

## Study visit group report

Group No 224

<b>Title of the visit</b>	Bulgarian school experience of forming key competences in mathematics and science
<b>Topic</b>	Learning Mathematics and Sciences
<b>City, country</b>	Sofia, Bulgaria
<b>Type of visit</b>	General Education
<b>Dates of visit</b>	10 - 14 March 2014
<b>Group reporter</b>	Karen Knox, Newcastle upon Tyne, England

### I FINDINGS

The Study Visit had 12 participants, from 10 countries (Belgium, Czech Republic, France, Hungary, Italy, Latvia, Portugal, Spain, Sweden, and UK). We were a mixture of teachers, teacher educators and advisors in the subjects of mathematics and science across all age phases and based in schools, universities and teachers' centres.

We all agreed that the visit was well-organised and provided us all with plenty to think about, contacts to develop once back in our own countries and a thoroughly enjoyable experience.

The group feeling was that it is very hard to recruit maths teachers in every country; there are similar problems for science teaching. Examples of good practices encouraging recruitment and retention of the best staff include the Swedish system of extra incentives for the best teachers (known as first teachers). There can be only a few of them in every school. These teachers are not necessarily maths or science specialists, but as maths is an important subject, schools often assign maths or science teachers to become first teachers. The extra payment would be 600 euros a month approximately, and the money is provided by the government. In the UK golden handshakes are available for teachers in those shortage subjects, and good graduates can also apply for a bursary (from £9000 up to £25000) to train to be a teacher. In Sweden there is a grant rewarding graduates in maths, chemistry and physics.

PISA tables were mentioned and all delegates were aware of their country's rankings in the tables. Many of the participants think it is not a fair system for grading children's ability as, for example, in Belgium algebra is taught extensively but this is not reflected in the so there is not enough algebra in the tests.

Maths and science teaching should be referenced to real life contexts in terms of content, methodology and assessment. This type of approach may go some way towards providing a more engaging curriculum as students Europe wide are often not motivated to study or enjoy the study of maths and science. Much discussion took place over the week about relating to context, and delegates shared ideas and intend to continue to develop and share their work.

Cross curricular projects, for example, could be Environmental Education and Ecoliteracy. 7 schools in the Balearic Islands carry out a project called 'From the Earth to the Curriculum' (similar to the Californian Ecoliteracy project) directed at infant and primary school children, based on curricular integration using the methodology of Project Based Learning. The idea is to experience systematic thinking and the principles of ecology in action by working on organic gardens at school.

Topic approach is common in pre-school and primary but not in secondary. In Belgium there are a few schools using Decroly pedagogy which is entirely project-based.

There is a variety of methodology in teaching (especially in maths) from traditional to interactive. To reach a good level of pedagogy using discussion, coordination, maths in context and problem solving there must be a system of training and monitoring. Getting into classrooms, watching colleagues teach, sharing good practice is a good way of improving standards of teaching and learning in schools and departments. In Sweden it is one of the most important tasks for the principal to go into classrooms and evaluate teachers' performances. The performance of the teachers matters when it comes to getting the yearly raise of salary. The better teacher, the better the raise.

Both UK and Mallorca have various systems of lesson study. The process is to plan a lesson collaboratively, watch, analyse the learning and teaching and change practice and plan accordingly. The problem is that the improvements are not always sustained because the groups break up as staff move elsewhere or out of teaching altogether.

In Portugal there is a system of analysis of exam results against teaching grades and community and student feedback.

We were warmly welcomed in a variety of educational establishments, from primary and secondary schools to university. Impressions from school visits were that the lessons were delivered with traditional methods; the style was didactic and students were mainly passive. It was often knowledge being delivered with less focus on process. Students were able to present their definitions and knowledge with confidence. Classroom settings were the same in every room with students sitting in

rows facing the teacher. The teacher did not circulate in the room (but there was often no independent work from the students). The schools that we visited may not be typical of the education system.

We did see a promising start to the first lesson as the history of the topic under consideration was outlined using the interactive whiteboard. Generally, there was an effort in all lessons to embed history and facts in the subject development.

Interactive whiteboards, such as Promethean, were available in some classrooms, allowing access to the internet, and we saw them used effectively for display. We did not see the boards used as an interactive teaching tool such as monitoring and responding to student response or generating a kinaesthetic teaching approach. Questioning was usually addressed to one student only, or hands up with one student picked and opportunities were missed to generate and receive multiple responses.

Many rooms were quite bland, with no posters, student display or teaching materials on the walls or surfaces. We all agreed that it is important to use a classroom as part of your teaching repertoire. Make your room your own, and decorate it to use it as a teacher tool.

We appreciated the opportunity to watch these lessons, and would extend our thanks to the teachers, students and the schools concerned.

We found out, in discussion, that many schools run a clinic system for students with consultation hours assigned to each teacher. In Portugal the one hour has changed into a club and the attendance and impact has improved.

We wondered if the school day affected student performance. Patterns of the school working day included:

In Portugal teaching staff work between 8.30 and 6.00 (1 hour for lunch); there are lots of little breaks throughout the day.

In Belgium the school day is from 8.00 to 17.00 with one hour for lunch.

In Sweden there are 22 teaching hours per week.

In the Czech Republic the school week is 30 hours in primary school and 32 hours in secondary school.

In the UK the teaching week is about 25 hours and teachers are expected to prepare lessons, assess work and attend meetings and CPD opportunities during the school day and after school hours.

In France the school day is from 8am to 6pm.

In Italy there are 30 hours a week in middle school and secondary is 28 to 32 hours per week.

Hungary has an all day long school concept in primary school from 8am to 4pm. In secondary school there are 30 to 34 hours a week.

In Spain teachers have a 35 hour working week. Primary school children are taught for 25 hours per week and secondary school children have between 18 and 21 hours of teaching per week.

We visited the Resource Centre for special needs. In Bulgaria the support for children with additional needs is based outside of schools and children may receive no support in school; all extra time allocated is provided at the Resource Centre. Provision in other participating countries for children with special needs is usually based in each school and there are Special Needs teachers in some secondary schools whose role is to support and advise the teaching of students during the school day. Orientation and diversity in Balearic Islands support Special Educational Needs children and recently this provision has been affected by the financial crisis. In the UK and other countries children are assessed by the Special Educational Needs department and other professionals, and support is allocated at the appropriate level. In Italy children coded 3.1 have the most severe needs. In France, a school nurse and doctor will assess and decide the level of support for each child. It could just be for examination support (extra time).

Categories of support for Special Needs children in any school seem quite the norm in each country.

We think that support for the educational needs of students should be provided in school or should occur during the school day rather than as extra-curricular activities.

On visiting the university we discovered that teacher training is for all subjects is generally provided as a first degree program, rather than a post-graduate program. This could restrict the number of available secondary school teachers if the primary method of recruitment into teaching is for students to decide at the age of 18 or 19 to follow a career as a teacher.

Describe each of the good practices you learnt about during the visit (both from the hosts and from one another) indicating the following:

title of the project/programme/initiative	country	name of the institution that implements it (if possible, provide a website)	contact person (if possible) who presented the programme to the group	whom the project/ programme/ initiative addresses	what features of the project/programme/initiative make it an example of good practice
STEM Centers	UK	The National STEM Centre <a href="http://www.nationalstemcentre.org.uk/">http://www.nationalstemcentre.org.uk/</a>	Karen Knox	The STEM centre supports teachers in Science, Technology, Engineering and maths	There is an e-library of teaching and learning resources and a physical centre in York with staff dedicated to developing collaborative practice between education, industry and other interested agencies.
NCETM	UK	The National Centre for Excellence in the Teaching of Mathematics <a href="https://www.ncetm.org.uk/">https://www.ncetm.org.uk/</a>	Karen Knox	NCETM provides resources for the development of all aspects of maths education	This national project has a wide variety of training resources, curriculum development resources, teaching and learning resources as well as hosting community discussions and providing CPD for teachers.
MESH (Maths Hubs) in conjunction with NCETM	UK	The National Centre for Excellence in the Teaching of Mathematics <a href="https://www.ncetm.org.uk/">https://www.ncetm.org.uk/</a>	Karen Knox	The Maths Hubs will support all maths teachers in schools and be a local base for maths expertise and pedagogical development	There will be thirty new Maths Hubs, funded by £11 million from the government, each led by an outstanding school with a record of excellent achievement in mathematics, but each also in partnership with neighbouring schools and colleges, universities, and other organisations, maths experts and employers.
Math in the street	Belgium	Haute Ecole Francisco Ferrer <a href="http://www.jeuxmathematiquesbruxelles.be/evenements/maths-en-rue-2/">http://www.jeuxmathematiquesbruxelles.be/evenements/maths-en-rue-2/</a>	Marc Hamelrijckx	For everybody and for school people from 6 years to 21 years	Math in the street makes mathematics more accessible and shows everyone that mathematics can be beautiful and not as difficult as they think.
Economic business senior management – dental nurses + opticians	Italy	Ministry of National Education	Maddalena	For the Secondary school	Special project for adults (age 18+) These courses take place in the evening

Industry bringing engineers and scientists to school to encourage STEM participants	Czech Republic	Specific cooperating companies and institutions in the region - the agreement is between the school and partners	Petr Volník	Technical secondary school students (15-18 years old)	Practical experience in the partner companies - better possibility of finding work after graduation.  Cooperation between the school and the partner company on student projects - students solve a specific problem specified by a partner company in a team or individually.
Émile and Selo	France	Ministry of National Education and Research <a href="http://www.emilangues.education.fr/">http://www.emilangues.education.fr/</a>	Magali Didier – Casalta magali.didier-casalta@ac-grenoble.fr	For the Primary and Secondary school	(Émile) - Geography, Math, Sports, Arts and English. The teacher worked in USA for one year and brought back different teaching methodologies. These lessons are all taught in English. This beginning of the project. This will continue in the Secondary with the teacher who delivers maths in English and possibly sports.
Work with gifted Mathematicians in primary school provided by teachers from the HS	Bulgaria, Sofia	107 Primary school	Nedyalka Dimitrova, math teacher	National mathematics and science high school and 107 Primary school	Prepare for math competitions, continue in High school, and arouse interest in mathematics from an early age.
Environmental education (Ecoliteracy in California) – “From the Earth to the Curriculum”.	Spain. Balearic Islands.	Servei de formacio Continua Balearic Islands.  Teacher Center of Manacor	Miquel Martorell.  <a href="mailto:mmartorell@cepmanacor.es">mmartorell@cepmanacor.es</a>	Seven schools, from Pre-School to Primary	It is a Pilot Project that aims to integrate the subjects by means of methodology of Project Based Learning. Using a systematic and holistic approach to work on the basis of an Ecological School Garden.
Individual salaries as a strategy to reward good maths and science teachers	Sweden	The local school	Olli Joenväärä	Lycksele kommun (the employer)	The best teachers get the most difficult tasks (pupils, classes). The best teachers also have to teach more but will be rewarded with a salary increase each year.
Mathematic Society in Balearic – XEIX.	Spain	SBM – Math Society Balearic Islands – XEIX <a href="http://www.xeix.org">www.xeix.org</a>	Miquel Martorell.	Community and Students	SBM carry out different activities; Olympics Math, Math in daily life context, conferences, exhibitions, etc. aiming to improve student motivation, engagement and outcomes on the subject

János Bolyai Mathematics Society	Hungary	<a href="http://www.bolyai.hu/">http://www.bolyai.hu/</a> - Bolyai Society	Nárcisz Kulcsár	Community and Students	Similarly, this society has carried out different activities; maths in context aiming to improve student motivation, engagement and outcomes in the subject. + Publications
Mathematic Society, Belgium	Belgium	SBPMef : <a href="http://www.sbp.be/">http://www.sbp.be/</a>	Marc Hamelrijckx	Community and Students	Similarly, has carried out different activities; maths in context aiming to improve student motivation, engagement and outcomes in the subject. + Publications
Pupil Premium	UK	Department for education <a href="https://www.gov.uk/pupil-premium-information-for-schools-and-alternative-provision-settings">https://www.gov.uk/pupil-premium-information-for-schools-and-alternative-provision-settings</a>	Karen Knox	Pupils who have qualified for Free School Meals at any time over the last 6 years or who have been in care for 6 months or longer	This extra funding for schools is entirely focused on improving outcomes for disadvantaged pupils. The aim is to narrow the gap in both pupil progress and achievement. In the 2014 to 2015 financial year, pupil premium funding will increase to £1,300 for each eligible primary-aged pupil and £935 for each eligible secondary-aged pupil.
Nrich	UK	<a href="http://nrich.maths.org/frontpage">http://nrich.maths.org/frontpage</a>	Karen Knox	Teachers and students of all ages	A vast online resource of rich tasks and challenges to develop mathematic fluency and enjoyment
Improvement of Curriculum of Science	France	Ministry of National Education and Research	Magali Didier - Casalta	For the Secondary school	1h½ to 2h per week for practical experiments in Physics/Chemistry/Biology
Bilingual Program	Spain	Local Government	Carmen Guillen	Secondary Students	The students learn 2 subjects in English, and the aim is to speak another language fluently by the end of secondary school.
Tablets and new technologies	Spain, Belgium	Local Government, State of Bruxelles	Carmen Guillen, Marc Hamelrijckx	Secondary Students	They received and use tablets in order to improve the use of ICT
Integrate Program with local music	Spain	The Local Government	Carmen Guillen	Secondary Students	Students study music in the conservatory and then go to school in order to improve the attainment level of students
European Social	Latvia	Ministry of Education and	Ineta Helmane	All level teachers of	The preparation of teacher training courses in 3

Foundation EU Basic Education Teachers training		Science, National Centre for Education www.vics.gov.lv		primary school, pre-school, basic school	steps: 1 <sup>st</sup> step creation teacher training courses 2 <sup>nd</sup> step adaptation of teacher training courses 3 <sup>rd</sup> managing teacher training courses. Evaluation of teacher training courses.
Curriculum reform for 6-11 years old pupils	Latvia	Ministry of Education and Science, National Centre for Education www.vics.gov.lv	Ineta Helmane	6-11 years old pupils, primary school teachers	A comprehensive curriculum reform for 6-11 years old pupils promoting pupil-centred teaching; reading literacy and skills for work with information; coordination of the curriculum – aims, tasks, learning outcomes. From the school year 2014/2015 learning a foreign language will be compulsory from the 1st school year
<i>DARTKE Student Mentoring Program</i> in Service of Szeged and Hodmezovasarhely Desegregation	Hungary	University of Szeged and Dartke Association www.mentorprogram.eu	Nárcisz Kulcsár		The aim was to support the educational and social integration of gypsy pupils from an elementary school into their new schools, and to provide support staff for the mentor teachers and the institutions.
Meet the professor	Hungary	University of Szeged (Bolyai Institute, Department of Medical Physics and Medical Informatics) and University of Novi Sad www.model.u-szeged.hu	Nárcisz Kulcsár	Secondary students	Schools can invite professors from the university to take interesting lectures in the topics of mathematics and sciences.
Experience-centred Math/Art Movement	Hungary	Experience Workshop <a href="http://www.elmenymuhely.hu">www.elmenymuhely.hu</a> <a href="http://www.experienceworkshop.hu">www.experienceworkshop.hu</a>	Nárcisz Kulcsár	Students and teachers all level	Their goal is to present mathematical and geometrical ideas as sources of community experiences, discoveries and tools of joyful creation. They hold special MathArt-classes, organise interactive exhibitions and training sessions.
'Xarxipèlag project' Micro laptops and Smart Boards	Balearic Islands, Spain	Servei d'Informàtica Educativa de la Conselleria d'Educació	<a href="http://coordinatic.ieduca.caib.es/">http://coordinatic.ieduca.caib.es/</a>	All schools	This is a plan of modernisation of digital resources for improving education, accompanied by teacher training tools and methodology.



MIMO (Portuguese acronym for CARE) - Inclusive Methodologies, Increased Opportunities	Portugal	Escola Secundária de Loulé	Paulo Ribeiro Duarte Duarte Alexandre Costa	Educational Community	<p>The creation of a special classroom, with adapted materials and ICT resources for special needs students;</p> <p>The training activities aimed at the development of the educator's skills to facilitate the integration of students with special needs;</p> <p>The preparation of awareness events for students, parents and educational professionals;</p> <p>The establishment of an important partnership network with local institutions to guarantee the development of the training and awareness activities, to provide technical support and to offer professional experiences in internships to these students.</p>
NatTech	Czech Republic	The founder is the Moravian and Silesian Region <a href="http://www.nattech.cz">www.nattech.cz</a>	Petr Volník	Technical secondary school students (15-18 years old) pupils of primary school (11-15 years)	<p>Promoting technical and science education at primary and secondary schools. Supported subjects are physics, chemistry, biology, engineering discipline ...</p> <p>Activities: excursions, meetings, lectures, university professors, etc.</p>
Sbirkapříkladu.eu	Czech Republic	PrimMat – Soukromá střední škola podnikatelská, s.r.o. <a href="http://www.sbirkapříkladu.eu">www.sbirkapříkladu.eu</a>	Petr Volník	Secondary school students (15-18 years old) pupils of primary school (11-15 years)	Database of mathematics exercises created by teachers of mathematics in primary and secondary schools. Database accessible on the Internet ( <a href="http://www.sbirkapříkladu.eu">www.sbirkapříkladu.eu</a> ) for pupils and teachers.
Traineeships of teachers of technical subjects	Czech Republic	Ministry of Education, Moravian and Silesian Region	Petr Volník	Teachers of technical and vocational subjects in secondary schools in the Moravian region	Better experience and knowledge in the practice of engineering companies for teachers of technical and vocational subjects. One-day excursions or week internship during the year.
Modernisation of	Czech Republic	Moravian and Silesian Region,	Petr Volník	Technical secondary	Improving laboratory equipment for teaching

laboratory practical training		Secondary Technical School in Frydek-Mistek		school students (15-18 years old)	technical disciplines so that the conditions in schools as similar as possible to conditions and technologies in companies.
CA – Professores em prática	Portugal	Escola Secundária de Loulé	Paulo Ribeiro Alexandre Costa	Alunos do Secundário	Tutorial backup to students with the teachers that teach them or by the teachers of other classes from the same subject.

2. The study visits programme aims to promote and support policy development and cooperation in lifelong learning. That is why it is important to know what you learnt about such policies and their implementation during your visit. You are invited to describe your findings concerning the following:

**2.1 APPROACHES TAKEN BY PARTICIPATING COUNTRIES (BOTH HOST AND PARTICIPANTS') REGARDING THE THEME OF THE VISIT. ARE THERE ANY SIMILAR APPROACHES/MEASURES IN PARTICIPATING COUNTRIES? WHAT ASPECTS ARE SIMILAR AND WHY? WHAT ASPECTS ARE DIFFERENT AND WHY?**

We found the Bulgarian system of established specialist schools at secondary level clearly benefited those students attending them. Some countries have a similar special local schools, rather than national schools. The difference would be in the recruitment of students, as most specialist schools in other countries are not selective.

The system of encouraging mathematically talented primary pupils by having a secondary teacher prepare them for Mathematical Olympiads is an ideal way of developing young mathematicians and encouraging recruitment to the specialist schools. Many of the participating countries have a programme of liaison and transition between educational phases, and whilst some schemes focus on the most able students, many are to develop the confidence of young people as they move from one establishment to another.

**2.2 CHALLENGES FACED BY PARTICIPATING COUNTRIES (INCLUDING HOST) IN THEIR EFFORTS TO IMPLEMENT POLICIES RELATED TO THE THEME OF THE VISIT. WHAT ARE THE CHALLENGES? ARE THEY COMMON CHALLENGES? IF SO, WHY? IF NOT, WHY NOT?**

We identified that a major problem in delivering the best education in science and maths is the recruitment and retention of the most talented teachers. This is common to all phases, all countries and most of the STEM subjects. In some countries the style of teaching does not always reflect current research informing us of what makes effective pedagogy. Some countries are tackling the problem at a national level, and others are leaving it to schools at a local level to tackle the problem. Issues brought up by the group on this topic include the difficulty of moving staff forward when they have become set in their ways, and again some countries hold teachers to account more than others.

There are issues in many of the participating countries with children becoming disengaged with maths and science, and opting out altogether if given a choice. We agreed that teaching maths and science in context, rather than a set of possibly unrelated facts and processes would help to improve understanding and engagement.

**2.3 NAME AND DESCRIBE EFFECTIVE AND INNOVATIVE SOLUTIONS YOU HAVE IDENTIFIED THAT PARTICIPATING COUNTRIES (BOTH HOST AND PARTICIPANTS) APPLY TO ADDRESS THE CHALLENGES MENTIONED IN QUESTION 2.2. PLEASE MENTION SPECIFIC COUNTRY EXAMPLES.**

In the UK, graduates going into teacher training can claim funding up to £25000 (UK) and in Sweden, first teachers are rewarded with an extra 600 euros per month to make a difference to the teaching and learning in their own schools.

In the Balearics there is an Ecoliteracy project running to encourage the development of maths in context. In other countries there are mathematical societies and centres providing resources and training to develop pedagogy and imaginative delivery of mathematics. There is a huge expansion in the availability of very high quality online resources to support the teaching and delivery of maths and science and several are listed in section 1.

#### **2.4 ASSESSMENT OF THE TRANSFERABILITY OF POLICIES AND PRACTICES. COULD ANY EXAMPLES OF GOOD PRACTICE PRESENTED IN THIS REPORT BE APPLIED AND TRANSFERRED TO OTHER COUNTRIES? IF SO, WHY? IF NOT, WHY NOT?**

The methodology used in some countries of teaching a group of subjects in the medium of a foreign language is a very powerful way of becoming fluent in a second language. If teaching staff had the right level of expertise this could be adopted in more countries.

Links with primary schools are always desirable and using the extensive subject knowledge of an experienced secondary school teacher to develop talented youngsters in maths is a powerful way to build links and benefit children.

With sufficient financial support it would be desirable for Special Needs support to be based in schools at the point of need, rather than at remote or centralized centres.

### **3. Creating networks of experts, building partnerships for future projects is another important objective of the study visit programme.**

- Participants have made links with a view to developing an exchange with teachers and schools in the future
- Participants have exchanged pedagogical ideas and outlines of schemes of work
- Participants shared ideas for future Comenius projects
- Some participants intend to implement ideas that were shared during the study week in their schools upon their return

## TO SUM UP

4. What is the most interesting/useful information that the group believes should be communicated to others? To whom, do you think, this information will be of most interest?

We feel that pedagogy and expertise in the classroom make a vast difference to the learning experience and enjoyment of our students. The more that can be done to develop teachers' expertise and make staff more accountable for the quality of the experience in the classroom and beyond, the better the future will be for our children. We will then recruit more young people into fields related to maths, science and technology. We think that all departments of education should ensure that there are opportunities for staff to work collaboratively to improve standards and develop good pedagogy and resources.

In some countries the recruitment and retention of teachers is a major issue. There are elements of good practice in the participating countries which will help to improve the status of the teaching profession and ultimately help to improve the teaching and learning in schools. This again should be a concern of every department and ministry of education.

## THANK YOU!