Introduction

Why mathematics and educational policy as a subject for a round table? What does the title mean? Mathematics as a subject taught in schools and universities has a place within the social and educational politics of a country. In part, the place of mathematics in society is indicated by the structure of the educational system and the importance of mathematics within this system, the numbers of students taking the subject, and so on. Due to the greater mobility of the student population in Europe and the increasing need for a mathematically well-educated population, comparisons between the systems in the different European countries are being made more frequently than before. However, many of these comparisons are based only on personal impressions, often even on misinformation. Therefore, the results are usually not wholly accurate or complete. Decisions are made based on such comparisons and unless mathematicians at all levels have access to reasonably accurate information, the risk of perpetuating or repeating errors is enormous.

The purpose of the round table was thus to try and give a limited but more accurate picture of the place of mathematics within the educational systems of a small number of European countries. In fact, it became obvious as we began preparing the round table that our own knowledge of the general educational systems in countries other than our own was incomplete. Thus the report does not restrict itself to mathematics alone, but also gives a description of part of this general educational structure.

The task was huge, but was made more manageable by the publication of Geoffrey Howson’s book *National Curricula in Mathematics*, [GH]. This 235 page book attempts to map out the structure and content of the national curricula of the twelve E.C. countries plus Hungary and Japan. The book is divided into two parts, the first of which contains an analysis of the points of divergence in the various syllabi and a discussion as to the way in which the models of the learning process influence the content and the context of the national curriculum. He notes (p. 8): “It is at the secondary level, however, that differences in the structure of the various systems become most pronounced. This reflects not only different assumptions as to the desirability of streaming children by ability and
attainment, but also different beliefs and traditions, considering the degree to which the student’s curriculum should be tailored to ability, aptitude and aspirations.” He discusses various structures used for differentiating between students of various levels of ability and, where possible, looks at the reasoning behind these structures. The real aims of education are not always overt.

In his analysis of the content of the various curricula, Howson presents a table showing the relative stage of a pupil’s school life in which certain concepts are introduced in a selection of the different systems (p. 19). This is very instructive since for some topics there is very little spread in the age of introduction, but in others the spread can be six or eight years.

The divergence in course content and structure of both the curricula and the assessment procedures are such that it is clear that there is no simple comparison to be made between these structures. However, the transfer of ideas from one system to another might be possible with care. There are other solutions to the problems inherent in the teaching of mathematics than those found in our own indigenous traditions—and this is the great value of the book.

The second part of the book presents a reasonably detailed summary of the national curricula of the fourteen countries, each in a separate section. Each section starts with a diagram indicating the structure of school education in the country followed by a general discussion of this structure together with an annotated summary of the national curriculum in mathematics. The extent to which the system has been in full evolution nearly everywhere is striking. This is clearly evident in Spain, for which two structure diagrams are given since the system was in the process of changing when the book was being written.

Howson states in his introduction that he has not discussed many features of the educational systems that are relevant to mathematics, but rather has limited himself to topics directly related to national curricula. Problems of teacher training and numbers of teachers are thus not mentioned in detail (see the following report for a description of the recent complete renewal of the teachers educational system in France). The questions of the school/university transition, the university system, the structure of higher education qualifications and so on, are also not discussed. In our report we will try to make a start on providing some of this information, at least for a small group of E.C. countries (Belgium, France, Germany, Italy and the United Kingdom). Thus we hope to continue and expand the task that [GH] set out to do. The space available here is not sufficient to do more than describe and summarize the information, but we hope to produce a more lengthy version in the not too distant future.

Reference

Note: In view of this round table, a questionnaire was sent to the various mathematics associations in Europe in December 1991. The aim of this questionnaire was to gather information concerning the role of mathematics in the European educational systems. We received answers from fourteen countries, but not all the information could be fully exploited. These documents were handed out during the round table and still available from J. Camus (Department of Mathematics, University of Rennes I, France). The countries were: Belgium (W. Dewilde, N. Rouche), Czechoslovakia (J. Bures), Denmark (H.J. Munkholm), Finland (J. Laine), France (J. Camus), Germany (P. Bungartz, W. Haag, R. Strässer), Hungary (T. Nemetz), Italy (V. Villani), Luxembourg (J.P. Pier), the Netherlands (M. Bakker, P.C. Baayen, D. Sierma), Poland (Z. Bobinski, A. Rozkosz), Spain (J.D. Godino, M.C. Batanero), Sweden (T. Tambour) and the United Kingdom (A.C. McBride, G. Howson, T. Porter, J.C. Robson).

The Teaching of Mathematics

I. Pedagogical structures

The pedagogical structures are generally decided by central governments. There are a few interesting exceptions such as

- Germany. Each of the sixteen Länder has its own state organization and there is an attempt at harmonization through the Council of Ministers of Education.
- Belgium. The Belgian system with its three French, German and Dutch speaking communities is becoming more and more similar to the German system, with three Ministries of Education.
- The United Kingdom. The four regions (England, Scotland, Ulster and Wales) possess an educational network, the LEA (Local Education Authorities).
- Spain. Much like the UK, each region of Spain has an Education Council. Secondary education is generally divided into two cycles whose importance is quite varied depending on the country. For example, the first cycle is sometimes included in primary education as in Denmark, or nonexistent as in Germany. The French situation is unique.

II. The curricula

We can distinguish between two different kinds of situations. There is a first category, in which compulsory national (as in France) or regional (as in Germany) curricula exist that spell out contents and objectives and contain detailed instructions. The second category consists of countries where the national curricula only define national standards and where there is a certain amount of initiative left to local authorities or teachers, as is the case in the United Kingdom, Denmark and the Netherlands.

In the first case, the emphasis is rather on the contents of each discipline, whereas in the second case, it is more the overall coherence in view of objectives to be attained that is stressed.
Several countries went through the same problems as France concerning the so-called “modern mathematics” reform. What is the current state of affairs? In France, the last curriculum modification has just been applied in Terminale (last grade of high school). However, the pedagogical renewal in high schools that started this year in Seconde will certainly slightly affect the syllabi of Première and Terminale. It is worth noticing that since 1989 the curricula are under the responsibility of the Comité National des Programmes (National Curriculum Committee).

Concerning the contents, we refer the reader to the excellent book by G. Howson, *National Curricula in Mathematics*, published in 1991 by the Mathematical Association. This book gives in particular detailed information on the mathematical curricula in secondary education in fourteen countries. Without going into much detail, we can say that statistics and probability theory take a non-negligible space in British secondary education, that these disciplines are becoming more present in France and Italy and that the notions of structures, linear algebra and vector spaces remain in the Gymnasium teaching in Germany but have completely disappeared from secondary education syllabi in France.

**III. Mathematics**

Is mathematics a service discipline or a cultural discipline? In the scientific streams, the learning of mathematics is more cultural in the sense that emphasis is put on reasoning, the sense of proof and imagination. In other streams, mathematics is taught more as a service discipline. In short term higher education, mathematics is essentially an element of culture with a precise goal, mathematics as a tool. This can nonetheless involve relatively specialized knowledge as in certain sections of IUT (Instituts Universitaires de Technologie), for example for a DUT in statistics.

In long term higher education, mathematics is taught in every aspect depending on the stream considered, for example in France the Classes Préparatoires aux Grandes Ecoles/Grandes Ecoles stream or the pure or applied university streams.

Is mathematics playing a training role or a selection role? It is difficult to give an objective answer to this question, in spite of its importance for the layman. A partial answer may reside in the relative importance of mathematics in education, and more specifically in secondary education, and the weight of mathematics in the various modes of evaluation and orientation, notably in the transition between secondary and higher education.

The number of hours devoted to mathematics in secondary education is extremely varied, depending on the country. For example, the number of hours allocated to mathematics in the last year of the scientific stream of secondary education is, according to the answers to the questionnaire sent on the occasion of the European Congress of Mathematics:

- Belgium 8 h
- Denmark 5 h
IV. Orientation, evaluation and certification

The transition between the first and second cycles of secondary education varies with the countries, depending on their educational structure but also sometimes on the passing or failure of an exam. This is precisely the case in the UK with the General Certificate of Secondary Education (CGSE). In France, the Brevet des Collèges has no influence on the continuation and orientation of studies.

The end of secondary education is marked by a diploma or certification that falls into one of three categories:

- a national diploma, passed before a jury of teachers and possibly taking into account the results obtained by the candidates during their studies. This is the case in Denmark, France (Baccalauréat), Germany (Abitur) and Italy (Maturità);
- a diploma delivered by the teaching institutions according to certain standards. This is the case in Belgium and the Netherlands;
- a diploma delivered by private examination centers. This is the case in the UK (A-levels). These differences imply that the end of secondary education diploma does not guarantee access to higher education in every country. There is a case by case selection in Germany and a very strong selection in the UK for certain universities. In Belgium, a validation procedure is applied that allows the candidate to pursue academic or non academic studies.

Mathematics Teachers in Secondary Education

I. Recruiting

The recruiting of permanent teachers in secondary education for state owned institutions always involve a compulsory level of qualification that can depend on the cycle of secondary education in which the teacher is being recruited.

Recruiting can be national as in Belgium, France and Italy, regional as in Germany and the UK or local (e.g. by municipalities) as in Denmark and the Netherlands. In Belgium, as well as in the Netherlands, these remarks only apply to the state network, which is relatively modest compared to private schools who recruit directly. In the UK, regional authorities generally ratify the proposals of