Meteorology in European school curricula

Arne SPEKAT, European Meteorological Society, Berlin, Germany
(ems_sec@met.fu-berlin.de)
Jon WIERINGA, Wageningen University, Wageningen, Netherlands
(jon.wieringa@xs4all.nl)

Abstract
School systems for a number of European countries and existing presentations of meteorological and climatological subjects are compared with a focus on compulsory education ages. This is the beginning of an update of the review by Wehry (EMS Bulletin 1997, http://www.emetsoc.org/ems_education.html), for school education up to about 15 years. Starting ages, the age of crossover from universal primary schooling to various types of early secondary school, and the autonomy of schools are shown to vary significantly between countries. Equally diversified are the covered weather and climate subjects, their level of coverage and the used teaching subject area. It is discussed if some European countries have sufficiently similar primary education structures to have a chance of successful cooperation on environmental subjects.

1. Introduction and general remarks

The attempt of making a survey of the situation of meteorology and related fields in school education was first made by Wehry (1997). It was part of an activity of individual meteorological societies from Europe at a time when the European Meteorological Society (EMS) was not yet founded. Another focus was university education which by 1997 had led to ECTOM, the European Catalogue of Training Opportunities. EMS and its Education Committee now have launched activities to update both – which is an arduous task, requiring patience and perseverance.

This paper presents a comparison of a selection of seven (eight) countries. It should be noted that even official comprehensive studies, e.g. carried out by the European Union (EURYDICE, 2002) leave out countries like Croatia (which is the eighth country of this study) or Switzerland. It is clear that such surveying attempts to freeze a state in a constantly evolving system, as in the EURYDICE report on education systems. Yet, such surveys are segments of the process of understanding the subject better. We are not pretending to give a comprehensive overview; this paper is meant as a starting point for an update which is continuing.

When looking for meteorology and climatology and other related subjects in school education one should first give a good look to the school systems themselves and the general situation they are facing. This is done in Sections 2 and 3. Whatever co-operation will be possible depends highly on the autonomy given to the schools involved. Section 4 looks into these matters. Section 5 deals with the diversity of curricula and the liberty to decide on their composition. Section 6 compares the places given to meteorology and climatology in eight European countries. A discussion and conclusions are presented in Sections 7 and 8.

2. The spectrum of school systems

Generally speaking, in most of Europe – including those covered in this study – two important tendencies prevail

(i) The population does not grow, and also there are not as many young people as there used to be 20 years ago. This has consequences, e.g., for the priority given to school education and to the funding allocated to the education systems.

(ii) There is a tendency that everybody should get some qualification – to deal with progress as such and with the changing economic conditions. A consequence of the increased number of trained young people is that many of them have to accept

underpaid or temporal jobs for which they are over-qualified. It should be underlined, though, that getting a good education still pays.

Owing to the cultural diversity and the different evolutions of education systems, there is a tremendously large number of approaches and realizations in Europe. Even within one country, there can be several systems at work in parallel, e.g., in the U.K. with different approaches in England, Wales, Scotland and Northern Ireland, or in Belgium with its Walloon, Flemish and German regions, or in Germany with its 16 Bundesländer exerting regional autonomy in many fields, including education.

In order to have some tools for comparison an International Standard for Education (ISCED) was devised which classifies pre-primary schools as ISCED 0, primary as ISCED 1, and lower secondary as ISCED 2 – which is the top level of compulsory education in most countries. Upper secondary schooling is ISCED 3, and it continues to a level of ISCED 6 for post-university training. For the ISCED 1 level the school systems across Europe are rather comparable. Beyond that lies a vast ocean of varying ideas and realizations. We refrain from showing this variety here – there are EU-sources like EURYDICE, which extensively cover this field.

3. Primary school – ages and duration

As shown in Fig. 1 for a selection of countries, the entry age, the duration and the integration of primary education with subsequent education varies to some extent. Several countries, including Germany, France and the Netherlands, have a multi-tier structure, wherein primary and secondary education are kept rather strictly apart – secondary education is then arranged in levels and transition is either subject to an examination or a recommendation. These are denoted in black in Fig. 1. Other countries, e.g., the Czech Republic, Hungary, Norway and Sweden favour an integrated approach for ISCED 1 and 2, which is termed "Single structure" in Fig. 1.

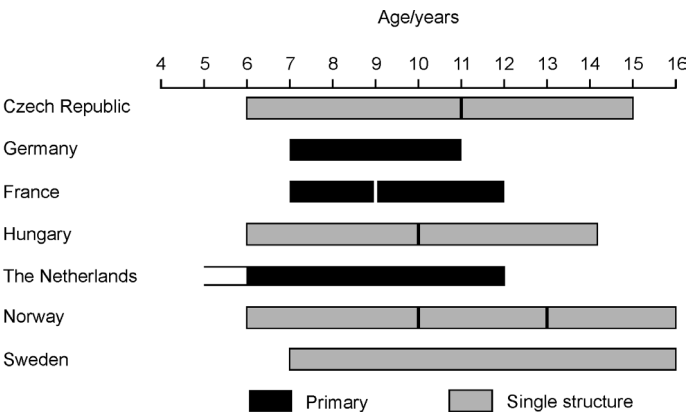

Figure 1: Primary and single structure education for a selection of European countries [data: EURYDICE].

Not only the general approach does exhibit some variety. So does the age and timespan which is considered compulsory, it normally goes to an age of 15 or 16 years. This is obvious from Fig. 1 for those countries who integrate ISCED 1 and 2 – the extreme being Hungary where it is compulsory to be schooled until the age of 18.

4. Freedom of decision

The independence of schools and their freedom of decision varies greatly. In a EURYDICE survey of 2002, the autonomy of public-sector primary schools was investigated for 34 European countries for the 2000/2001 in four sectors

(i) Time, e.g., number of days per year, of hours per year, of hours per week, of hours per subject, of distribution of subjects over the week;
(ii) Finances, e.g., buildings, equipment and running costs;
(iii) Teaching staff, e.g. appointment of head teachers, number of posts, teacher recruitment;
(iv) Teaching itself, e.g., textbook and method selection.

They were given "no autonomy", "limited autonomy" or "autonomy for decision" status. With a weighting of 3:1:1:5 for the four sectors mentioned above, which will be helpful for determining similarity with respect to *contents*, we have carried out a "poor man's cluster analysis" to see if a grouping is possible.

Though this paper generally focuses on selected countries it is worthwhile looking at a more comprehensive picture for a moment. The analysis shows that, indeed, the surveyed countries/regions can be arranged as follows:

Table 1: Similarity of autonomy within 34 European countries/regions. Highlighted are the countries for which presentations of meteorological and climatological subjects are compared. Within each cluster the entries are sorted according to their similarity with the first member.

1	2	3	4	5
Luxemburg	Bulgaria	**France**	Denmark	Italy
Cyprus	**Hungary**	Belgium_fr	Finland	UK_Scot
Greece	Iceland	Belgium_de	Estonia	**Norway**
Germany	Slovakia	Portugal	Belgium_nl	**Sweden**
Liechtenstein	Poland	Spain		UK_N Ireland
	Slovenia	Austria		UK_Engl/Wales
	Romania	Ireland		**Netherlands**
	Czech Republic			
	Malta			
	Lithuania			
	Latvia			

Cluster 1 contains countries in which autonomy is least granted to the schools (so Luxemburg has the highest degree of contralization) and the degree of autonomy increases towards cluster 5 in which there is a rather high liberty given to decide on teaching. Such liberty, however, rarely includes financial matters.

This is of course just one aspect of the dynamics involved when the decision processes are considered. Another factor, which one must not overlook, is that in many countries parents and parent organizations are involved in many school decision processes, particularly in Central Europe.

5. Composition of curricula

When looking for places in which atmospheric or environment sciences could enter a curriculum or maybe take a greater place, it should be taken into account how the different countries/regions arrange the topics and how much autonomy is given in some. Fig. 2 shows the composition for the primary schools of a selection of countries.

The variety is staggering. In the light of the previous section it remains to be seen, if it is an advantage or disadvantage to encounter either a "centralized" school system or one that is more loosely structured in terms of topic distribution flexibility. The choice would be to deal with a few authorities or with a large number of individuals determining the contents of their lessons.

If you miss information technology in the above distrubutions as individual subject it is due to the fact that in all countries considered here this topic is to be integrated into other subjects rather than to be taught independently.

Another factor which defines the boundary conditions for the curriculum is the time available. Fig. 3 shows the number of hours for primary schools. The whole survey which covered 34 countries, yielded that the available time varied by a factor of two, between about 475 (Latvia) to almost 1000 (Italy).

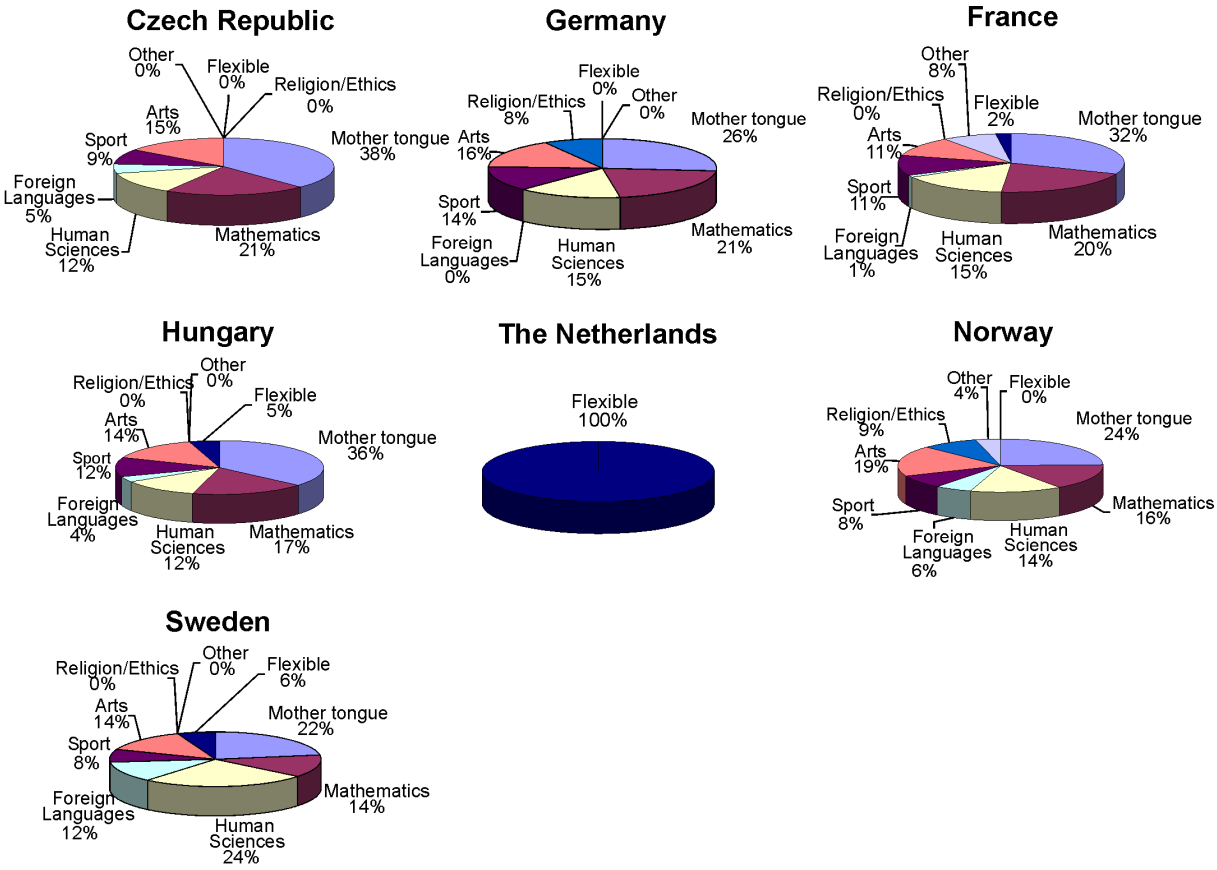

Figure 2: Composition of subjects in primary schools for selected european Countries [data: EURYDICE].

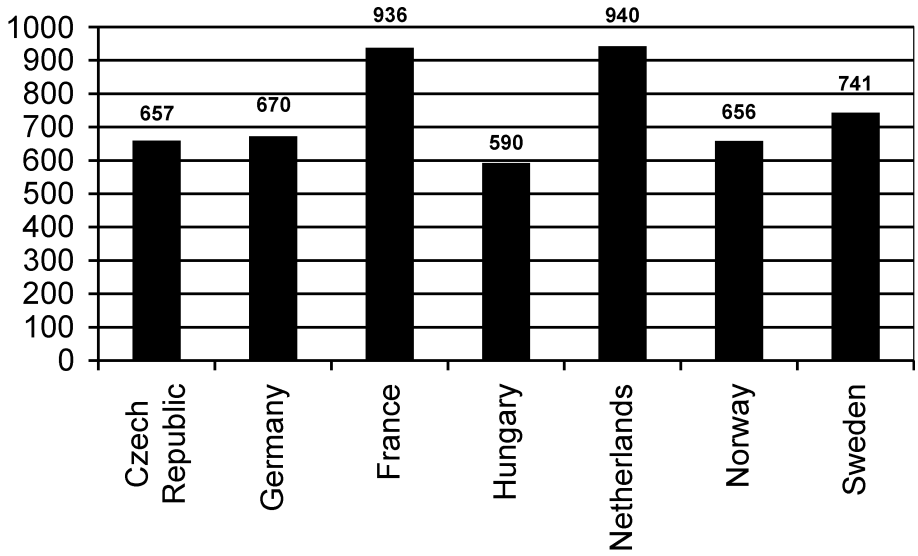

Figure 3: Average minimum annual number of hours of teaching in primary education (ISCED 1), 2000/2001 [data: EURYDICE].

6. Meteorology in schools

In the following paragraphs, the national preferences with respect to the placement of any meteorological and climatological subjects in compulsory education are summarized. The focus is on primary schools, the ISCED 1 level. Rather frequently the authors had to draw from national experiences, often obtained through the network of the European Meteorological Society.

- The **Norwegian** school system, e.g., phrases it like this "…the key words for the *primary stage* are play, wonder, experience, observation, classification and concepts." (pers. comm. Pal Kirkeby Hansen 2002, 2003). The concepts for introducing meteorology throughout the years spent in school are rather well-developed there.
- **Croatia** has a coverage of weather and climate-related phenomena throughout the whole primary and secondary education. It starts in grade one (at age 7), where focus is given to the seasons. In grade three, some basics on rivers, lakes and the ocean are taught – in that grade there is a first appearance of climat; it should be noted that the distinction between climate and weather, which is covered at that age is taken up again at age 15, when climate zones are compared. In grade four, scientific aspects are touched upon by identifiying the sun as a source of energy, by taking first weather measurements and by making simple experiments. This continues for the next grades, with one focus in nature studies and life sciences and one in physics (e.g. energy and energy conservation issues). For secondary school, whatever meteorolgy finds its way into the curricula is placed in geography. (pers. comm. Marina Grcic, 2003).
- In the **Netherlands** a bit of meteorology is introduced as part of the environment education in primary school. The distribution of teaching hours is broadly similar to that in other European countries (e.g. about one-third is spent on the mother tongue), but the primary schools have freedom to decide how much time will actually be spent on each subject (Fig. 2). In secondary school geography, and sometimes science, lessons can optionally deal with the atmosphere more deeply. (O'Donnell and Micklethwaite, 2000; pers. comm. Kees Floor, 2003).
- **Sweden** puts great weight on interdisciplinary approaches, which is pursued at all ages in school. It is interesting, that the subjects are prescribed, but not so much the age at which they should be treated (O'Donnell and Micklethwaite, 2000).
- **France** places meteorology-related subjects under life and earth sciences with a bit of physical background in physics and chemistry. All children in primary schools study science in some form (with regard to "discovering the world" and with regard to technology), according to the preferences of the teachers. However, there is much more systematical teaching with respect to the environment in secondary school, interestingly in both *life and earth sciences* and in *physics and chemistry* (O'Donnell and Micklethwaite, 2000; pers. comm. Vincent Pircher, 2002, 2003).
- In the **Czech Republic**, apart from the introduction of basic principles in primary school, a rather wide range of physical aspects with relation to processes in the earth system is dealt with. A range of 4 to 10% of the time is reserved for this kind of teaching throughout the classes 6 to 11 (pers. comm. Tomas Halenka, 2003).
- In **Hungary**, the initial focus is on observation and the subject is placed in environmental education. In later years, physics comes into play (pers. comm. Pal Ambrozy, 2003).
- In **Germany**, there is room for experiencing phenomena of nature foreseen for an age of 8 years. It is firmly rooted in an environment-minded approach, the amount of it tapers off in the subsequent years, to be revived at about age 14, when the world is covered (or uncovered) in geography and a few basic facts of climate are touched. At age 16 to 17, interdisciplinary dealing with matters such as water availability or energy ressources lead to some improved understanding of the earth system (presentation at EMS Education Workshop by Christian Zick, 2002).

7. Discussion

In most countries, matters related to meteorology or the environment are taught at ISCED 2 and 3 levels (lower and upper secondary school) and there is not much taught at the ISCED 1 level. Three stages are rather common:

(i) a simple, environment-minded encounter with nature in primary school – the subject under which this falls varies;
(ii) imparting a grasp of the climate system, including some general knowledge on the general atmospheric circulation in lower secondary school, often in geography;
(iii) learning in a more thorough, occasionally process-oriented or interdisciplinary way in upper secondary school – mostly in geography, sometimes in physics.

We could wrap up the investigation at this point, maybe suggesting to extend it to more countries to round off the whole picture. However, several things can be said in favour of getting a more thorough understanding of our environment, including the atmosphere **as early as possible** – which is in primary education: For one, high value should be placed on the fact that the average common knowledge about the earth system is improved. Meteorology, climatology and a more thorough understanding of environmental processes and interdependencies are a well-suited vehicle to introduce principles of physics and other natural sciences into the classroom in an attractive and non-austere way.

For two, an interest in more science-leaning topics should be kindled, of course, because it will also raise the number of those choosing science as a carreer lateron. We witness a tendency of hard science falling into disgrace among youngsters because it is too difficult or not enough helpful for a solid career or even both (Wieringa and Spekat 2003).

If the idea is pursued further to introduce more meteorology or environment matters to ages representative for primary schools throughout Europe it should be considered where this is achievable. First of all, in principle it is of course possible everywhere, since curricula allow for some evolution. In light of the results presented in Section 4 and 5 there should be a grain of realism thrown in where this seems to be more and where less difficult.

- There may be room for improvement but the overall situation seems already rather satisfactory in **Norway**. Yet, the teaching time available is comparably short.
- The situation is problematic to assess in **Croatia** since this country is left out in a lot of studies and surveys. It should be noted that meteorology and environmental matters seem to be rather well-covered already.
- A combination of rather high overall autonomy, flexibility to determine the distribution of subjects taught and a large number of hours foreseen for school education each year characterizes the conditions in the **Netherlands**. Thus chances look good for successful broadening the scope of science taught in primary education.
- The situation is rather favourable in **Sweden**, too, with its well-developed autonomy, though the curriculum strictly prescribes a composition of the subjects. It is favourable that the age at which subjects appear in class is not strictly fixed.
- **France** is in a middle position, because a great deal of influence lies with the school authorities, yet the basic attitude is rather science-friendly. Furthermore, a lot of time is available to be distributed among the subjects.
- In the **Czech Republic** and **Hungary**, centralization is rather high; it seems like the science-oriented ISCED 2 education might be benefitting from a well prepared “input” by the preceeding level. All this has its constraints by the time available and some effort would have to go into proposing its increase.
- **Germany** has a quite multi-faceted situation, since autonomy is granted on a different level, giving the authorities in each of its Bundesländer a lot of independence to develop their own schemes and mechanisms. However, the introduction or the rank of meteorological and related matters seems to be improving, though any measures would face a rather tight curriculum with comparably few hours to spend.

8. Conclusions

Although it is far from being in a desirable, well-developed state, it should be noted that atmosphere and environment play an, albeit minor, role in the curriculum of primary and secondary education. There is at any rate room for much improvement. Approaches to introduce the matter might in some countries mean to involve national education authorities; in other countries, where it is left much more to teachers or their local school environment, a bottom-up strategy, in which courses for teachers are organized looks more promising.

This survey is part of an ongoing activity of the European Meteorological Society. Its Education Committee has a main focus on school education. Meteorological and other scientific Societies seem to be a good resource for this kind of activity, since they draw from a number of sources and have rather long time horizons, which is highly necessary when education matters in particular are considered.

Acknowledgement

The authors acknowledge the provision of factual information supporting this ongoing description job by some of our colleagues from different EMS countries.

References

EURYDICE, 2002: Key data on education in Europe. – European Commission/EURYDICE/ Eurostat, Brussels.

O'Donnell, S., C. Micklethwaite, 2000: Thematic Probe: Science for the 21st Century. – International Review of Curriculum and Assessment Frameworks http://www.inca.org.uk

Wehry, W., 1997: Education for the general public. – EMS Newsletter online **3** http://www.emetsoc.org/ems_education.html

Wieringa, J., A. Spekat, 2003: Teaching natural science at primary schools – politically not important or educationally too difficult? – Paper 20, Conference CD, EWOC Conference, 7-11 July, 2003, Madrid, Spain.

EMS Secretariat, Institute of Meteorology, Free University of Berlin, Carl-Heinrich-Becker-Weg 6-10, 12165 Berlin, Germany, ems-sec@met.fu-berlin.de