contents of the programmes (curricula and syllabi) and the guidelines to develop teaching and learning resources. It issues the licences and credentials needed to open comprehensive education institutions. Teachers working in the public sector are remunerated from the state budget but are not civil servants. The Ministry of Education and Science is directly responsible for the coordination of education quality assessment systems.

The *local – municipal - authorities* (in liaison with the appropriate ministry) can establish, reorganise or close education institutions, while observing education legislation. The 109 municipalities coordinate the development of the network of

education institutes. They coordinate the inclusion of children who have reached the age of compulsory schooling. They provide financially the maintenance of the institutions through subsidies they get from the national budget.

The municipalities organise professional development of teachers. They coordinate and support methodological activities and provide in the provision of after-school activities. Cities and districts are responsible for pre-primary school institutions, primary schools, lower and upper secondary schools, with the exception of some run directly by the central government, or those that are privately maintained.

The Education institutions themselves are relatively independent as regards organisation of their work, drawing up of internal regulations, appointment of teaching staff and responsibilities assumed by their teaching and technical staff and use of their resources.

Levels and profiles

Guntis Vasilevskis gave information about the different levels of education ranging from pre-school education, to compulsory general basic education (grades 1 to 9 or ages 7 to 16) and to general secondary education (grades 10 to 12 or ages 16 to 19).

As to the general secondary school he stressed there were four educational profiles or streams within which pupils could choose: a comprehensive profile, a humanities and social profile, a maths, natural sciences and engineering profile and a vocational profile.

Assessing students

He also expanded on the system used to assess the students' learning achievements. Teachers carry out continuous assessment on pupils' progress at classroom-level, using a grading scale 1-10 and non-grade system. Achievements of pupils are assessed without marks in the 1st class; a grading scale from 1 to 10 is used in the 2nd and 3rd class for mathematics and native language. Achievements of pupils in classes 4-9 are assessed by using the grading scale 1-10.

Overall the students are subjected to four tests during their school life from grade 1 to grade 12. The first test is after grade 3 focusing on natural science (from 2010 social science), maths and mother tongue. It is a national test but marked at municipal level. Its content is centralised and it takes place on the same day. The same marking criteria are used all across the country.
The second test is after grade 6 about two subjects: maths and mother tongue. It is also run nationally but marked at municipal level.

The third test is after grade 9. It is run nationally but marked at municipal level. If a student is not successful in this test he/she has to repeat the year or prepare himself/herself to repeat the test making use of private repetitors. He/she can also choose to go to a VET school.
The fourth test is the national test after grade 12. It is centralised national test: the same day the same test all over the country and it is marked at national level.

He went on to highlight some of the problems Latvia has to face such as the number of students that have to repeat classes and the students with low achievements. He also focused on the study streams of students in HEI which show a preference for social studies, law and business and a limited interest in MST.

Teacher training

He ended by focusing on the school teachers in Latvia who are trained at university tertiary level in five higher education institutions. Two groups of programmes provide teacher training: academic and professional. Thus initial teacher training is provided in the following programmes: second level professional higher study programmes (integrated Bachelor programme), academic study programmes in pedagogy followed by professional higher study programme, and first level professional higher study programmes.

He stressed the teaching profession is not attractive due to low social prestige and relatively low salary levels. Of the total number of teachers in the general education sector (grades 1-12) 88% are women, in the vocational education sector 70% are women. In 2004-2005 15% of teachers were 30 years old and younger.

Professional development of teachers is thought to be very important. About 300 programmes of further education are approved. In 2008 about 8120 teachers attended teachers' in-set training. The teachers of priority subjects (chemistry, biology, and physics, natural sciences, mathematics, computer sciences and foreign languages) from 2008 onwards have been able to apply for special grants for their professional development using ESF funding.

In-service training is organised and implemented through the State Education Centre (VISC) and is expanded upon further in this report. The State asks what teachers want or need and then organises a competition between in-set providers. Universities are one of those providers of In-set. In-set initiatives may also be taken by the municipality. Teachers are invited to attend a certain volume of in-set over a three-year period. One of the problems is that some teachers do not take the appropriate in-set courses such as those focusing on IBSE.

In 2010 the Ministry of Education and Science is starting the implementation of the national programme project "Creation of the Methodological Network and Provision for the Further Education of Pedagogues" as a national programme making use of the EU Structural Funds.

The inspectorate

There are no subject inspectors but there are teams of inspectors carrying out whole school inspections.

General Information about the State Education Centre (VISC)

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

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

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

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

The two ESF projects implemented since 2005 to promote the quality of maths and science in the basic school and in the upper secondary school are run by a special

project management unit situated within the State Education Centre or VISC. In this way there is a very close interaction with the three VISC departments dealing with all the other aspects of school education.

Part III Maths and Science reforms

General presentation of the Maths and Science reforms

Introduction

Dr. Dace Namsone, head of the ESF project management unit for the Maths and Science Reform within VISC, expanded upon the efforts made by the Latvian Ministry of Education and Science in close cooperation with VISC to improve the quality of education in natural sciences, mathematics and technology subjects at the upper secondary level and basic level over the last five to six years. These efforts had been made concrete in the development and the implementation of two major ESF projects focusing on science and maths: one from 2005 to 2008 and a second one from 2009 to 2011.

Dr. Namsone stressed that the key problems of the Latvian economy within the EU were the lack of science and technology professionals and the insufficient number of students in science fields. The reasons for these were the unpopular image of science, the inappropriate learning process and the inappropriate preparations and in-service training of maths and science teachers.

To solve those problems the goals had to be changed in the curriculum documents and cooperation between various actors and stakeholders had to be promoted. To support these activities Latvia participated in comparative education researches and took advantage of key reports published such as the Rocard report and the report "Science education in Europe: Critical reflections" by John Osborne.

The three phases of the reforms

All reforms developed and implemented since 2005 had followed the same model composed of three phases: a preparation phase, a piloting phase and an implementation phase. Cooperation between the various stakeholders such as the schools, the teachers, the universities and the employers has contributed to the success of the reform and will no doubt have an effect on its impact and sustainability.

During *the preparation phase* the subject standards were developed focusing on teaching and learning goals of science subjects and on the expected learning outcomes. Subsequently the curriculum and syllabi were designed focusing also on methodological approaches and strategies. New teacher support materials were developed and adapted to the new curricula. Lastly, syllabi and teacher training programmes to train teachers working with the new methods and materials were

developed. During *the piloting phase* a limited number of schools were invited to introduce the new curricula and syllabi and make use of the new teacher support materials. These schools received also new equipment and were involved in the in-set teacher training programmes. They also received support from expert teachers.

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

Scientific and mathematical literacy

It was also decided within the reform that science and maths teaching and learning (leading to scientific or mathematical literacy) should contribute to the acquisition of various skills such as problem-solving skills, communication skills, digital skills, social skills and entrepreneurship skills. Those skills should be acquired by introducing inquiry-based science education working with case studies, by working with texts, discussions, presentations, writing, by using ICT, by combining within science and maths lessons group work, cooperative learning and individual work and by using new methods with games, simulations, workshops, fieldwork and project work.

It was thus hoped that the reform of maths and science would contribute to the demands of Latvian society: reinforce the necessity to think creatively and critically, teach study skills, pay more attention to practical activities, link maths and science to real life and to professions and trades and promote more non-traditional teaching and learning methods and approaches.

It was also hoped that the reform would be able to address the demands set to the teachers such as the use of different teaching strategies, the use of modern technologies, the need to focus more on cooperation between teachers and the reinforcement of planning and realising outcomes.

Indicators

The following *indicators* are used to prove that the reforms have indeed led to a contemporary teaching and learning process in science and maths: the students' understanding of science and maths, the use of the scientific inquiry method (IBSE), the link with real life, contemporary teaching and learning strategies used by teachers and the use of ICT in maths and science.
Evidence has been gathered making use of these indicators that the reforms of maths and science have indeed a positive impact on the teaching and learning of those subjects.

Detailed description of the two ESP projects on Maths and Science

Project I: "Curriculum Development and Teacher In-service Training in Science, Mathematics and Technology" (2005-2008)

The objective of this first ESF project was to modernize the curriculum, to develop support materials for teachers of science and mathematics and to improve the working capacity of science and mathematics teachers to work with the new curriculum and devised support materials for teachers.

The Project was designed with an aim to address the current problems in the science and mathematics education in secondary schools (grades10–12) in total. The necessity to introduce some changes in the science and mathematics education has been proved by international comparative studies in science and mathematics (Study of Trends in International Mathematics and Science (TIMSS) and studies of the Organisation for Economic Co-operation and Development (OECD)), where Latvian students have shown comparatively low results.
It is important to highlight that the theoretical framework of this first project was based on the world's leading scientific research in maths and science education.

During the Project, clearly determined activities were performed, promoting the achievement of the objectives of the National programme and implementation of education policy in general. The Project activity was directed to such fields as curriculum and school environment, where the teaching and learning process is carried out, and the teachers are leading the teaching and learning process

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

- A modernized curriculum in the upper secondary educational stage (grade10-12) in biology, chemistry, mathematics, physics and science;
- 15 sets of teacher support materials (all together 90 booklets, 34 CDs) developed, published and distributed;
- more than 6000 students acquired advanced curriculum by using the support materials developed during the Project;
- 50 pilot schools were given an opportunity to become regional methodical centres;
- 2950 teachers given an opportunity to enhance their qualification in the in-service training courses;
- enhanced professional capacity of field experts in science and mathematics education.

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

The project was designed to continue to consistently implement the ongoing changes in science and mathematics education Latvia started in 2005 so as to enhance the sustainability of the reforms. Those reforms are also being implemented according to the changes taking place in today's world of natural sciences and mathematics education and it is important to stress that the theoretical framework of this second project is based on the world's leading scientific research.

It was stressed that the objective of the Science curriculum is to promote scientific literacy and mathematical literacy. Scientific literacy is understood as the human ability to use scien knowledge in the solution of real life situations that may be investigated and analysed with the help of scientific methods, and by grounding the conclusions on observations and experiments. These conclusions are vital for understanding and taking responsible decisions about the surrounding world and the changes human activity brings into it.

Mathematic literacy is the human ability to identify and understand the role of mathematics in the world, to make mathematical judgements, and to use mathematics in a way to become a dutiful, concerned and thinking individual.

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

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

Key problems

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

Sustainability of the innovation in maths and science after the 2 ESF pilot projects

A key challenge towards the future is the sustainability of the innovative changes implemented through the two ESF projects on maths and science. A university has proposed to be actively involved in further developing or implementing the changes in maths and science. The links with the universities and especially with the teacher training for maths and sciences within the two pilot project which lead to the involvement of university professors and future teachers are also important elements to enhance the sustainability. The universities have received and are using all the materials developed within the framework of the 2 ESF pilot projects.

Cooperation has also been set up with centres and universities in other European countries such as SLO in the Netherlands and the Science Centre (of Stems) in York. Latvia is also investing in cooperation with its neighbouring country Estonia which can be beneficial to both countries.

In this way it is hoped to strengthen the sustainability of the changes brought about between 2005 and 2011.

Budget for the two ESF pilot projects

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

Curriculum in "Mathematics and Science"

Goals and objecttives of national standards and subject standards

Valga Kakse, of the State Education Centre and member of the MST Cluster, started by outlining the way in which the new curriculum for maths and science had been developed taking as an overall basis the national standards of compulsory basic education and general secondary education which have been approved by the Cabinet of Ministers. The national standards focus on the aims and principles, on the mandatory contents of education and on the principles and procedures of evaluation to be used. The normative documents used are the Regulation on the National education standards for basic education and the Regulations on the National Education Standards for general secondary education.

Based on those national standards the subjects standards are developed stressing which aims and principles they are based on, which contents (in learning outcomes) have to be achieved and how those learning outcomes have to be assessed at the level of each subject. Once the subjects standards are agreed upon, the curriculum can be developed which is drafted down in the form of syllabi. Based on those syllabi the teacher support materials could then be developed.

As to the structure and the contents of basic education a distinction is made between the subject as such, the educational components and educational spheres. The educational component focuses on the following elements: creativity and self-esteem, social skills, mathematical literacy, learning skills, analytical and critical thinking skills and moral and scholastic evaluation. The educational spheres focus on the following elements: self and society, the fundaments of science and technology and arts. All of the elements mentioned in the educational components have to be integrated into the teaching of the subjects: maths, natural science, biology, physics, chemistry and geography.

The ultimate goals are through the subjects to harmonize the development and education of every student, to promote his or her sense of responsibility, to develop the foundation of further (lifelong) learning and ensure the acquisition of knowledge, skills and attitudes for private and public life.

The curricula of science

She then expanded on the curricula of mathematics and science in particular.
In accordance with the essence of scientific literacy, curricula in all science subjects – physics, chemistry, biology and science – are structured in three blocks (or three

structural components): “Nature and Technology”, “Scientific Enquiry” and “Scientific Aspects of Human, Society and Environment Interaction”.

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

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

The curricula for maths

As to mathematical literacy one has to stress the ability of an individual to carry the skills and knowledge obtained during the education process and general skills gained during the mathematics education process over to various life situations when it is necessary to take a decision, solve a problem, develop an idea while living in nature, social and culture environment.

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

The Conceptual Model of Curriculum in Mathematics developed during the

ESF Project involves three blocks: "Mathematic models", "Scientific enquiry" and "Scientific aspects of human, social and environmental interaction". The first block (component) – "Mathematic models" – stresses knowledge on mathematical models, their diversity, the knowledge on mathematical methods and skills to use them. The second block – "Scientific enquiry" – directs the improvement of cognition and communicative skills through scientific enquiry, problem solving, judgement conclusion, communication and cooperation. The third block – "Scientific aspects of human, society and environmental interaction" – concerns context and is directed to understanding the role of mathematics in everyday life and mathematics' role in the development of other sciences, society and the individual by allowing recognition of results and methods of mathematics as science, evaluation of experience and empowerment in the use of mathematics.

The new curriculum is reflected in the regulating documents – subject standards that are developed from the student perspective. They describe the learning outcomes of compulsory curriculum for students at the end of secondary educational stage. The subject's model teaching and learning programme has been made in accordance with each subject standard by planning the results to be achieved by students acquiring topics in a gradual sequence. Subject's teaching and learning programmes are developed to be interrelated among subjects by emphasising the trans-disciplinary links.

Teachers support materials

The development of the teacher support materials (TSM) in the framework of the ESF Project II: Mathematics and Science was expanded upon by Ilze France, Inga Riemere, Liesma Abolina and Andris Nikolajenko.

The people and the phases of the development of TSM

They started by stressing that the work of the Project management unit implementing the maths and science reform was carried out by different divisions within this unit: the teacher support materials division, the division dealing with methodological approaches, the IT division to develop IT and interactive tools, the professional development division in charge of developing the in-service training of teachers and the project implementation division.

The working groups within the teacher support materials division were composed of experienced maths and science teachers, university lecturers and experts (members of the project implementation committee). It was thought to be important to have several team members with a PH.D. This contributed to have researched centred activities and to develop TSM that took into account recent developments in research

in science and maths education. The working groups were also influenced by the contacts with experts of other countries through study visits or attending conferences and seminars. In general it was added that the development of the TSM materials had been influenced on the one hand by the various contacts across Europe and the USA but that on the other hand there hand there is a clear influence in particular from the Soviet school and from the German speaking community. Participants were reminded that before 1920 the gymnasium in Latvia was in Russian or German. Thus it can be said that at the moment maths and science education bear the marks of English / American, Russian and German influence.

The working group members were selected based on clear quality criteria: they had to be experienced and good maths or science teachers, they had to be open to new developments and approaches and they had to have a good academic background at least a Master's in science or maths or a PH.D.
The support materials developed can be subdivided into four parts: TSM for teachers, TSM for students (with a.o. worksheets), printed works and CDs and DVDs.
The TSM were developed in three phases: the preparation of the TSM, the piloting of the TSM and the implementation of those TSM.

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

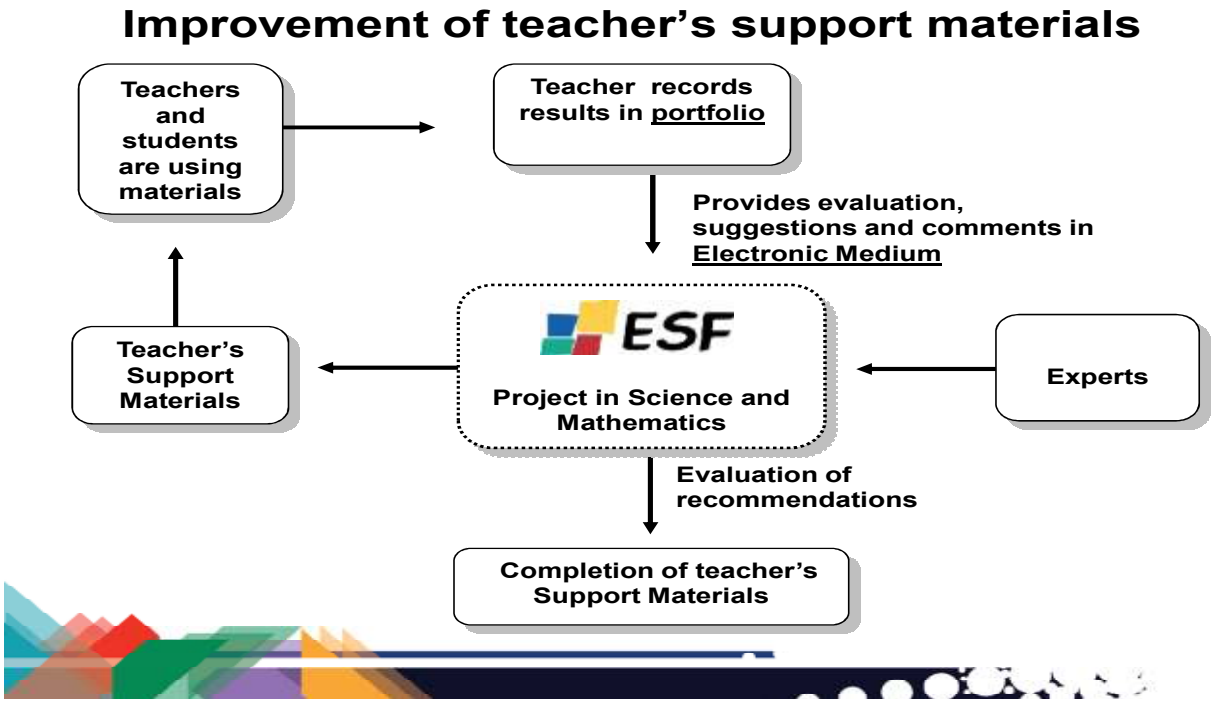
The development of IT materials such as CD and DVD

Andris Nikolajenko showed various examples of IT materials (CD, DVD) that had been developed as TSM to support the new maths and science curriculum and syllabi. The materials can be divided into three categories: self-learning materials, video materials for teachers and educational films that can be used in the classroom. In this category excerpts of TV broadcasted programmes and educational games are also included.

He stressed that the educational IT materials had all been developed by experts and that in some cases employers had also been involved in the development. While developing the materials special attention was given to see to it that the IT materials linked as much as possible with reality. Special attention was also given to the interactive nature of the IT materials and to the fact that teachers could find good materials on the internet. Many of the materials facilitate simulations for maths and science. All the materials can be easily accessed on the website of the maths and science reform.

Piloting of the curriculum and teacher support materials

Dace Namsone , director of the Project Management Unit for the maths and science reform within the State Education Centre, expanded how the new maths and science curricula, the syllabi and the teacher support materials had been piloted.



She reminded the participants of the PLA of the key elements of the different phases of which the pilot projects were composed:

- The development of the maths and science reform leading to new subject standards, to new curricula and new syllabi
- The development of the TSM, teacher support materials to fit the curricula and syllabi
- The use (or testing) of the TSM by teachers and students
- Records of the teachers having used the TSM in a portfolio.
- Evaluation of the TSM by the teachers with suggestions and comments for improvement
- Transfers of the outcomes of the evaluation of the TSM to experts who make recommendations for changes
- Evaluation of the recommendation by the maths and science project management unit
- Finalising the TSM taking into account the recommendations

Key to the success of the reform with all its rich aspects was the piloting of the TSM. Twelve schools were involved in the piloting from 2005 to 2008 and another 38 from 2006 to 2008, but 26 (12 schools from the 1st project and 14 new schools) are involved

in the 2nd phase from 2009 to 2011. The schools selected to be pilot schools were a mixture of all the different kinds of schools in Latvia: small schools, big schools, rural schools, urban schools etc. spread all over the different districts of Latvia.

In every pilot school one teacher was involved for maths, physics, chemistry, biology and natural science. Those teachers were supported by a team coordinator who stimulated the team of teachers involved, observed the lessons, solved practical problems during the piloting and organised how the in-set seminars were attended.

In the first project some 210 lessons were observed and in the second project there were lessons observed every week. Two persons, one expert teacher and someone form the project management unit of the VISC, the State education Centre, attended the observation. Attention was paid by one of the 2 experts to the class management by the teachers and the other one paid attention to the students. Thus the first one would pay attention to the pedagogical methods used stimulating various models of cooperation within a class. He/she observed whether the teaching was frontal, frontal + group work, in a dialogue form with pupils, with various forms of group work, with project work etc. This observer would also pay special attention to how the inquiry skills were enhanced. Every teacher in each pilot school was visited once a year. The coordinator of the project management unit visited all the lessons of all the pilot teachers. Each of the observers filled in a form on which information was jotted down as to the pedagogical methods used and the time spent on the various activities.

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

The experts who in the final phase made recommendations based on the suggestions for improvement of the teachers in the pilot schools, filled in a separate form. In this form they focused on whether the TSM material had been clearly understood by the teachers, the links the TSM had with real life and the contribution the TSM made to enhance the inquiry skills.

Questionnaires also had to be filled in by the pupils, by the expert teachers and by the teachers themselves. At the end those teachers involved in the piloting had an extra questionnaire with 12 questions. There was also a questionnaire for the school

coordinator. Focus groups were also organised involving teachers, school coordinators and students.

Feedback was given to the teachers involved in the piloting based on all the data collected during the observation sessions and with the questionnaires. This feedback happened during the seminars that were orga nised – one every two months - for the teachers of the pilot schools

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

It was added that next to the TSM materials special events were also organised involving certain groups of students to work with some of the TSM. Thus competitions, summer camps and seminar were organised for interested students. These events also proved to be very useful and inspiring.

In-service training of the project "Mathematics and Science"

Introduction: target groups and forms of in-set

Marita Melvere and Aira Kumerdanka, the ESF project management unit for the Maths and Science Reform within VISC expanded on the in-service training of teachers within the project "Maths and science". She highlighted that in order to successfully implement the modernized curriculum and provide teachers support in the implementation of the subject standards and subject's teaching and learning programmes developed within this project, it was vital to develop in-service training programmes for teachers of mathematics, physics, chemistry, biology and science. These programmes were devised in accordance with the modern science education, mathematics, and technologies, based on modern research findings as to the development of teachers' in-service training programmes.

Thus the target groups for the in-service training were clearly defined: first the teachers of maths and science (biology, physics, chemistry, natural science); secondly the teachers of the pilot schools, thirdly the field experts in maths and science (supporting the teachers in the pilot schools) and finally the school's administrators (heads, deputy heads). It is important to stress that not only the maths and science teachers of the pilot schools were invited to the trainings organised but all teachers of maths and science could participate in the in-service training. No schools could get hold of the boxes with the TSM, teacher support materials, if they had not been involved in the in-service training.

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

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

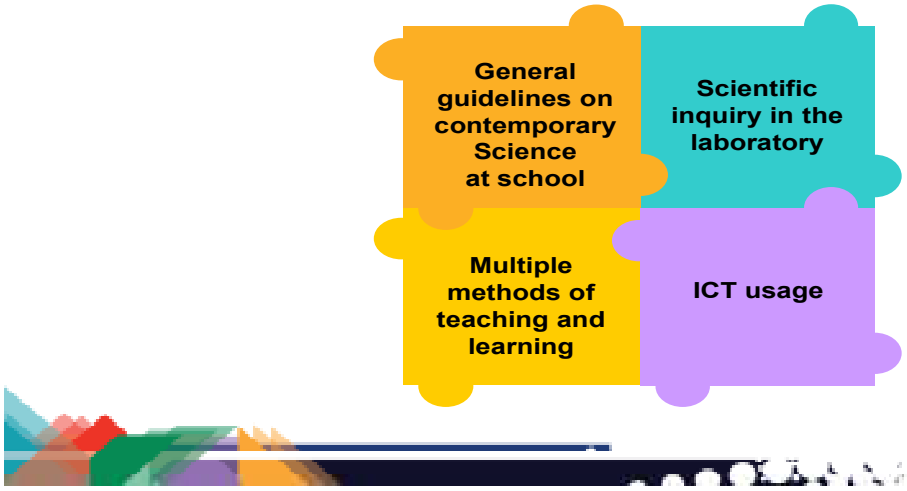
b) **The "Working together" training activities**. These involved the schools and the teachers were trained on how to work with the boxes containing the teacher support materials. The key agents of the pilot project implementation unit focused on piloting the teacher support materials, observing and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

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

d) The four modules of the in-service training

The in-service training programmes were designed with an aim of improving teachers' professional capacity when working with the modern curriculum, in accordance with the projects on subject standards and curricula developed within the project using the teacher support materials.

The in-service training programmes consist of four modules.



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

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

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

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

Organisational aspects

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

Quantity of in-set plus quality assessment

72 hours of in-set were organised for the teachers of maths and science (grades 10 to 12) in the 2005 – 2008 phase.
54 hours of in-set were organised for basic schools that had not been involved in previous training
36 hours of in-set training was organised for the teachers of grades 7 to 9 who attended the 72 hours of courses already organised from 2005 to 2008

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

Collaboration partners in the project

Introduction

The two ESF projects have involved several partners in order to ensure that up-to date information on the processes taking place in science and industry reaches the

classroom of science and mathematics, as well as to ensure that the learning environment in schools complies with the modern requirements.

One of the main collaboration partners of this project have been the municipalities – the establishers of schools. They have been improving the school environment by finding financial means for repair work in classrooms of science and mathematics. Modern equipment in an organized environment is a big step forward in order to raise students' interest in the subjects of science and mathematics.

Another important aspect is that 50 pilot-school teachers have been provided with better equipped classrooms, furnished with modern equipment to work with. The teachers have also been trained to sue the new teaching approaches and to work with the new equipment. As a result of this project, 39 municipalities have refurbished or rebuilt the classrooms of science and mathematics in 50 pilot schools. The Pumpuru Vidusskola visited during the PLA was one of them. In this ESF Project, there was cooperation with the Latvian Union of Municipalities, as well as meeting with the heads of municipalities, this way getting support for reaching the objectives of the Project.

University lecturers engaged in this Project as participants of working groups for particular subjects and experts in teacher support materials. Within this Project, agreements with the University of Latvia, the Daugavpils University, and the Liepaja Academy of Pedagogy were concluded.

During the time of cooperation, several seminars with the teaching staff of other higher educational establishments in Latvia were organized to discuss the topics to be included in the curriculum of secondary school, as well as the information on higher education establishments to be included in the teacher support materials. Universities dealing with pre-service maths and science teachers were also involved at the level of the development of the teacher support materials on the one hand and on the other hand to involve pre-service teachers by informing them of the maths and science reform and by organising for them internships in the pilot schools. Information on the ESF project and on the changes introduced has been provided for the representatives of the Council of Higher Education and the Latvian Rectors' Council.

To ensure that the newly created teacher support materials were varied and compliant with the modern scientific trends, members of the ESF project management unit visited scientific laboratories several times, where specialists of the respective field introduced them to their work of research.

Thanks to the collaboration between the higher education institutions and their scientific institutes, educational films have been made within this ESF project, focusing on processes in science and scientific achievements.

In order to emphasize the importance of science and mathematics in different professions and to ensure that the examples provided in the teacher support materials reflect the recent developments of technology and equipment in the Latvian industry, there was a successful cooperation with entrepreneurs. Following the initiative of the project team, several collaboration agreements with enterprises in Latvia were concluded. During the meetings, the entrepreneurial specialists provided information on the development of the company, on the technology used and on the changes in the production processes. As a result of this collaboration, the information on the Latvian enterprises and their development were not only integrated in the teachers' support, but were also, first time in Latvia, depicted in educational films.

Four examples of cooperation

a) The Natural History Museum of Latvia

Ms Diana Meiere, Head of department of Education of the MNHL and Ms Guna Bagrade, deputy director MNHL expanded on the various pedagogical activities for schools of the Museum of Natural History of Latvia.

The NHML has some 100000 visitors a year of which ¾ are school children/students.
The Natural History Museum of Latvia (NHML) has various permanent exhibitions and several temporary exhibitions. The permanent exhibitions cover: Dynamic geology, Palaeontology, Botany, Life in the sea and Entomology.
The temporary exhibitions cover various topics and all of them have great potential to support science education on the one hand or cross-curricular topics such as environmental education in particular. They may be developed in close cooperation with other partners such as one, focusing on art and science that was developed in cooperation with a Japanese artist. Other temporary exhibitions cover: bees, mushrooms, conifers

As an introduction to the pedagogical activities of the NHML for schools it was made very clear that those activities intend to support the school curriculum in close cooperation with the Ministry of Education, the State education Centre and the schools themselves. Seventy-five percent of all visitors to the museum are school groups for with appropriate and adapted guided tours are developed in close cooperation with the teachers. Thus 40 different types of school guided tours have been developed. In some cases activities are developed for children with disabilities such as hearing or visually impaired children.

All the guided tours developed for children are characterised by activities that invite the children to be actively involved. They focus on hands-on activities, include role-playing, simulations, debated or practical research activities (e.g. children excavate fossils) carried out by the students. All the senses are involved in the activities as children may be invited to use their eyes, their taste, their smell etc.

Several exhibitions are open on the one hand to school groups but on the other hand also families are invited to visit the museum during the weekends or family days. Special trails are also created within the museum such as presently one trail about Darwin. Furthermore birthday celebrations for children can be organised in the museum during which a child and its friends visit the museum.

The students do not only come to the museum but the museum also goes to the school with the initiative "The Museum in our luggage"; Educators of the museum thus go to the schools with luggage containing various elements to be used in specific lessons. The activities in the museum may have some follow-up session in the schools.

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

Next to the activities for children there are, of course, also various activities for adults which have to be seen in the framework of enhancing scientific literacy of the larger public. Thus there are visits for adults to the storage rooms of the museum, days dedicated to mushroom as mushroom picking is a national traditional activity in Latvia, a visit "The earth, the sun and" for adults, etc. Lectures and courses are also held. The latter may be in close cooperation with specific organisations such as teachers of biology or gardeners.

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

Within this framework two Interreg projects have been launched. One Interreg IV A project focusing on "Communicating about the Baltic" and another Interreg III B focusing on "Nature centres and environmental interpretation in the Baltic Sear region".
Finally some team members of the NHML also carry out scientific work in the museum.

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

b) Latvia's State Forests Company

Information was given about the collaboration with the Latvian State Forests Company by Tomass Kotovics assisted by Inga Mikena.

Latvia's State Forests Company (LSF) considers nature to be the best class in the world and thus organises many activities to raise the awareness of youngsters (and adults) as to the importance of the forest in the life of every individual and in the economy of Latvia. LSF cooperates with various official and other partners within Latvia: such as the Ministry of Education and Science, the Ministry of the Environment, the Ministry of Economics, the Forest development Foundation and the Environmental Education Fund. LSF also cooperates with various European partners such as Nature schools in Norway and Nature Schools in Sweden.

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

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

Latvia's State Forests Company works in schools with teachers and students and organises various events – field work activities – in the forest. It is the free choice of the schools and/or teachers to participate in LSF initiatives. So far some 200 of the 1000 Latvian schools make use of the offer of LSF involving some 15,000 students.
Environmental guides are trained so as to be able to work with youngsters. Thus there are forest days or pick nicks in the forest, trees are planted together with youngsters (15,000 to 20,000 a year), events such as maths or science in the forest are organised plus various so-called mammadaba events.

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

c) Grindex, Baltic Pharmaceutical Company

Ms Inese Kaleja Human Resources department and Training Specialist of Grindex expanded on her company's involvement in and cooperation with educational institutions in Latvia. Grindeks has several departments: research, development, manufacturing and sales of original products, generic products and active pharmaceutical ingredients. It has 4 daughter companies, 2 subsidiaries, 5 representative offices across the Baltics, Russia and other CIS countries. Its turnover is 88.4 million € and 96% of the production is exported. It has 660 employees in Latvia and 200 representatives abroad.

She highlighted the activities of the Grindeks Foundation for Support of Education and Science of which the overall target is to support the development of science and promote specialists' growth and professionalism in engineering, natural sciences and pharmacy and raise its' prestige. The target groups are: secondary school teachers, lecturers of Vet schools, students of universities and Latvian scientists. By doing this it contributes greatly to the aims of the ESF reform in maths and science.

This overall target is translated into the following aims:

- Support higher and secondary education to improve their material and technical equipment (labs and chemistry classrooms) and teaching aids;
- Award grants to teaching staff of secondary professional, secondary and higher education establishments
- Award grants to students of specialities necessary for pharmaceutics
- Present material support to training aids (e.g. books, brochures)
- Give awards and financial support to the best scientists such as the "Gold Owl" awarded to experienced scientists and the "Silver Owl" which is awarded to young scientists.

To reach its aims Grindeks implements the following concrete activities:

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

youth of Latvia and with youth organisations for common projects for young people;
- It organises professional / vocational courses for students conducted by Grindeks employees;
- It offers internships in JSC Grindeks for local and foreign students;
- It develops career movies about job opportunities' in the field of chemistry;
- It organises study trips to JSC Grindeks for students and teachers.

d) Cooperation with the universities

Professor Janis Mencis expanded upon the cooperation between the Latvian State University , the Ministry of Education and Science and the State Education Centre in general and the cooperation with the ESP project implementation Unit dealing with the maths and science reform in particular.

He started by expanding how initial teacher training is organised in Latvia stating that school teachers in Latvia are trained at university tertiary level but that it is difficult to attract good students to become teachers. There are two groups of programmes providing teacher training: academic and professional. Thus initial teacher training is provided in second level professional higher study programmes (integrated Bachelor programme), in academic study programmes in pedagogy followed by professional higher study programme and first level professional higher study programmes.

All teachers to be qualified to work in a school must undergo study programmes leading not only to higher pedagogical education but also to a teacher qualification at the respective level of education. Besides, most programmes prepare teachers of certain subjects. Thus, completion of a certain kind of programme entitles them to teach the respective subject at the respective level of education.

At present, the reform introduced by the Bologna Process regarding the issue of teacher training, is under consideration. Today, an academic bachelor's degree in pedagogy does not entitle the holder to teach in a school; in addition, also a professional teacher qualification is necessary. The idea is to approximate academic and professional programmes of teacher training till 2010, to reduce the programmes of academic bachelors in pedagogy and to increase the number of professional programmes.

He stressed that university lecturers had been involved in the development of the teacher support materials either as experts in drafting and developing some of the materials or to evaluate the materials during the pilot phase so as to improve them.

He also highlighted that pre-service teachers were informed about the objectives of the reform in maths and science and that they were initiated into the teacher support materials that are used in the schools within the reform. He stressed that it was also possible for pre-service teachers to have an internship or placement in a pilot school involved in the maths and science reform so as to experience the innovation which was being implemented.
He also stressed that all university rectors had been informed about the developments related to the reform of maths and science. He concluded by stating that young professors are open to innovation whereas it was more difficult to convince the older professors.

Work with talented students

Agnese Mila of the VISC, the State Education Centre, expanded on the work with talented students which was implemented in Latvia.

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

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

Subject Olympiads (Secondary Education)

Technology and Sciences	Arts and Household	Self and Society	Language
		The bases of business economy	Russian
Physics	Visual art	Geography	Germany
Chemistry	Household	Political Science	English
Biology		History	French
Natural Science (team work – Physics, Chemistry, Biology)		Cultural history	Latvian
Mathematics		Environmental projects	
Informatics			

NATIONAL INTERNATIONAL

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

The assessment and authorisation of textbooks

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

A special part is available in the state budget for the purchase of textbooks by the schools. In many cases the textbooks are bought by the schools and given on loan to the students. Whether the textbooks are bought or not by the school depends also

upon the extra funds that the municipality is willing to give as the financial support of the state is limited for textbooks. In some cases the textbooks are bought by the parents.

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

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

Students' achievement assessment

Ingrida Kamarute, head of unit the state examination department of the State Examination Centre (VISC) and Rudolph Kalvans, head of unit within this department, expanded on external assessment and monitoring of student achievement in Latvia. They started by giving a brief historical overview of the centralised state exam to explain the current approach.

Examinations at school level

Teachers in classrooms carry out continuous assessment on pupils' progress using a grading scale 1-10 and a non-grade system (pass/fail or descriptive assessment). Descriptive assessment means that parents of pupils receive a short oral and written assessment report on pupils' progress, describing development of knowledge, skills, attitude towards learning and class participation.
The criteria building up the assessment of learning performance are as follows: the extent and quality of attained knowledge, learned skills, attitude toward learning process and dynamics of learning performance development.

Achievements of pupils are assessed without marks in the 1st class, i.e., by using a descriptive assessment. A grading scale 1-10 is used in the 2nd and 3rd class for all subjects except native language, mathematics Latvian language for minority pupils and also natural sciences (in the 4th class), where the descriptive assessment is used.

In the classes 5-9 the grading scale 1 to 10 is used in all subjects.

At the end of the 3rd, 6th and 9th class pupils are obliged to pass centrally determined tests in certain subjects. The assessments of tests in the 3rd and 6th classes affect pupils' end-of-year evaluation, while that in the 9th class does not.
Pupils receive a school-report showing grades in every subject at the end of each semester. Pupils of the 9th class receive a school-report only once – at the end of the first semester. The Ministry of Education and Science approves a sample of a school-report issued to pupils.

The principle of variety is used as a measure to assess study achievements, such as written, oral and integrated tests, evaluation of individual and group work, and different test works such as diagnostic tests, project works and examinations. A 10-point grading scale is used to evaluate educational achievements of pupils in secondary education (classes 10-12). Pupils receive a school-report showing grades in every subject at the end of each semester. Pupils of the 12th class receive the school- report only once – at the end of the first school term. The Ministry of Education and Science approves a sample of a school-report to be issued to pupils.

The centralised or central exams

Compulsory exams in secondary education are: foreign language, maths and Latvian language. When students take exams at the end of the secondary school they receive the SEC Certificate but this certificate is just an appendix to their secondary education diploma. All results of the centralised state exams are used to classify students for entering university. Students can also choose to take a state exam from 9 other subjects: English, German, French, Russian, history, physics, chemistry, biology, geography and Latvian language (non-native speakers). Students will take a state exam in those subjects which they want to study at the university.

The present system was implemented in 2004. Before that universities had their own entering exams which don't exist anymore. However in medical studies a special entrance exam exists for chemistry and biology and in architecture / arts studies a special test exists in the form of an assignment given to potential students. In each university there is a limited number of budget places, for which money is available from the Latvian state budget. These places go to the best students. If some students have equal results at the central exams, the university may also look at the results obtained previously at school.

The procedure for developing the centralised state exams

The procedure to develop the centralised state exams is composed of 7 phases:

- Phase 1: 4 to 5 experts prepare a first draft of the state exam in one subject the year before it will be used;
- Phase 2: Some tasks of the central exam are piloted at schools with specialists from the state examination department;
- Phase 3: The same 4 to 5 experts of phase 1 prepare a second version taking into account the feedback of phase 2;
- Phase 4: Other experts review the new version of the central exam;
- Phase 5: A teacher is invited to do the test of the national exam as if he / she was a student;
- Phase 6: A layout of the final version of the central exam is developed by one person
- Phase 7: The central exam papers are printed one person.
- Phase 8: The central exam papers are distributed to school boards

The copies of the test of central exams are corrected by special evaluators, school teachers or university lecturers, at national level. This is different from the local exams which are assessed by local teachers. Each test is corrected by two evaluators. In some cases a third one may evaluate it when the difference between the two other evaluators is very large. Schools like their teachers to be involved in the evaluation of the central examinations as this gives prestige to the schools. The teachers involved as assessors or evaluators are called "Methodologists" and get a special certificate from the VISC, the State Education Centre. In total some 1300 evaluators are involved in the assessment of the central exams.

In the centralized examinations of general secondary education, another system of evaluation is used. The educational achievements of pupils are evaluated at six levels (A, B, C, D, E, F levels, where A is the top level and F is the lowest level). The levels of evaluation of the foreign language examination are determined according to the recommendations of the Council of Europe. In other subjects the Ministry of Education and Science works out the levels of evaluation.

All copies of the previous tests of the centralised exam are available on the website of VISC and are definitely used by teachers to prepare the students for the state exams at the end of secondary school.
A key issue is of course the secrecy and the confidentiality as to the contents of the central exams. Major efforts are made to avoid any possible leaks.

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

Assessment in science and maths subsequent to the reform

Efforts are also made to change the assessment of maths and science after the reforms in maths and science have been implemented. Assessments have to integrate the use of active and interactive education methods so that not only knowledge but also skills and attitudes can be assessed but this is still a major challenge.

Visit to the Pumpuru Vidusskiloa in Jurmala

Participants had the pleasure to meet in the school: Ms Irena Kauseniece, head of the school, M. Edvins Rafelds, deputy head education, M. Andres Urabacans, deputy head ICT and Ms Ramona Ukrina, the English teacher acting as an interpreter. Furthermore the participants attended the lessons of two science teachers: Ms Ausma Bruniniece (Physics teacher) assisted by M. Martins Bulbis (doing a Teacher First placement in the school) and Ms Vesma Vijupe (Biology teacher).

The head of the school Ms Irena Kauseniece started by giving detailed information about the school which has a total of 612 students (of which 279 girls) spread over the 12 grades of the school. Overall there are 50 teachers of which 43 are women.

The school buildings have been partly refurbished thanks to the support of the municipality and it is hoped to refurbish the rest of the school in the near future. The school is very well equipped with interactive boards, computer beamers, internet connections and science equipment thanks to its involvement in the ESF maths and science reform.

The Pumpuru schools are very active and is involved in various activities such as first of all the maths and science ESF Pilot project (involvement in the two projects covering the two phases). Furthermore it is involved in Nature Watches, the Globe project, Healthy school activities, the Dream team Project together with UK schools, in an astronomy project and in the catch a star project.

The school prides itself in a large offer of after school activities such as a folk dance group, two choirs, one of which is a girls' choir, a musical ensemble, a students' board to promote active citizenship, a theatre group and club and a handball team. It is cooperating closely with a Finnish gymnasium on environmental issues as to swamps. It is not involved in Comenius partnerships within the LLP programme of DG EAC. Students also participate in science Olympiads and have won seven prices in recent years.

Two 40-minute lessons were attended: one focusing on physics with the Archimedean lifting force during which students of grade 9 were invited to apply IBSE methods such as carrying out small experiments in subgroups of two to three students. The second lesson attended with students of grade 11 focused on biology with the issue of how the quantity of starch present in potatoes can be measured. This class worked in small teams of four pupils implementing the various phases of IBSE successfully.

The two teachers visited pointed out that they are both involved in the ESF project ~~reform~~ and that for this reason their teaching is limited to some 16 hours a week; the rest they spend on various activities in the framework of the ESF project such as attending in-service training sessions and organising information sessions for teachers from other schools about the ESF pilot project they are involved in.

The interaction with the two teachers was interesting but slow due to their limited knowledge of English. They were convinced that the new approach using IBSE promoted the learning of science greatly and that it contributed indeed to acquiring next to scientific knowledge also various skills such as an open attitude towards scientific inquiry. They were very proud to be involved in the ESF projects.

The Teach First Initiative

During the visit to the Pumpuru school one of the teachers involved in the Teach First project was met. Here below is some further information about this initiative partly received through a discussion with the teacher Martins Gulbis. The information given focuses on Teacher first in the UK but the initiative has been exported to countries around the world.

Teach First is an independent charity launched in 2002 to bring excellent teachers into challenged secondary schools across the UK.
The mission is to address educational disadvantage by transforming exceptional graduates into effective, inspirational teachers and leaders in all fields.
Teach First aims to close the achievement gap by helping top graduates become excellent teachers in challenged schools, committed to leading in their classrooms and overcoming the obstacles of deprivation in order to increase the access, achievement and aspirations for the thousands of young people that lack the opportunities that many others take for granted. Long-term, the goal is to develop Ambassadors into leaders who will create the systemic change necessary to improve these statistics in a national scale.

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

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

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

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

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

Part IV. Discussion sessions during the PLA

The fourth chapter expands on the discussions which were held within the PLA, usually at the end of every day but very often also after each of the presentations or visits. The part on the strong points highlights the strengths which have been observed in the maths and science policy development and implementation in the country which is visited. The issues of concern expand on topics which are considered to be of concern for maths and science education in different countries and not only in the country visited.

Strong points

A coherent, consistent reform of education in general and MST in particular

All participants agreed that Latvia had achieved major and concrete outcomes as to the restructuring of its school education in general moving from a totally centralised system imposed by the soviet regime to the present-day decentralised subsystem with much power given to the municipalities and the schools on the one hand but also with cooperation with the central bodies such as the Ministry of education and science and other the local partners..

The success of the education reform in general was, according to the participants, due to many actors not the least the motivation and the commitment of all of those involved in the reform and the clear long-term vision and steering by the Ministry of education and science and the bodies working on behalf of this ministry such as the State Education Centre (VISC) and within this centre the project management unit of the 2 ESF projects in maths and science.

Efficient and effective use of ESF funds for HR development

Participants thought that the decision of the Latvian **Government to allocate by priority ESF funds to reforming maths and science education** was a very wise and strategic decision which will have a major impact on HR development of Latvia and on its economy in the near future.

The size of the country had according to the participants also facilitated the large scale implementation of the reform in general and specifically in maths and science. Participants were also impressed by the speed with which the reforms of the education system had been developed and implemented.

A holistic reform with clear vision and policy

All participants agreed that the strength of the maths and science reform had been to develop **a holistic reform based on a clear vision and policy** involving all the stakeholders of society: authorities - central and municipal- , schools and their staff, universities, companies and NGOs. It was agreed that the maths and science reform had clear and realistic objectives within this overall reform of education which had started in the 90ties. It was thought to be important that the maths and science reform has also been built on the one hand on results of research and on the other hand on expertise available in other European countries. Latvia has not copied other reforms but has, through research and contacts with experts across Europe and the world, tried to make use of many good practices existing elsewhere.

Close cooperation between national and municipal authorities

Participants also thought that **the close cooperation between the central bodies such as the Ministry of Education and Science in general and the state education centre (VISC) in particular and the municipal authorities** (responsible for education) had had a very synergetic effect on the implementation and the multiplier effect of the reforms in maths and science.

Active involvement of all stakeholders

Participants also agreed that the **active involvement of all the stakeholders** ranging from the Ministry of Education and Science to the schools with the teachers, to the universities (especially the faculties training teachers and the faculty of pedagogy in general), to the companies and to other organisations, was a major factor that had contributed to the maths and science reform.

Efficient and effective implementation

Participants agreed that the mechanism and structures put in place to develop and implement the maths and science reform had been working **very efficiently and very effectively a**s clear objectives and a clear (political) vision were available.

The model used for the maths and science reform was based on the following components: rewriting the subjects standards, drafting curricula and syllabi, developing teacher support materials and testing all of these through a network of pilot schools, organising in-service training for all maths and science teachers and reviewing at each phase what had happened. This reform was thought to be a model

that had produced very tangible, concrete and effective results that in turn were producing a clear impact.

Strong and efficient project steering

A key success factor stressed by the participants is the fact that the whole reform process has been **clearly steered by the project management unit** within the State Education Centre which succeeded in inspiring and motivating the stakeholders at all levels of the education system.

Focus on training of present and future maths and science teachers

The focus on teachers in-service training both at the level of the pilot schools but also at the level of all the other schools and the involvement of pre-service school teachers through internships in cooperation with the universities was definitely a key success factor in the effects that have been brought about so far in this reform.

It was also considered very important that the Government and the Ministry of Education and Science were already seriously working on the sustainability of the effects and impact of the ESF projects for maths and science by **integrating the results of the reform on initial teacher training and in in-service teacher training**. Furthermore it was considered to be very important that the authorities were looking for possible sources of funding to further develop the reform from grades 1 to 6. Possible European funding and possible cooperation with publishing companies that are producing the textbooks accredited by the Ministry of Education and Science were possible ways to secure funding in the near future notwithstanding the present crisis.

Sustainability of the reform

Participants also agreed that the reform of maths and science had laid the basis for **further development and for sustainability** of the actions and effects once the 2nd ESF project is over by focusing very strongly on the in-service training of all teachers of maths and science. Well trained motivated teachers able to use the new methods and the new curricula and standards are a key factor for the long term success of the reform.

The sustainability was definitely also enhanced by the fact that universities had been involved at all stages and in all the activities of the reform. University professors or lecturers had been involved in working groups developing new teaching materials etc. and would go on playing a role in further developments of maths and science reform. The sustainability potential was also thought to be strengthened by the fact that future teachers had been introduced to the new standards, curricula and teacher

support materials so that they could use them in their turn in their future classrooms.

Active cooperation with and involvement of science museums

Participants also welcomed the **positive role of science museums** such as the Natural history Museum of Latvia in raising awareness for science with youngsters and adults. The activities of such museums, as was proven already through visits in science centres at the occasion of other PLAs, make a major contribution to enhancing scientific literacy and motivation for an interest in studying MST more in depth. It was stressed that that science museums or science centres should really be integrated into the whole process of MST education very closely linked to the curriculum. The MST activities in the science museums or science centres should not be perceived as something special outside the classroom but should be seen as an integral part of MST education. Hence the need for very close cooperation and interaction between MST teachers and the pedagogues in science centres or science museums.

Active cooperation with and involvement of companies

Participants also welcomed strongly the **active involvement of companies** who apparently also contribute actively to the implementation of the objectives of the reform of maths and science. Their contribution to providing equipment, organising internships for students and study-visits for teachers and pupils is important to enhance professional opportunities for MST graduates as this is still a problem as highlighted under the next part "Issues raising concern". It was also noted that for the further implementation of the reform from grades 1 to 6 the Latvian Ministry of education and science hopes to build on cooperation with private partners such as the publishers that produce textbooks for schools.

Issues raising concern

The elements mentioned under this heading "Issues raising concern" are the results of the discussions held during the PLA. They concern issues raised by several members of the cluster and do usually refer to issues that are of concern to all the members of the MST Cluster.

The evaluation of maths and science education reforms

The previous PLAs had already made it clear that in very few cases there had been an in-depth evaluation or meta-evaluation of all the aspects of maths and science education reforms focusing fully on the relevance, efficiency, effectiveness, impact

and sustainability of such reforms. Some countries have evaluated what they are doing but in most cases only in a limited way.

During the PLA in Latvia several elements of an overall evaluation were available: the in-service training materials were piloted (or evaluated) before being finalised and used by the teachers involved in the pilot schools, the in-service training courses organised for teachers and other key staff were evaluated by the participants filling in questionnaires, the implementation of the new subject standards for maths and science is being monitored based on indicators, the pilot schools and the teachers involved in the pilot activities are being monitored by collecting information in questionnaires filled in by both teachers and students or by having the teachers observed by expert teachers who gave feedback to the teachers. Furthermore it was mentioned that the first ESF pilot project was evaluated after the first three years.

No detailed information was, however, made available as to an overall evaluation of on the one hand the first ESF pilot project for the grades 10 to 12 and on the other hand for the grades 7 to 9. Building blocks of an overall evaluation were mentioned but it was not possible to make a coherent picture as to evaluation. However based on the information received so far one can conclude that an overall evaluation is scheduled in the near future. The evaluation of the project activities so far have been done different ways such as asking participants to in-service training activities to give feedback to the trainings. The overall evaluation of the reform is planned for the year 2011, when all schools will have implemented the new standards. Implementation means that students must learn according the new standards from the grade 10-12. Before launching the overall evaluation of reform, the Ministry of Education and the Sate Education centre will be piloting up from the beginning of 2010 the evaluation procedure in pilot schools in year 2010. The same evaluation procedure will be organized at a later stage for basic school.

During the discussions it was also suggested by one of the PLA participants to set up a meta-evaluation to make a comparative evaluation of the different maths and science reforms that had been implemented over recent years in all the countries visited so far. Such a meta-evaluation could reveal interesting elements on the one hand on how evaluations of maths and science education should be organised and on the other hand which are the most efficient actions to be taken to bring about a sustainable reform.

Assessment of students

This issue has already been addressed at different PLAs of the Cluster MST but still raises much concern. If maths, science and technology have to be taught or learned by using active, interactive and inquiry-based methods, several members wonder how the effects of using these methods can be measured or assessed when testing the students. This issue is closely related to the issue of the learning outcomes as to maths and science on the one hand and how to measure the competences achieved in terms of knowledge, skills and attitudes.

One of the key concerns is how the IBSE (Inquiry-Based Science education) method can be thoroughly assessed as the assessment has to focus on various elements – the knowledge, skills and attitudes- acquired by the students in the teaching and learning process.

Professional opportunities for MST graduates in some European countries

Most European countries make large efforts in various ways through reform in MST on the one hand to increase the interest in and motivation for maths, science and technology and on the other hand to have more students study MST in higher education and hopefully graduate.

However, professional opportunities for students having studied sciences are limited in some countries mainly due to economic developments or to the lack of industry and the economy requiring graduates with high scientific skills. Hence it is thought to be difficult to motivate youngsters having studied MST to stay in the country and this results in brain drain towards e.g. the USA. Another danger linked to this lack of professional opportunities is the fact that students will no longer be motivated to study sciences in higher education.

It was suggested by one of the PLA participants to look more in depth into this issue and to find out how some countries had tried to solve this problem. Swedish universities propose studies which enable to combine MST with other areas of studies such as engineering combined with teaching / pedagogy or engineering linked to MBA studies. Another participant thought it was important to combine MST studies in HEI with the promotion of entrepreneurship so that MST graduates have the competences and skills to start companies in specific MST areas that may contribute to future economic development of the country. Examples were also given of countries that bring MST graduates working abroad back and of countries

investing in MST graduates to take a PH.D abroad with a view to take advantage of their competences when they return to the home country.

It was also suggested that countries with this problem should make conscious decisions to promote professional careers in the field of MST and look more closely into how different fields of study can be combined so as to enhance professional opportunities for the graduates.

The role of young / new teachers to promote innovation

Several participants wondered what the impact can be of new teachers that have just been trained at university to make older teachers accept new pedagogical and didactical approaches and working methods. Experience in different European countries shows that young teachers even if they have been well trained to use new interactive methods very often comply with the 'old' methods which are still used by older teachers. Research shows that when teams of younger and older teachers develop their lessons together, the old teachers all too often impose their old methods. One member of the cluster spoke of "the oppression of the creativity of the young or new teachers" that has to be avoided

This would definitely need further reflection taking into account that many countries had started implementing induction systems for newly appointed teachers. One of the key questions is how to overcome the suspicion of some older teachers especially those for whom reforms in education are seen as threatening due to their past soviet experience. Initiatives like "Teach First" which are also used in the maths and science reform in Latvia are thought to be interesting ways of overcoming this suspicion. Hence it would be useful to describe good practice as to how the creativity of young teachers is made use of and enhanced. "Creativity is a key element of the joy of teaching" as another member of the cluster put it.

Collaborative forms of work between teachers

The issue mentioned above raised the question to which extent collaborative work between teachers is really being implemented in Latvia and in other countries. How such cooperation should be organised and what are its effects. In previous PLAs examples of collaborative learning had been witnessed such as the Learning study in Sweden (based on the Japanese Lesson study) or the team of two teachers working on maths innovation in Portuguese schools. It was thought to be necessary to look more closely into various forms of collaborative learning amongst teachers and pinpoint examples of good practice to be disseminated.

The need for detailed syllabi in certain countries

Some countries stress that their teachers want to have very detailed syllabi to see to it that the mandatory programme is clearly followed in their lessons. The need to have very detailed syllabi is closely related to the fact that students have to be prepared to take national exams. More and more parents question the teachers if one of their children hasn't been successful at the final exam. Parents also want to have clear marks (points) to be given to their children and no other forms of appreciation of the work of their children.

In relation with this last point, the question was raised whether the education system of most European countries provides an official text describing the responsibilities and the duties of the teachers and the headmasters of the schools. Such descriptions exist in several countries such as e.g. Sweden and can be used in case of legal disputes with parents or other parties.

The MST cluster activities and the cluster's future role

Several of the cluster members stressed the importance of the activities of the MST Cluster in general and of the Peer Learning Activities on policy development and policy implementation as to maths and science in their respective countries in particular. They explicitly hoped that the work of the MST cluster would be continued in the future. The cluster members stressed that they are convinced that the work of the cluster and the PLA is pushing forward innovation in maths and science education considerably.

The PLA and the exchange of information within the MST cluster contribute to validation and justification of the policies the countries are developing and implementing. The examples of good practice seen at work during PLAs help to confirm other countries in the choices they have to make as to MST education policy. PLA facilitate policy development greatly in this way. One should however, be aware that the impact of the work of the cluster and of the PLAs will only be fully visible in the medium or long term.

They also hoped to be kept informed about the developments in the 7th framework programme which focus within the Science in Society programme on the promotion of active and interactive methods in general and inquiry-based science education methods in schools in particular. They stressed to be particularly interested to be involved in the assessment and/or evaluation taking place within the projects funded within science and society and that focus on maths and science education in schools. It will be important to see what the impact of those projects is on

disseminating new and interactive science education methods. The members of the cluster could also play an active role in the dissemination of the outcomes of those 7FP projects.

Conclusions of the PLA Riga on Maths and Science Reform

Relevance

The holistic and comprehensive maths and science reform implemented since 2005 is extremely relevant to the objectives which Latvia has set itself as to education in general and maths and science education in particular.
It is also particularly relevant to the objectives of the detailed work programme set up by the European Union in the framework of the Lisbon agenda. The maths and science reform in Latvia definitely contributes to quality and efficiency in education by putting the stress on improving education and training for maths and science teachers, by developing skills of educational staff and students for the knowledge society, by enhancing access to and the use of ICT in education and by having an impact on the recruitment to scientific and technical studies It clearly works on facilitating access to maths and science for all by making the teaching and learning of maths and science more attractive by using more active, interactive and IBSE methods. It also contributes to opening up education to the wider world by enhancing cooperation with all the stakeholders in maths and science: the central and local authorities, the schools and their staff, the students, the companies, museums, NGOs and the universities.

Efficiency

The Ministry of education and Science has definitely set up a very efficient strategy to implement the maths and science reform in cooperation with the State Education Centre by setting up the ESF Project Implementation Unit lead by Dr. Dace Namsone. The structure of this unit, the expertise available, the openness to expertise outside the unit, the links with research and the variety of activities of this unit have definitely contributed to an efficient implementation of the two ESF projects so far. The Project implementation Unit has succeeded in involving and motivating all the stakeholders to the benefit of the maths and science reform. The unit has thus created a spider web network linking together and involving actively all the key stakeholders as to maths and science education in Latvia

Effectiveness

The whole maths and science reform was very well thought of with clear objectives and actions to implement those objectives within a clear overall education policy. All of this was well planned and successfully implemented within a fairly tight

calendar. The objectives outlined in the maths and science reform have definitely been reached up to now and all elements are present to guarantee the successful implementation of the second ESF project which is still running till 2011. Lessons have been drawn from the first reform (2005 – 2008 for the second one so as to optimise the implementation of the objectives. However more attention could be given to the overall evaluation of the two reforms.

Impact

The quality of the activities implemented within the framework of the maths and science reform have already had a clear impact on all the pilot schools involved and on all the thousands of teachers that have been participating in the in-service training courses. It is too early to measure the full impact on the quality of the teaching and learning of maths and science on the one hand and on the number of students that study MST in higher education and graduate but there are clear indications that the quality of maths and science in improving. No doubt the impact is also enhanced by the fact that the maths and science reform has an excellent website where all information and materials are accessible to all those interested. Key information is also available to foreign ministries in English.

Sustainability

Key elements in the sustainability are the fact that all the maths and science teachers will be trained on the one hand through the in-service training activities and on the other hand that pre-service teachers are also involved in the maths and science reform through the cooperation with the universities. In this way the future teachers can also contribute to innovation in maths and science in the years to come.

The sustainability of the reform is also strengthened by the fact that, in the years subsequent to 2011, the reform will be implemented from grades 1 to 6 so as to have reached all the grades of the compulsory school. Sustainability is promoted by the fact that the Ministry of education in cooperation with the State Education Centre is already taking action to try to secure the necessary funds to implement this new phase of the reform through cooperation with companies such as the textbooks publishers. The activities implemented so far will contribute to the sustainability and the further development of the pedagogical tree which was planted to improve maths and science education.

Part V. The programme

Tuesday, December 1

14.00 -18.00
The Education System in Latvia:
- Structure of the education system
- Basic and general secondary education
- Vocational education
- Higher education
- Teacher education and teacher in-service training

General information about the State Education Centre , VICS

Educational reform of general education (structure of new curricula, implementation)

Reflections within the PLA group

Wednesday, December 2

9.00-13.00
9.00 Bus from the hotel "Valdemars"
Visit to the Pumpuru secondary school (10-12 grade) – pilot school of the Project
- Meeting with the school administration
- Observing a Math, Biology, Chemistry or Physics lessons and analysis of the lessons
- Discussions with teachers and students

Lunch at school
14.00 -14.30 **Walk through Old Riga**
15.00 -17.00 **Visit to the Museum of Nature (**K. Barona street 4, Riga)
- Cooperation between museums and schools (lesson at the museum; exhibitions)
- Event "Scientist night"

Reflections within the PLA group

Thursday, December 3

9.00-17.00
The European Union Structural Funds Latvian National Program

"Development and improvement of Subject Curricula in Natural Science, Technology and Mathematics in Secondary Education" Project "Curriculum Development and In-Service Training of Teachers in Science, Mathematics and Technology" and Project "Science and Mathematics".

- Curriculum in Science and Mathematics
- Teachers support materials
- Piloting of the Curriculum and teacher support materials

Lunch

- In-service Training system of the Project
- Collaboration Partners in the Project

Reflections within the PLA group

Friday, December 4

9.00-12.00

Work with talented students

The assessment and authorization of textbooks

Students' Achievements Assessment (system of state examination; assessment in Science and Mathematics)
Reflections within the PLA group

Conclusions
Lunch

Part VI. The participants to the PLA

List of Latvian participants

M. Mareks Gruskevics, Secretary of state of the Latvian Ministry of Education and Science
M. Guntis Vasilevskis, Director of the State Education Centre (VISC)
Dr. Dace Namsone, head of the ESF project management unit for the Maths and Science Reform within VISC

Ms Irena Kauseniece, Head of the Pumpuru School
M. Edvins Rafelds, Deputy Head education
M. Andres Urabacans, Deputy head ICT
Ms Ramona Ukrina, English teacher acting as an interpreter
Ms Ausma Bruneniece , physics teacher
M. Martins Bulbis (Teacher First science teacher placement in the school)
Ms Vesma Vijupe, biology teacher

Diana Meiere, Head of department of Education of the MNHL
Guna Bagrade, Deputy Director MNHL
Kristina Ilganza, pedagogical expert MNHL

Velga Kakse, State Education Centre, expert maths and science curriculum and member of the MST Cluster
Ilsze France, ESF project management unit for the Maths and Science Reform within VISC , expert maths
Inga Riemere, ESF project management unit for the Maths and Science Reform within VISC, expert maths
Liesma Abolina,, ESF project management unit for the Maths and Science Reform within VISC , expert biology
Andris Nikolajenko, ESF project management unit for the Maths and Science Reform within VISC , expert biology
Marita Melvere, ESF project management unit for the Maths and Science Reform within VISC , in-service training
Aira Kumerdanka, ESF project management unit for the Maths and Science Reform within VISC , in-service training

Tomass Kotovics, Latvia State Forest Company
Inga Mikena, , Latvia State Forest Company
Inese Kaleja, Grindex Pharmaceutical Company

Professor Janis Mencis, State University of Latvia

Agnese Mila, State Education Centre, Olympiads
Imants Vasmanis, State Education Centre, head of unit
Ingrid Kamarute, State Education Centre, head of unit of the State Examination Dept
Rudolph Kalvanis, State Education Centre, head of unit

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Part VII. Evaluation of the PLA

All participants to the PLA filled in the Evaluation form which is added under Annex 1 to the present report. The evaluation of the participants is overall VERY positive.

Quotes from participants

It was very interesting and I have learned a lot which is going to be useful, e.g. when I am writing government proposals or commissions to our national agency for education. However, my country is so much decentralised so it is not possible to implement new steering documents in the way Latvia is doing it.

I was especially impressed by the well thought of strategy of implementing the curriculum-reform concerning MST, in the context of restructuring the education system anew (from scratch). It was impressing to see the careful considering, which traditions should be taken up or should be newly implemented, and the careful taking into account of the experiences of other countries.

They all agreed that the programme was very well balanced as to the contents giving a full overview of the different activities and issues related to the reform of maths and science in Latvia.

In the evaluation form they stress that the programme was very well balanced as to the contents giving a full overview of the different activities and issues related to the reform of maths and science in Latvia.

The participants agree that t he colleagues of the host country were available to answer any question at any time.

The participants mention that enough examples of concrete activities / projects were given so that participants could grasp how the different aspects of the reform of maths and science are implemented.

The programme of the PLA was definitely an interesting mixture of theoretical input, visits to schools, discussions with various stakeholders and discussions within the group of PLA participants.

Although the participant think that the background paper sent to participants in advance proved to be very useful in preparing oneself for participation, a few would have preferred some more information.

Quote *from a participant* *It would have been useful to have received some more information about the project in advance. At first, I found it a bit difficult to grasp the concept of the new curriculum and the new syllabi.*

All participants, except one, think that there was enough time for discussions within the group of participants of the PLA in Riga. They also considered the discussions within the PLA group were well organised and fruitful.

The participants unanimously agree that the PLA in Riga was very well organised and smoothly implemented. They all appreciated the hotel accommodation plus the nice evening at the opera with Verdi.

As a conclusion the participants agree that the PLA in Riga will prove to be useful for policy development and implementation in their country. They also mentioned that the PLA should definitely be continued in the future.

Part VIII. Interesting sources of information

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

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

Project „Science and Mathematics" http://dzm.lv/

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

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

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

National summary sheets of education systems in Europe and ongoing reforms: Latvia (Eurydice)
http://eacea.ec.europa.eu/education/eurydice/documents/eurybase/national_summary_sheets/047_LV_EN.pdf

Information about Latvia in the Eurydice EURYBASE
http://eacea.ec.europa.eu/education/eurydice/documents/eurybase/eurybase_full_reports/LV_EN.pdf

Annex 1. Evaluation form

The evaluation form for the PLA in Riga, Latvia, 1 – 4 December 2009

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 reform of maths and science in Latvia.				
2. The programme enabled the participants to meet all the key actors or beneficiaries concerned by the reform: senior officials, decision-makers, teachers, heads, inspectors, universities, companies etc.				
3. The colleagues of the host country were available to answer any question at any time				
4. Enough examples of concrete activities / projects were given so that participants could grasp how the different aspects of the reform of maths and science are implemented.				
5. The programme of the PLA was an interesting mixture of theoretical input, visit to schools, discussions with various stakeholders and discussions within the group of PLA participants.				
6. The background paper sent to participants in advance proved to be very useful in preparing oneself for participation.				
7. There was enough time for discussions within the group of participants of the PLA in Riga.				
8. The discussions within the PLA group were well organised and fruitful.				
9. The PLA in Riga was very well organised and smoothly implemented.				
10. The PLA in Riga 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 12 December 2009**

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