



EMS

**European Mathematical
Society**

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**Committee on
Mathematics Education**

**Niveaux de référence pour l'enseignement des
mathématiques en Europe**

**Reference levels in School Mathematics
Education in Europe**

National Presentation

HUNGARY

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1. General description of the mathematics teaching context

1.1. Description of the country school system

After World War II the new socialist government initiated radical changes in the Hungarian educational system. It has been divided into 4 levels:

1. Pre-school institutions (Kindergarten) education (age 3-6)
2. Primary school (age 6 -14)
 2. A: Lower elementary (primary) (age 6 - 10)
 2. B: Upper elementary (age 10 - 14)
3. Institutions for secondary education (age 14 -18)
4. Institutions for higher education (age 18 - 25).

The basis of the new system was the eight-year *compulsory primary school*, divided into 2 grades (primary and upper level). After several years' experience, however, it became clear that curriculum requirements were too high for teachers and learners as well.

Until 1990, Hungarian secondary educational system consisted of 3 well-distinguished types of schools of different educational level:

Secondary grammar school (gymnasium): For preparing students for academic studies or for jobs requiring secondary education.

Secondary technical / vocational schools: For preparing students for practical work or for further education in special fields.

Vocational training schools: For training skilled workers.

From 1945, Hungary has gone through several fundamental changes in politics, economy, social and educational structure. In consequence, the curricula have been restructured several

times (1950, 1958, 1961, 1963, 1965, 1968, 1973, 1978, 1979, 1986), but the general framework of the educational system has remained.

Current changes

From 1990 the range and significance of secondary schools have notably expanded. In 1995 and 1996 new laws were made by Parliament. Their goal was to introduce a new National Curriculum that ensured guidelines for, and defined 50% of, the syllabuses of school subjects. From 1990 onwards, Hungarian educational system has continuously been in a period of transition. New forms of primary and secondary education have been introduced, e.g. 4- or 6-year primary schools, and accordingly 8- or 6-year secondary schools.

In October 1995 a new educational system *NAT* (Nemzeti Alap-Tanterv, National Basic Curriculum) was established. Since then, the concept and form of maturity exams at the end of secondary school studies have become the subject of nation wide discussion by educators and laymen as well. *NAT* will take effect in 2003 or 2004, and the renewed final examination in 2005. It is optional for primary and secondary schools to choose between the former or new version of the examination. For the age group 6-16, *NAT* describes the obligatory, common part of knowledge. The *local curricula* will contain the additional part which is necessary for the final examinations of secondary schools. Depth and content of the local curriculum will be determined by the secondary schools, their teachers, their pupils, the parents of pupils, by the lower or higher level of the final examination and the requirements and expectations of society. Mathematics is one of the compulsory subjects at the maturity exam, and the higher-level exam will serve as college or university entrance examination.

Primary and secondary formation

Class	Age	Period	Institutions			
1e	6-7	(Primary) 1 st section	Primary School			Primary and Secondary School
2e	7-8					
3e	8-9					
4e	9-10					
5e	10-11	Upper Elementary 2 nd section			8-year Secondary School	
6e	11-12					
7e	12-13					
8e	13-14	Secondary "gymnasium"	(Traditional) Secondary School	6-year Secondary School		
9e	14-15					
10e	15-16					
11e	16-17					
12e	17-18					
FINAL EXAM						
ENTRANCE EXAM TO UNIVERSITY						

Table 1*

* Table took from: Emese OCSKO, Rapport sur la Hongrie

1.2. Place and importance of mathematics in the curriculum

The National Curriculum

NAT ordains requirements, including minimal level of knowledge that pupils are to meet at the end of the 4th, 6th, 8th, 10th school years. Requirements of the complete (12 years) school system are defined by the Framework Curriculum.

The curriculum determines guidelines for teaching mathematics from the beginning of elementary school to the end of grammar school. It focuses on developing mathematical thinking and fostering problem solving abilities.

According to the Act on Public Education, schools of all levels are entitled to modify number of classes pro subjects.. During the four consecutive academic years students have usually 3-4, 3, 3, 3 hours per week, in accordance with the recommendations of the basic curriculum. Statistical data confirm that mathematics is one of the "respected" subjects, because many schools decided to increase the number of math classes. In addition to compulsory lessons, more than 20 secondary schools incorporated extra math classes in the local curricula.

Types of math classes

Despite recent changes, secondary schools can still be divided into 3 main groups:

Secondary Grammar schools (gymnasium)

Technical and vocational schools

Vocational training schools

Among secondary grammar schools there are a number of elitist institutions of high standard. They provide a sort of sophisticated training that serves for preparing students for further education.

In technical and vocational schools the number of maths classes pro week depends on the type of specialization, being either more or less as compared with grammar schools.

In vocational training schools students are prepared for competence in a special profession. Mathematics is restricted to the re-capitulation of compulsory material, plus some scarce off-core topics.

In most cases, gifted students choose secondary grammar schools, students with average abilities go to vocational schools and the remaining 40% attend vocational training schools.

At the age of 16, grammar school students can choose between two eligible forms of mathematics:

-*form A*: 5 classes per week,

-*form B*: 6-7 classes per week.

As a consequence mathematics is taught on 3 different levels in secondary grammar schools:

1. General (3-3-3-3 hours / weeks)

2. Elective A (3-3-5-5 hours / weeks)

3. Elective B (3-3-6-6 hours / weeks)

In Elective A and B pupils have extra classes in the last 2 grades, in addition to the ones required by the basic curriculum. The compulsory material is completed with special subjects such as number theory, differential and integral calculus, set theory, mathematical logic, probability and solving of tasks for math contests.

Since the 60s *special mathematical classes* can be organized for pupils with outstanding abilities. At the beginning there were only 7 specialised classes but this number reached 20 by now. In these special classes students of high ability receive a very thorough training in mathematics.. Students are expected to formulate and solve mathematical problems on their own. These special classes enable students to manage mathematical studies at the university level, and to apply mathematical knowledge in related topics.

2. The main objectives of mathematics

The aim of mathematics teaching is to develop a flexible, disciplined way of thinking, to discover things and to search for creative solutions. Thus the objectives described herein must contain elements performing to the development of mathematical thinking as well as list of the essential concepts and most frequently used methods. This the purpose of the chapters “Developing Mathematical Thinking» and later “Mathematical Thinking». Heuristics, constructive thinking, and the use of analogies all have part in thinking processes. Student should see that mathematics can be applied in practice and in the sciences. The history of mathematics contain many interesting motivational aspects.

Interpreting and solving mathematical problems and comparing results with the reality. Examining simple short mathematical texts all add to the development of independent learning. Understanding concepts and acquiring basic mathematical knowledge develop the memory, the individual will and strengthen persistence both in work and in learning.

The learning of the methods of mathematical proof provide opportunities to discover the basic relationships between mathematics and reality.

The teaching of mathematics cannot disregard any of the following:

- that certain teaching subjects require the application of mathematical knowledge at a certain level relatively early,
- that the ability to think in abstractions within a peer group (an be very different,
- that, in themselves, the development of mathematical concepts, relationships and the development of mathematical thinking account for a spiral structure in school curricula.

Thus, understanding of certain concepts and skills dependent on them reappear in the objectives at the end of the grades 4, 6, 8 and 10, adjusted to fit the appropriate level of students' age characteristics. For this reason, the same main headings are used at each level.

3. Basic contents

Before 1965 the key words for mathematics education were: problem solving, developing mathematical concepts, increased emphasis on set theory, mathematical structures, geometrical transformations, functional relationships, approximations methods.

The syllabus of 1965 for secondary grammar schools added to the list some further topics as vectors, sets, differential and integral calculus, combinatorics, probability. The scope of this material proved to be too broad, and the requirements too demanding.

That is why in 1973 the amount of material was reduced. It was only the *basics or core material* that was directly determined by the Ministry. This material does not depend on type of the secondary school. Its content is sufficient for the university entrance examination.

A complete curriculum (NEW MATH) was gradually introduced in 1978 in all the 8 years of compulsory school. It included the following themes:

Sets, logic

Arithmetic and algebra

Relations, functions, sequences

Geometry and measurement

Combinatorics, probability and statistics.

This curriculum does not require the introduction of exact mathematical terms, but after a preparatory period it does require the use of the most important terms and exact definitions of mathematical notions concepts.

Although the latest General Education Act determines compulsory school years from age 6 to 16, around 20% of the children leave school at the age of 14. This phenomenon is due to the characteristics of the Hungarian educational system (see Table 1)

The new National Basic Curriculum tries to define certain requirements adjusted to various school types.

The future Mathematical education in the future is to be based on the following main principles:

Way of thinking (heuristic, deductive, inductive, constructive, analog, abstract, concrete, etc.)

Arithmetic and algebra.

Relations, functions, sequences

Geometry, measurement.

Probability, statistics.

Content

Following is a short description of these topics in key words.

Algebra: algebraic expressions, operations with algebraic expressions, special algebraic products, and factorization of expressions.

Linear equations, inequalities, system of equations. Quadratic equations, inequalities, systems of equations. Equation with square roots inequalities. Exponential, logarithmic and trigonometric equation, inequalities, system of equations.

Linear, quadratic, rational, polynomial, exponential, trigonometric functions.

Geometry: triangles, quadrilaterals. Congruence and similarity. Geometry of circles. Area, surface, volume.

Combinatorial operations: permutation, variation, and combination. Logical sieve, pigeon-box principle, binomial theorem, Pascal triangle.

Graph theory: basic notions.

Vectors: basic operations, scalar product, applications in geometrical proofs.

Trigonometry: trigonometric functions, addition theorems, trigonometry of triangles.

Analytic geometry: lines, circle, parabola.

Sequences: arithmetic and geometric. Geometric series.

For elective courses in mathematics, elements of differential and integral calculus, statistics and probability, linear algebra are optional.

4. Exemplary topics

4.1 Quadratic equations

The current version of the National Curriculum recognises the central role of quadratic equations, it is the core-topic of algebra in the 10th grade (aged 16 years).

The annual number of mathematics lessons is 111. The part of algebra and arithmetics takes nearly one-third of it, approximately 34 lessons. Around 22 lessons out of it serves the following:

- solve quadratic equations, and inequalities
- the role of the discriminant
- factorisation, Viéte-formulas (correspondence of roots and coefficients)
- geometric mean of two real numbers
- quadratic equation systems with two variables

- graphs of quadratic functions, their transformations
- minima and maxima problems
- quadratic equations with parameters

4.2 Pythagorean Theorem

In the 10th grade the part of geometry is huge, including trigonometry it is more than 40% of the total 111 lessons. We can meet the Pythagorean Theorem at four steps:

(a) The proof of Pythagorean Theorem and simple applications of it. This is in the middle part of congruences. The students should know a few three tuples of integers satisfying $a^2+b^2=c^2$.

(b) The second time we meet the Pythagorean Theorem at similarities. The theorem about the legs and the hypotenuse of a right triangle gives a second proof of it, with a different approach.

(c) After the first steps of trigonometry one of the first identities of sin and cos is $\sin^2x+\cos^2x=1$.

(d) There is no 3D geometry in the focus of the National Curriculum at this grade, but using the Pythagorean Theorem the students can determine the length of the diagonal of a rectangular brick.

4.3 Similarity

Approximately one -third of the geometry lessons used for teaching similarities. It means 15 lessons during the year. The National Curriculum underline the importance of transformations. The students should know how to enlarge triangles and other figures. They should know 4 conditions leading to the similarity of two given triangles.

The National Curriculum mentions explicitly two topics related to similarity. The first one is about the medians and the centroid of a triangle. The other is about the right triangle, the theorem of the legs and the hypotenuse. Here we can find a link with 4.1, we can construct not only the arithmetic, but also the geometric mean of two given segments.

Relation between the factor of enlargement and the ratio of the area of a figure and the image of it. The same question in 3D with volume. The bisector of a triangle divides the opposite side into two parts, the ratio of these parts is the same as the sides of the angle.

For the top 25% there are additional materials, such as:

- Ceva theorem
- Menelaos theorem
- Ptolemaios theorem
- Apollonios circle

4.4 Word problem

Looking at the National Curriculum one can have the feeling that there is a lack of interest in "word problems". It is mentioned at quadratic equations (4.1) as: "The students should be able to solve simple word problems leading to a quadratic equation. They should know how to use this method solving problems in various fields of natural sciences."

We have to add that the tradition is sometimes behind the National Curriculum and not in it. This means that all the textbooks are aware the importance of this didactical tool. A rich collection of them helps the teaching of algebra, arithmetics and also number theory. However when a problem can be better presented using symbols they rarely force them to be presented using words.

4.5 Percentages

This topic is not significantly present in the National Curriculum. Simply you can not find this word "percentage" anywhere at the age of 16. The reason of it is quite complex. To understand it, here is the list of the most important facts related:

1. The basic calculations with percentages start at the age of 11 and 12. After the concept of fractions, and decimal fractions students learn about it in the primary school. The vast majority of pupils are expected to calculate percentage parts or simple percentages, though most of them understand it as number of parts per hundred.

2. A few years ago there was no probability and statistics in the National Curriculum. Instead of it there was combinatorics, which covered 10% of the lessons of the year. (10-12 lessons) The revised National Curriculum have probability and statistics. At this level percentages are needed in the level of application. The students should be able to determine probabilities in terms of percentages.

- 3 There is a serious trend to teach more statistics. This field has not been the strongest part of our mathematical heritage, and tradition.

4.6 Additional topic: series

The two types of series which are taught for the pupils at this age are the arithmetic and the geometric progression. They should know how to express the n th term of the progression with the first term and the difference or the quotient. They should know how to add up the first n term of these series.

For the top 25 % there is an additional other type, the Fibonacci series. In the textbook the students may read a short essay about the history of Leonardo Pisano. Sometimes there is a little bit of the history of mathematics in the textbooks. The pupils should have a view of the cultural history as well.

This is a preparatory level of analyses, although the further concepts about series does not occur at this grade. Indicating the importance of this topic one should know that among the 7 problems of Matura examination, and among the 8 problems of higher level Matura examination most cases there is a problem with series.

5. Other subjects of interest for mathematics education around 16 year old

5.1. Regional characteristics

1. Special attention is paid to talented gifted children. Learning teams, competitions, summer training camps for the talented, periodicals, problem collections and team publications are the usual means to serve this purpose.

2. Problem-orientedness. Mathematics instruction has traditionally been centred around problem solving. The main characteristics are creativity, simple and clear solutions and use of common sense argumentation. .

3. The selection of course books is optional (up to the teachers' choice). Some of them are written in traditional style, some are workbooks in which the subject matter is taught through appropriate sequences of problems. The appearance of new school types (with 6 or 8 years of instruction) inspired some teachers of certain schools to produce authentic textbooks of their own, preserving traditional values.

4. Mathematical exactness.

Teachers make efforts to present mathematics as a science at an appropriate level. Sometimes these efforts may lead to formalism, excessive abstraction. Efforts are made to teach mathematical ideas in their exact scientific form, but allowing for the appropriate level of students' thinking. In some cases, however, these efforts result in formalism or excessive abstraction.

5. One of the traditions in math teaching which is worth preserving is to present problems in a more explanatory context.

Example: *Find the number of solutions of the equation $x_1 + x_2 + \dots + x_k = m$ with $k, m \in \mathbb{N}^+$, in the set of positive integers.*

Solution: On a hot summer day k children want to buy ice-cream. They have a coupon that contains m units. The units are separated from each other by means of perforations. The number of perforations is $m-1$, the number of solutions is therefore

$$\binom{m-1}{k-1}$$

6. Free movement. The free movement from one type of school to another is an unsolved problem. In the National Curriculum, to be gradually introduced, there is an attempt to solve

this problem by standardising the system of requirements, but this problem will remain for a long time, because of the differences in standards among schools.

Switchover from one type of school to another. This is still an unsolved problem of the Hungarian educational system. In the National Curriculum--which is to be gradually introduced--attempts are made to help this process by standardizing the requirements for all school types. However, there is no easy answer for this problem, because the standards of schools considerably differ from each other.

7. Achievement - centism. There exist elite schools with high reputation and requirements. In these schools students find inspiring and informal atmosphere, but examinations are strict. The overall result is good average achievement of Hungarian children.

8. Lack of applications of mathematics in real-life situations. One of the most important tasks for the future is to bring mathematics teaching closer to everyday-life, particularly in secondary schools with special math classes. The purely abstract or formal approach should be replaced by real-world mathematics.

9. Societal respect, including financial acknowledgement of teachers in Hungary is very low.. This causes a great number of excellent teachers, mainly male teachers, give up teaching profession for good. Some references on the Hungarian mathematics education of the last decades in Hungary: Surányi J. - Halmos M., (1978), Varga T. (1986), Nemetz, T. (1988), Tettamenti, E (1988), Howson, G.(1991), Nemetz, T. (1992)

5.2. Teacher training

In accordance with the classification of the three school grades, three kinds of math teachers' training institutions exist in Hungary:

I. *Teacher Training College for primary schools.* These institutes train teachers for the lower elementary level (grades 1 - 4). The training period lasts for 3 years, with a turn-over to 4 years.

II. *Teacher Training College for intermediate level,* i.e. for the upper elementary teachers (grades 5 - 8.) The training takes 4 years.

III. *Universities.* Training teachers for the secondary level (grades 9 - 12). The training period is 5 years.

With the change of the school system the task of universities has been modified. The 8-year and 6-year secondary schools have given the universities a new task, namely, to prepare math teachers-to-be for the upper elementary level, too.

The subjects taught at universities and colleges are prescribed for different semesters. The dominance of control is one of the most important characteristics. The students need to achieve 5 - 6 marks and to take 5 - 6 exams pro semester.

Mathematics teacher training at universities

Since 1991 it has become possible to choose only one major at university. There was a period when a lot of students only studied mathematics. The level of teachers' training has become higher, but from the economic point of view this proved to be inappropriate for the schools. During the last few years most students have chosen a second major besides mathematics.

Lesson-plan at the Eötvös Loránd University

	Semester									total
	1.	2.	3.	4.	5.	6.	7.	8.	9-10	
Algebra and Number Theory	2+2	2+2	2+2	2+1						15
Geometry			2+2	2+2	2+2	2+2				16
Analysis	2+4	2+2	2+2	2+2	2+0					20
Stochastics					2+2					4
Elementary mathematics					0+2	0+2	0+2	0+2		8
Numerical analysis						0+2	0+2			4
Teaching of mathematics							0+2	0+2		4
Foundation of mathematics							2+0	2+0		4
Discrete mathematics		0+2								2
Computer technics		0+2				###				2
School experience						0+2				2
Teaching practice									13	13
Facultative block						0+2	0+2	0+4		8

5.3. Examples of incentives for activities

Special classes

Hungary has had a long tradition of selecting for, and dealing with mathematically gifted children. At present this system has a number of components. We will list these components one by one.

Special classes within the official school system

Special mathematics classes are organized for mathematically gifted children. At present there are 20 secondary schools with such classes with 25 - 30 children in each. This means that every year about 500 - 600 children receive special training in mathematics. The number of math classes is twice as much as in normal classes, and the level is considerably higher.

These special classes (established in the early 60s) have curricula of their own, with slight modification and serve as a basis for training selected children. These classes are eligible only for those children who pass a serious entrance examination. Their previous achievements in math contests are also taken into consideration.

School Periodicals in Mathematics

Selecting Special care for the talented is a priority, and the history of the selecting process goes back to more than a hundred years. Hungary was the second country in Europe where a special journal of school mathematics had been launched. The first was published in France in 1875. In our country the famous KöMal (Középiskolai Matematikai Lapok, Secondary School Mathematics Journal) has continuously been published ever since its foundation in 1892. For its centenary in 1992, a special issue in the English language was published. This issue gave an impression for the reader on the influence of this journal upon mathematical life and instruction. Since its foundation, each issue of this journal has included contained a problem solving section, proposing 6-8 problems every month, adapted to various age groups. Anybody can join the competition, there are no preliminary conditions of entry. The evaluation of the competition is carried through separately, being adapted to grades in the age group 12 - 18. The career of some famous Hungarian mathematicians can be traced back to their activity in KöMal's problem section. KöMal regularly publishes the solutions to the proposed problems, usually the best version available.

In addition to KöMal, another periodical Észkerék (Wheels of Mind) addresses children aged 10 - 14. It contains problems, mathematical games and puzzles, the solutions of which can be sent to the editors for evaluation. Another periodical is Poligon, edited in Szeged, a university town in southern Hungary, for the use of schools, students and mathematics teachers.

The well-known periodical for popularizing scientific knowledge, Élet és Tudomány (Life and Science) used to publish a mathematics problem solving section. This section is not restricted to a well-defined age group. Its problems and puzzles can be read and solved by children and grown-ups as well.

The system of mathematics competitions

Competition as a means of mathematics education, has a hundred-year history in this country.

It has two objectives: search for talents and increasing the efficiency of learning and teaching as well.

The basic principle in the selection of problems can be formulated as follows:

The problems raised in the test examine the depth and not the quantity of the competitor's knowledge. Either the content of the problem or the ways leading to the solution are taken into consideration. The problems are selected so that the solutions can be found within the allocated time.

Apart from other countries the most important feature of our competition system is the fact that it starts at a relatively young age. There are several regional competitions by correspondence for children in Grade 3 (9 years old). In these competitions there are 6 problems proposed every month.

Another correspondence competition is organised by TIT (Association for the Popularisation of Science), named by László KALMÁR for children of 9 - 14.

Among the centrally organised national competitions the first is the Tamás VARGA competition in three rounds, for children aged 12-14..

Students who achieved the best results in the competitions and those with the best scores of KöMaL are invited to participate in summer mathematics camps or in regular meetings.

For secondary schools there is a great number of local, regional or national competitions:

- Dániel ARANY Competition for two age groups and three categories according to school types for children aged 15-16.

- National Secondary School General Competition in three categories for students aged 17-18.

The records of these competitions are regularly published in KöMaL, and the solutions of the proposed problems appear in a separate volume in each year.

- Kangaroo Test Competition for children aged 15 -18,

- Mathematics Without Frontiers, a team competition originated in France.

Special attention should be paid to an initiative started in 1991 under the paradoxical name:

International Hungarian Mathematics Competition. The explanation for this name is that there is a Hungarian minority in most of the neighbouring countries and elsewhere in the world. Participants arrive primarily from neighbouring countries but Hungarian speaking competitors are welcome from any country in the world. There are four age groups in this competition.

Finally we have to mention the "top of the iceberg", study teams preparing for international Olympiads. It is a fact, that Hungary has already played a significant role at the launch of international events. The study teams are animated by a great number of university lecturers, secondary school teachers, and university students. These teams consist of talented students from the whole country, with significant competition background. They meet every week for a 3-hour session. In the last 24 years more than 60% of the members of the Olympic team

have been recruited from those learning in special mathematics classes. A prominent school in this respect is the Fazekas Secondary School in Budapest.

The role of the Bolyai Society

The Bolyai János Mathematical Society was established in 1947, as one of the legal successors of the earlier Society for Mathematics and Physics, founded in 1891. In the Bolyai Society special sections are organized. Its members are mathematicians, applied mathematicians, teachers and students. This is the only national organisation of the mathematical community. Its major functions are:

- publication of periodicals,
- organization of competitions.
- organization of conferences in various fields in mathematics.

The Society had many initiatives. They launched for example a project on up-dating secondary school mathematics. This project led to a reform of math curriculum.

For the community of math educators the Society organizes the *Rátz László Conference* that deserves special mention. , It is the biggest conference for teachers of mathematics in the country. It lasts for one week each year, and its history comprises more than 30 years of continuous activity.

Discussion on the problems of gifted children is always on the agenda. It is worth mentioning that the Society was the host of ICME-6 in 1988.

5.4. Computer and other technology

In order to apply computers at schools, appropriate supply of computers, programs and a suitable teacher preparation are needed. As far as equipment is concerned, there are huge differences between schools, but in general, IBM personal computers are the most frequent. Because of the costs involved, any enlargement and purchase of programs can be financed only through tenders or relying on assistance from various foundations. Possible ways of progress are: program development based on the existing equipment and the training of users.

The methodology of the application of the media has recently been introduced into teachers' education. In the application of computers we concentrated upon functions designed for preparation and facilitation of classroom work. An important supplication of the work in the preparation phase is the use of Internet, text editors, graphical editors. There is an increase in the number of programs running under Windows system as well as in that of programs actionable in Hungarian (either selfprocessed or translated). In 1992 we learned that there existed a society in Germany for teachers who were interested in the renewal of mathematics teaching. These ideas inspired us Hungarian math teachers to organize MATHNET within the auspices of the Bolyai Society in 1993. Our aim was to introduce a way of teaching that was nearer to everyday life, to the needs of various school types and the chosen future career.

Activity of teachers was the key word, and many themes were elaborated philosophically. The main aim of the association has been to directly connect math teachers in the country. The technical network of MATHNET was capable of creating connections between teachers of many different subjects and various schools with similar objectives. This helped rapid and immediate flow of information on public instruction.

5.5. Didactic of mathematics as a scientific discipline

Course in Didactics of Mathematics

The two main aims are: to provide theoretical foundation of teaching and learning mathematics, and the know-how of math teaching as related to the concrete topics of the curriculum.

Content

Introduction into the didactics of mathematics. What is mathematics? What is didactics of mathematics? The main goals of teaching mathematics. The psychological background of learning mathematics.

Typical teaching situations: teaching of notions, theorems and proofs, algorithms. Problem-solving. Model building. New trends in teaching mathematics. Didactical principles of mathematics teaching. Assessment and evaluation in mathematics education.

The questions of teaching related to special topics: The main questions of teaching arithmetics, algebra, geometry, analysis and stochastics.

Elementary mathematics

The main objective is the development of the problem-identifying, problem-solving, problem posing ability of mathematics teachers-to-be.

Main questions:

- Problem-solving phases according to G. Polya. *Understanding of the problem - Devising a plan - Carrying out the plan - Reflection (Control, conditions of the solution, discussion, generalisation)*
- Precision on the school level. When can a problem be considered as being solved ?
- The development of oral, communicative and written abilities of students.
- Analogy and generalisation in the problem-solving process.
- Devising of sequences of problems.
- Solving of competition tasks.
- Conscious use of the heuristical strategies in the solution process.
- Investigation of some typical problems of various topics that are taught in the secondary school.

Preparatory teaching in school

Prospective math teachers in their 6th semester visit 7 or 8 math lessons in schools. In addition, they teach themselves 3 or 4 lessons. The intention is to introduce the prospective teachers to the realities of everyday school practice and the complexity of the educational task of teaching mathematics. The 9th and 10th semesters are mainly spent in schools. Under the control of a supervisor students are required to perform 17-20 lessons of teaching in each semester. This period is called *the main practice*. Eötvös Loránd University has three special training schools with excellent teachers and selected students. This system is sometimes criticised, on the basis that students would not be aware of the difficulties of teaching less able pupils, or because of the small number of lessons of actual teaching. Facultative block

From the 6th semester on, students are required to select one 8-hour block in a freely chosen topic from the following subjects: Analysis, Algebra and Number Theory, Geometry, Stochastics, Numerical Analysis, Informatics, Didactics of Mathematics and Elementary Mathematics. The intention is to make it possible for the students to gain deeper insight in one special field, to learn about new results, do research work on their own. The block of Didactics of Mathematics is very popular., 50 - 60 % of the candidates choose this subject.

Content of the didactical course:

The design and use of visual aids and models in teaching mathematics. The role of computers in the learning process. Philosophical problems of mathematics. Argumentation, reasoning, proofs. . Selected problems from elementary mathematics: Solution of maximum-minimum problems with help of elementary tools. Combinatorial geometry, Lattice geometry. Characteristics of convex figures. Estimation of random events, evaluation of hypotheses.

RESEARCH IN DIDACTICS OF MATHEMATICS IN HUNGARY

Following is a list of places of mathematics research, with key words of interest and names of researchers.

1 Eötvös Loránd University, Group of Didactics of Mathematics

H-1088 Budapest, Rákóczi - út 5.

Problem-solving in mathematics education.

Motivation through geometrical interpretations. (Discrete and combinatorial geometrical problems)

The axiomatic background of school geometry. Problem-oriented geometry- teaching.

Stochastics in school mathematics.

The role of analogy in mathematics education.

Computer-based mathematics education.

The use of graphic calculators in mathematics education.

Stochastics in inservice teacher training.

Participating persons: Ambrus András, Deák Ervin, Hortobágyi István, Vancsó Ödön, Vásárhelyi Éva.

2 József Attila University Szeged, Department of Education

H-6700 Szeged, Aradi vértanúk tere 1.

Measurement of pupil's achievement. Preparation for the examination of mathematics at different age level.

Participating persons: Nagy József, Vidákovics Tibor.

3 Mathematical Institute of the HAS

Research group for teaching stochastics around.

For information contact the home page of T. Nemetz.

<http://www.math-inst.hu/nemetz>

4 Eötvös Loránd University Teacher Training College Faculty,

Department of Mathematics

H - 1055 Budapest, Markó - u 29-31

Teachers inservice and preservice university preparation in the domain of applied mathematics and calculator - computer applications.

Curriculum development in Great Britain and in Hungary. A comparative research of the content of curriculum's for age 10 - 14, based on pedagogical traditions and teacher opinions.

Comparative study of English, German, Hungarian preservice teacher training.

"Half - microteaching" A new organisational form for the teaching - practice of students.

Participating persons: Ambrus Gabriella, Munkácsy Katalin, Pálfalvi Józsefné, Szeredi Éva, Sztróckayné Földvári Vera, Török Judit.

5 Budapest Teacher Training College, Department of Mathematics

H - 1126 Budapest, Kiss János alt. u. 40.

Learning difficulties in mathematics

The role of the mother language in mathematics instruction

Geometry teaching in early childhood

The role of manipulative materials in mathematics learning.

Participating persons: C. Neményi Eszter, Makara Ágnes, Szendrei Júlia, Vassné Varga Edit.

6 National Institute of Public Education, Center for Evaluation Studies

H-1051 Budapest, Dorottya u 8. E-mail: Tompa@ces.hu

Pupil's assessment (Monitoring)

Item Banking

Participating persons: Lukács Judit, Tompa Klára.

7 Vitéz János Teacher Training College Esztergom

H-2500 Esztergom, Majer István u. 1-3.

Integrated teaching of mathematics and didactics of mathematics at the teacher training college.

Participating persons: Papp Olga, Szilágyi István, Török Tamás.

8 Juhász Gyula Teacher Training College Szeged

H-6700 Szeged, Boldogasszony sgt. 6

The possibilities of the development of the notion of number.

The role of the motivation in the mathematics teaching.

Participating persons: Németh József, Szendrei János

9 Bessenyei György Teacher Training College Nyíregyháza

H-4400 Nyíregyháza, Sóstói út 31.b

Participation in the Kassel-Exeter International Comparative Project in Mathematics Teaching and Learning

Curriculum development. Construction of local mathematics curriculum's.

Problem-solving in mathematics education.

Development of gifted students from mathematics

Participating persons: Czeglédy István, Róka Sándor, Szalontai Tibor.

10 Károli Gáspár University Teacher Training College Faculty Nagy_k_rös

H-2750 Nagy_k_rös, H_sök tere 5.

"Realistic Mathematics Teaching" Common project with dutch (holland) teacher training colleges.

Participating person: Szilágyi Mihály