



CEDEFOP

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of Vocational Training



Education and Culture DG
Lifelong Learning Programme

Study visit group report

Group No	85
Title of the visit	Teaching science in primary and secondary education
Topic	Learning mathematics and science
City, country	Salzburg, Austria
Type of visit	Mixed
Dates of visit	4/2/2013-8/2/2013
Group reporter	Lorna Grant and Ásdís Ingólfssdóttir

I FINDINGS

This section summarises the findings of the group while visiting host institutions, discussing issues with the hosts and within the group. You will be reflecting on what you learnt every day. But to put them together and give an overall picture, you need to devote a special session to prepare the final report on the last day of the visit.

In this section, it is important that you describe not only things you learnt about the host country but also what you learnt about the countries represented by group members.

1. One of the objectives of the study visits programme is to exchange examples of good practice among hosts and participants. Cedefop will select well-described projects/programmes/initiatives and disseminate them to former participants and a wider public, including potential partners for future projects. Therefore it is important that you identify and describe all aspects that, in your view, make these projects/programmes/initiatives successful and worth exploring.

The group consisted of 13 participants from 11 different countries; France, Hungary, Poland, Iceland, UK, Germany, Italy, Greece, Spain, Sweden, Turkey.

We had an opportunity to exchange information about the education system in each country and to consider the approaches to Science education in particular.

We learned a great deal about the education system in the host country, Austria through visits to the Paedagogische Hochschule, to a Primary School, a New Middle School, a Higher Technical Institute, a Lower Secondary School and an Upper Secondary School. We also spent time in the Science Museum in Salzburg, the Haus der Natur where we were given presentations on educational support provided by the museum to schools and took part in one of the workshop tasks offered to school pupils. We were also fortunate to be

able to attend a Science Day at the Paedagogische Hochschule and one of our group helped to deliver one of the workshop sessions.

The first day was used for introductions.

1. Martina Grogger: Presentation of programme and of Austria and the city of Salzburg.

2. Josef Kriegseisen: Teaching Science in Teacher Education.

- Austrian school system. Science within our Curricula. Standards and Research
- PH, the host school, Paedagogische Hochschule. They train teachers for the primary schools and for the dual system (not for the Gymnasiums).

3. Participants worked in groups and gave short presentations about themselves, their professional background and science education in their countries.

4. Dr. Günter Maresch, Teaching Science in Secondary Education. Teacher in Service Training.

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
Teacher In-service Training	Austria	University of Education Salzburg	Prof.Mag.Dipl.Mag . Marina Grogger	School Teachers	In service training delivered to teachers in the region. This is tailored to suit the requirements of the Ministry of Education , the Curriculum and Innovations in Education
Education System	Austria	Ministry of Education	Prof.Mag.Dipl.Mag . Marina Grogger	Pupils from age 14	Pupils have the opportunity to go into apprenticeships combined with training in vocational colleges
Education Competence Centres	Austria	www.imst.ac.at	Dr Guenter Maresch	School Teachers and pupils	Aimed at raising the standard of Science education. Provide guidance and also funding for specific projects. There are also centres at a regional level.
Student Teacher training	Austria	University of Education Salzburg	Josef Kiriogseisen	Student Teachers	Student teachers go on teaching practice in classrooms from the beginning of their training course. The university uses a model/practice school as well as other schools within the region. Students start with small parts of lessons assisted by

					mentor teachers but progress to whole lessons
Additional support	Austria	Neue Mittelschule Hauptschule Mittersill	HD Josef Wimmer VD Wolfgang Zingerle	Gifted pupils	Additional lessons are offered to pupils who are gifted in specific subjects
Preparation for progression	Austria	Neue Mittelschule	HD Josef Wimmer	Pupils from 5 th to 8 th grades	Preparation for progression from school provided as guidance
Support for Science Education	Austria	Haus der Natur	Mag. Markus Proetsch	Schools	Motivational programmes delivered to schools through workshops and experimentation
Science Day for Schools	Austria	University of Salzburg	Josef Kriegseisen	Pupils from Kindergarten to Upper Secondary	The university ran a science day for schools in the region which consisted of 18 workshops which were ran by the university's students. The day promoted active learning and was of mutual benefit to schools and university.
Interdisciplinary Learning	Scotland	Scottish Government/SQA/ Education Scotland		Children from 3-18	New Curriculum starting in 2013/14 which highlights interdisciplinary learning and includes a Science strategy to raise standard of Science education, not only for pupils who will specialise in Science but also as means of improving Science literacy for all.
Development of High Order Skills	Scotland	Scottish Government/SQA	Lorna Grant	Secondary school pupils aged 17-18	To prepare pupils for study at university through the development of high order skills such as

					independent learning, research, problem solving, interpersonal and organisation skills the Scottish Baccalaureate in Science is offered to pupils in the final year of secondary school. Included in this award is an interdisciplinary project – pupils choose the theme, plan how to undertake the project, decide how to present their findings and finally evaluate the project and themselves.
Laboratory Centre for Sciences	Greece	4th Lyceum of Chania	Roumpini Moschochoritou	Teachers and pupils	Support and motivation for Sciences through experimentation and laboratory work. We have 75 centres for this purpose.
Researchers' Night	Hungary	University of Pannonia	Agnes Werner-Stark	Secondary School pupils	The research laboratory opens in the evening and pupils can see different laboratories (cardio-electro imaging, virtual realities and imaging technologies, intelligent control systems research and bioelectric and neuroimaging), simulations and researchers working in a laboratory. The pupils will gain experience of control systems for fault diagnosis purposes and the information system laboratory in Medicine etc.

Robotic Laboratory	Hungary	University of Pannonia	Agnes Werner-Stark	Secondary School pupils	The pupils can work with the university students to build some robots together and learn robotic programme language.
Jules Verne Programme	France	Ministry of Education	Frédéric Girardet	Primary and secondary teachers	This programme allows French teachers to undertake a twelve month work placement in a similar organisation in another country. This project helps to embed the notion of internationalisation of science teaching.
Team teaching in science	France	Ministry of Education	Frédéric Girardet	Secondary pupils from a technological and scientific school	One hour a week science is taught in a foreign language. Two teachers (in science and foreign language) deliver the lesson in the foreign language.
Science teaching methodology	France	Ministry of Education	Frédéric Girardet	Secondary school pupils	The curriculum is divided into several themes; each theme is taught through physics, chemistry and biology. This enables the pupils to develop an understanding of the connections between the different sciences.
Teacher partnership to develop good practice in science teaching	Sweden	National Agency of Education	Astrid Sundstroem-Lindstroem	Teachers of 6-9 year old pupils	Teachers from different schools participate in an education programme. This is offered by the National Agency of Education on how to teach according to the new curricula and how to assess so

					<p>that the assessment stimulates student learning. The education programme consists of 4 learning sessions of two days each during one semester. The teachers have to practise what they learn in between workshops and report the results of their work.</p> <p>For more information: www.skolverket.se/fortbildning-och-bidrag/enstaka-kurser/nt-kurser-f-3-1.180219</p>
Teaching chemistry through the medium of English and peer mentors	Iceland	Kvennaskolinn Reykjavik	Asdis Ingolfsdottir	Pupils in Upper Secondary School/Junior College	Chemistry is taught in English in the national science department and a text book from USA is used which is better than any text books produced in Iceland. The teaching method was changed to group peer mentoring (2-4 in a group). Pupils take responsibility for their studies and learn together with peer mentors helping them to understand the subject. The school network is used to record progress and to provide tools to help such as word lists, instructions, short texts etc.
Geology as a compulsory subject	Iceland	National Science Department	Asdis Ingolfsdottir	Pupils in Upper Secondary School/Junior	Geology is compulsory for all students in all upper secondary schools. This helps pupils to have a

				College	better understanding of their environment
	Iceland	Kvennaskolinn Reykjavik	Asdis Ingolfsdottir	Pupils in Upper Secondary School/Junior College	In other departments of the school (Social Subjects and Humanities) a different teaching approach has been adopted. In the first year pupils have an obligatory three hours during which time they have workshops (practical experiments and short pieces of written information in Icelandic). Teachers prepare PowerPoint presentations which are given as homework. The approach is to start with practical work and then move on to the theory. This approach has reduced the dropout rate from 30% to 1%.
Project presentation	Germany	Realschule Bavaria	Guenter Lenyk	Pupils in secondary school	In every year group pupils are given a special topic and then trained in presentation skills e.g. How to create handouts, short videos, powerpoints etc. A very important part of the final examination is that they are given an unknown topic and as a group have to prepare a presentation. It is important that the pupils choose five different presentation methods to demonstrate what they have learned. The audience consists of

					younger pupils, peers, teachers and parents who are invited as guests.
Implementation of new curriculum for environmental education	Poland	Provincial Teacher Training Centre Skierniewice	Agnieszka Dabrowska	Primary and upper secondary schools	Through the provision of in service teacher training the institution has enabled the organisation of networks of teachers to enable the cooperation, exchange of experience and good practice.
Teacher training Progetto 'm@t.abel' science education	Italy	Ministero dell' Istruzione dell' Universita e della Ricerca MIUR	Palma Rosa Legrottaglie	Teachers of all Italy from Kindergarten to Lower Secondary	Experimental learning for teachers to apply to pupils (aged 3-13) – 'Learning by Doing'. Interest in research and innovative methods in scientific subjects.
The Teaching Experimental Science Plan	Italy	Istituto Superiore Statale G. Mazzini	Chiara Schettini	Pupils up to the age of 15.	A nationwide project initiated in 2005 aimed at achieving a lasting and effective change in the teaching of experimental sciences based on a research action plan. Funds were made available for the establishment of science labs and financed refresher courses for science teachers.
CLIL teaching	Spain	Department of Education of Navarra MEC recursostic.educacion.es/descartes/web/	Leandro Gonzalez-Knowles	Secondary school pupils from ages 12-16.	Pupils are required to use English to learn different subjects (e.g. Mathematics). This greatly improves their language skills and builds confidence. They use ICT and manipulative tools to learn Mathematics and help them to

					understand the concepts.
Learning through projects	Spain	IES 'Padre Moret Irubide' centros.educacion.navarra.es/iespadre1/	Leandro Gonzalez-Knowles	Secondary school pupils from ages 12-16.	Projects requiring Mathematics are developed which motivate pupils to learn by doing things they consider useful. These projects can be interdisciplinary involving other subjects such as science, geography and PE.
Method Project	Spain	IES Julio Verne www.iesbargas.com	Angel Delgado-Aguilera Munoz	Secondary school pupils	Pupils are given a real problem and have to choose different solutions, make a forward plan, design and construct a prototype. First they have to produce drawings showing perspective and views with scale and dimensions. Electric sketches are also required. They then check and evaluate the project, introduce modifications, if necessary, and then create a marketing plan. They complete the project by writing a report.
'Chemistry is all around us'	Turkey	http://projects.pixel-online.org/chemistry/info/index.php	Dr Murat Demirbas	Teachers and science educators	To develop materials for science education and also to identify barriers and success factors in lifelong learning of science concepts.
Space Camp Turkey	Turkey	ERBAS-Kaya Tuncer http://www.spacecamp		Adults and young people.	To motivate students to study science, mathematics and

		turkey.com/defaulteng. asp			technology. To provide them with the opportunity to move into a career in this area.
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** You can describe as many good practices as you find necessary. You can add rows to the table.*

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?

A. - ARE THERE ANY SIMILAR APPROACHES/MEASURES IN PARTICIPATING COUNTRIES? WHAT ASPECTS ARE SIMILAR AND WHY?

Some methodologies are used in all countries, for instance:

- LEARNING CYCLE, which has three main stages:
 - 1) Students research materials and collect data.
 - 2) Teacher explains concepts.
 - 3) Students apply their knowledge in different areas.
- The CONSTRUCTIVIST approach: Students can put the theoretical concept learned into practice.
- The application of the REPORT ROCARD ON SCIENCE EDUCATION (IBSE Methodology) is well developed in Italy. This methodology could be applied at all levels of education. It takes place in several stages:
 - 1) ENGAGEMENT.
 - 2) PRACTICE.
 - 3) EXPLANATION.
 - 4) ELABORATION.
 - 5) EVALUATION.
- DISCOVERY METHODOLOGY. Devoting as much time as possible to practical work in workshops or laboratories.
- MONTESSORI METHODOLOGY; based on “learning through manipulating things”, the teacher is mainly an observer. In the classroom there are a lot of materials to guide pupils (focused on the kindergarten pupils).

B. - WHAT ASPECTS ARE DIFFERENT AND WHY?

In general, we can find some different aspects.

- 1) We would like to highlight the fact that students' motivation seems to be different. We have observed that Austrian students are highly motivated.
- 2) It is also apparent that teachers' motivation is different because some continue to use old methods.
- 3) Class sizes have been reduced in few countries. For example, in Austria, in primary school there are around 14 pupils in a class and in secondary school

around 24 pupils. In the other countries there are around 25 in primary and 32 in secondary.

4) The number of periods dedicated to learning science in Austria is around 6, in the rest of countries it varies between 2 and 4.

5) In Austria time spent by pupils in the laboratory is around half of the total time. This percentage is higher than in other countries, where more theoretical lessons are taught by the teacher.

6) Perhaps the teacher training programme could be improved in the majority of countries. We were very impressed by the teacher training in Austria, in particular the importance of the link between university and school. In addition, the resources received by teachers from the regional school board are impressive.

C. - WHAT COULD BE IMPROVED?

In general terms, we would like to highlight:

1. - Motivation of teachers and pupils.
2. - Teacher training, because we have to adapt to new methodologies. This is a process that requires continual review.
3. - Infrastructure.
4. - Human resources. In technical classes, two teachers would be recommended.
5. - It is essential to try to change society's view of science and to dispel the myth that science is boring, difficult, or only for high ability pupils.

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?

In all participating countries, there is an alarming decline in young people's interest in science and mathematical studies and this could affect the acquisition of those skills that are essential in a society increasingly dependent on technology.

So it is necessary to bring about a radical change in young people's interest in the study of science which is the main challenge for everyone.

Most participants believe that the origins of the declining interest among young people in science studies could be traced back to the way science is taught in school. It is therefore necessary to bring about a change in the methodology of science teaching in school from mainly deductive to inquiry-based methods (for example IBSE methodology). This would apply to both primary and secondary levels and would be effective for all kinds of pupils from the weakest to the most able. It is also a priority to encourage the participation of girls in science activities.

Another common challenge is the need to promote partnerships between the stakeholders of both formal and informal education, involving firms, scientists, researchers, universities, associations and parents.

It is also necessary to improve 'in service' teacher training methodologies with specific resources for the classroom as well as online resources. It would also be beneficial to encourage exchanges between science teachers, scientists and pedagogical experts.

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.

External laboratories within large factories (Germany)

European projects (Comenius, Erasmus MIA, E-twinning, Leonardo): all the participants

Renewal of science curricula, based on a new pedagogical approach: almost all the countries

Outdoor education projects (Poland)

Science festival, Science day (almost all the countries)

Improving information technology for example smart boards, new software, virtual reality (Hungary)

Teacher training in schools (almost all the countries)); in Austria the partnership with University of Pedagogy is well developed.

There is a National Project "Science Education" to train lower secondary science teachers using an Internet platform and repository of practical activities (Italy)

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?

We have seen many examples of good practice in the schools which we visited. We also obtained information about good examples in other countries from the participants in the study visit. All participants have described many examples of good practice and policies in their countries, some of which are presented in the table in Section 1. Students in all countries have difficulties in understanding science and for this reason their motivation in science is at very low level. Therefore, we should search for ways to increase their motivation in science. There are possible ways to achieve this; (1) we should explain science in a more comprehensive way by linking the concepts or theories with everyday life (2) we should provide more practical training in laboratories, (3) extra science activities in small groups should be provided to the pupils after the formal science classes, (4) Science days, science festivals, as in some countries such as Austria and Italy, in order to share knowledge and experiences in science among students and teachers should be organised in other countries, (5) science exhibitions, science museums, and interactive science centres for pupils/people should also be extended to all cities in every country. For example; Hungary has special evenings for science in which teachers in universities work collaboratively with university students and with secondary school pupils on robotics. These are very important to make science education more attractive for our pupils. Moreover, science curricula should be based on a real-life context-based approach as in many countries, and this should be adopted by others. Crowded classes in some countries (Turkey,

Greece) may make it difficult, but in general there is no reason why this could not be done.

All participants also claim that learning science in English would be better for students because the language of many science resources (documents, encyclopaedias, videos, etc.) is English. Therefore, the language of science courses, partly or wholly, should be English. Moreover, English courses should include technical terms. In many countries, such as France and Spain, they teach science both in English and in the mother language. There are two teachers (science and English) in the science classes. To transfer this to some countries (Greece, Hungary, and Turkey) may be difficult because most science teachers and pupils are not good at English. To overcome this difficulty, the National Ministries of Education in these countries should provide in-service training for their science teachers.

In-service teacher training already exist in various forms in many countries. Austria has a well-organized in-service teacher training system. Teachers attend courses relevant to their teaching and learn about both the subject and how to teach this to their pupils through practice. Italy and Scotland also have an online system for in-service teacher education. A website provides information about new teaching/learning approaches, teaching methods, and also teaching materials which can be used in the classroom. These are good examples of in-service teacher training and could be adopted other countries.

Austria and Germany have good partnerships with local industry. This helps to enrich the learning experience and encourages students to study and succeed in science. Active links between schools, industries and universities of education have a positive effect for pupils, industry and schools. Pupils have an opportunity to practise their knowledge. However, in some countries these partnerships do not exist and it may be difficult to develop them due to a lack of industry.

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

Please state whether and which ideas for future cooperation have evolved during meetings and discussions.

The group has agreed to continue to network and share ideas using the following tools:

- Email communication
- Using a shared folder for the documents on the internet

Chemistry Teacher Group

Participants from some countries such as Italy, Turkey, Greece, Iceland, Austria and France would like to form an informal network and possibly organise a preparatory visit to Hungary.

They would like to create an “Erasmus for all” partnership. The network would like to develop a method of teaching chemistry “How to teach chemistry in Europe?” The aim is to develop a European resource for teachers as a result of comparing different methodologies implemented in each country. Following on from this project in service training could be suggested.

They would aim to promote the good practice in the countries represented by the participants.

Headteacher/headmaster network

Participants from some countries such as Germany, Greece, Austria, Hungary and Sweden would like to form an informal network.

They would like to create an “Erasmus for all” partnership. The network would like to develop methods of teacher assessing. The aim is to develop a guide to support the assessments. We share the same problems and would benefit from comparing different experiences implemented in each country. Following on from this project could be a visit study.

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?

It was very interesting that the participants came from other countries and these people worked very well together.

The participants work in different areas of education e.g. teacher, head teacher, associate professor, researcher, qualification authority, teacher trainer.

The active teaching methods observed in the primary school and the secondary school were regarded as being an example of excellent pedagogy and which could be shared with others.

It was interesting to note that most countries represented had similar concerns about the standard of science education and the ways in which this could be raised to improve the science literacy of all pupils.

Finally, all participants agreed that having a clear vision for the progression of our students from primary to university level is vital and the sharing of this vision between countries would be advantageous. The intention of the University of Salzburg to extend their on line platform for science education to other countries would be a very positive step forward.

THANK YOU!