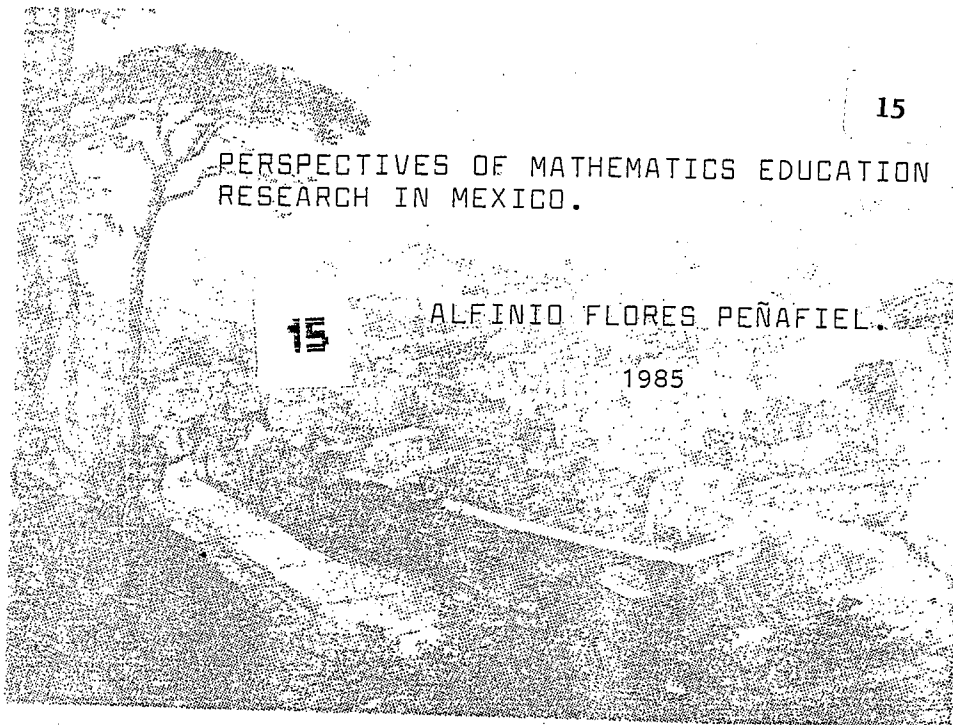


COMUNICACIONES DEL CIMAT



Presentado en: Research Pre-Session. NCTM 63d Annual Meeting,
1985, San Antonio, Tex.

CENTRO DE INVESTIGACION EN MATEMATICAS

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PERSPECTIVES OF MATHEMATICS EDUCATION RESEARCH IN MEXICO

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17 April 1985

0. Overview of some population characteristics.
1. Overview of Educational System in Mexico.
 - 1.1 Structure.
 - 1.2 Growth.
 - 1.3 Perspectives.
2. Overview of Mathematics Education in Mexico.
 - 2.1 Mathematicians.
 - 2.2 Math Educators.
3. Needed research.
4. Institutions where research in Mathematics Education is done.

0. Population.

Mexico is a young country. Although Mexican culture and traditions go back many centuries, the population is formed mainly of young people. This is due to a fast growth of population during the last 40 years. (see figure 1) The birth rate has declined in the last years; but since a significant percentage of people are young, the population will continue to grow for some years. Mexico is also a country of sharp contrasts. Although big advances have been made in many fields, still many Mexicans live in marginal conditions. With respect to education, there are still many adults without elementary education.

Table 1 Instruction of population over 15 (1940-1970)
(Necesidades esenciales de México 2 Educación, 1982)

Year	1940	1950	1960	1970
Population over 15	11.5	15.0	19.5	25.9
Percentages:				
Illiterate	52	42	35	26
Without instruction	76	58	40	31
Elementary incomplete	13	28	40	39
Elementary Complete	11	14	20	30

1. Educational System in Mexico.

1.1 Structure.

Educational levels in Mexico

Nivel	Level	Ages	Grades
Preescolar	Kindergarten	5	K
Primaria	Elementary	6 - 12	1 - 6
Secundaria	Secondary	12 - 15	7 - 9
Bachillatario	High School	15 - 17	10 - 12
Superior	College	18 - 23	13 - 17

Education is free and compulsory grades K-9. At public institutions, a nominal fee is charged at higher levels.

Education in Mexico is provided by the government (state and federal) and by private institutions.

Percentages of students by type of control

Level	Control	1970	1974	1978
Elementary (1 - 6)	federal	66	68	69
	state	27	26	24
	private	8	5	5
Secondary (7 - 9)	federal	55	60	63
	state	17	16	14
	private	28	25	23
High-School (10 - 12)	federal	23	25	29
	state or autonom.	50	52	46
	private	28	23	25
Normal (9 - 13)	federal	29	28	27
	state or autonom.	30	32	29
	private	42	40	44

Main points of differences (as compared with U.S.)

Elementary (1 - 6)

Centralized system

- curriculum is determined by the ministry of education (federal).
- same textbooks are used throughout the country (free).

Secondary (7 - 9)

High-School (10 - 12)

- often is part of a university.

University

- very few universities are organized in departments, follow the european model (school of engineering, school of chemistry, school of sciences).

The ministry of education (federal) plays a central role in educational policies in Mexico.

Public expense in education (Solana et al, 1981)

Year	Percentage of total expense
1953	11.5
1956	12.5
1959	15.8
1962	20.4
1965	23.4
1968	26.8
1971	27.8
1974	16.7
1977	19.5
1980	13.0

1.2 Growth of educational system.

Enrollment in elementary school as a proportion of the population of ages 6 - 14.

	1940	1959	1970	1977	1979
Total	27	61	74	83	86
D.F.	63	80	86	70	68
Guanajuato	13	45	59	78	100

Secondary.

Comparison of enrollment in secondary school and population ages 13 - 15.

(Necesidades esenciales de México 2 Educación, 1982)

Year	1940	1950	1970	1977	
enrollment	0.04	0.35	1.1	2.3	(millions)
population	1.4	2.37	3.5	4.6	(millions)
percentage	3	15	31	50	

Superior.

Year	Students	Teachers	Schools
1964	109 000	14 000	158
1969	246 000	19 000	240
1974	472 000	42 000	484
1979	770 000	58 000	749

The growth of the educational system is not only due to an increase of the population, but to the increase of the proportion of people who want to go to higher levels of educational system. Education is perceived as a gate to better opportunities. There is a high correlation between educational level and income.

Income per household according to the level of education of the head of the family in 1977 (Necesidades esenciales de México 2 Educación, 1982)

Educational level of head	Income per household (per semester)
without instruction	14 000
elementary incomplete	21 000
elementary complete	34 000
secondary incomplete	38 000
secondary complete	47 000
high-school incomplete	59 000
high-school complete	59 000
university incomplete	66 000
university complete	102 000
post-graduate degree	136 000

1.3 Perspectives.

The educational system will experience a continued growth in the following years. Growth will be less impressive at the elementary level due to reduction in the rate of population growth and that big progress was made in previous years. Growth will be most impressive at a high level (university and graduate). A big number of university professors has to be prepared.

2.1 Preparation of mathematicians.

Licenciatura Maestría Doctorado

Universidad Nacional	L	M	D
Instituto Politécnico	L	M	D
Universidad Metropolitana	L	M	
Puebla	L		
Morelia	L		
Jalapa	L		
Mérida	L		
Hermosillo	L		
Monterrey	L		
Guadalajara	L		
San Luis Potosí	L		
Guanajuato	L		

2.2 Preparation of teachers of mathematics.

2.2.1 Preservice.

Inspite of the demand of teachers of mathematics, there are few institutions that have a special program to prepare teachers of mathematics.

Teachers for kindergarten go to Normal Preescolar. They get 6 semester courses of mathematics.

Semester

	Unit 1	Unit 2	Unit 3
1	logic and sets	relations	integers
2	rationals	real numbers	real numbers
3	linear equations	systems of equations	equations of 2nd. deg.
4	geometry	geometry	trigonometry
5	analytic geometry 1	analytic geometry 2	analytic geometry 3
6	probability	statistics 1	statistics 2

At the elementary level teachers have to teach not only math but also all other subjects. Until 1984 elementary teachers were prepared at Normal (4 years after grade 9).

Mathematics courses at the Normal school (1975, modified). 6 semesters of mathematics, 3 hours a week.

Semester

	Unit 1	Unit 2	Unit 3
1	logic and sets	natural numbers.	numeration systems
2	integers	rationals	functions and graphs
3	real numbers	integration to geom.	paralellims and area
4	transformations	solids and volumen	similarity
5	functions	analytic geometry 1	analytic geometry 2
6	probability	statistics 1	statistics 2

Methods courses.

2 semester courses: special didactics and teaching practice 1 (didactics or arithmetic) and special didactics and teaching practice 2 (didactics of geometry).

Since 1984 a requisite to become an elementary teacher is to have bachillerato (high school). The enrollment was much lower that year.

Another place where personnel for elementary schools is formed is at the Universidad Pedagógica Nacional. (Licenciado en Educación Primaria o Preescolar).

Teachers for the secondary level are prepared at the Normal Superior (4 years after normal), where they study more mathematics, although they seldom go beyond one variable calculus. These teachers are also certified to teach at bachillerato, although most of them are employed in grades 7-9.

Mathematics teachers for high school (grades 10 - 12) are mostly people who studied engineering or some other technical field. Usually they don't go through any methodos courses.

Some institutions have a program to prepare teachers for bachillerato. The programs can vary significantly.

Universidad Autónoma de Puebla. This institution offers a licenciatura (8 semesters) where students take most of their courses in mathematics. They can choose an option in mathematics education.

Universidad de San Luis Potosí. They offer the option for mathematics teachers in 5 semesters.

Guanajuato (Licenciatura en Matemáticas, especialidad en Educación Matemática) 10 semesters.

2.2.2 Inservice.

Dirección General de Capacitación y Mejoramiento Profesional del Magisterio.

For teachers at the following levels: preschool, elementary, secondary, normal. Has 46 Regional Centers in the country. During 1983-84 a course for 178 elementary teachers was offered.

Teachers were released from their teaching duties. They studied: sets and logic, arithmetic, geometry, probability and statistics.

For secondary teachers they offer a cyclic course of 32 modules that cover the mathematical content and didactical methods that all secondary teachers should know. (Santamaría, 1984).

Universidad Pedagógica Nacional (Sistema de Educación a Distancia). Teachers study on their own and can consult a specialist on Saturdays. This system has not worked as well as desired.

Mathematics 1

- overview of mathematics and problem solving.
- geometrical constructions with ruler and compass.
- the real numbers.

Mathematics 2

- divisibility.
- equations and inequalities.
- functions.
- similarity and trigonometry.

Statistics 1

- graphical and numerical description of information.
- probability.
- estimation and hypothesis testing.
- inference of the mean.
- inference of proportion.

Several universities offer inservice courses, but not on a regular basis.

Inservice courses are also promoted by professional organizations like Sociedad Matemática Mexicana, Asociación Nacional de Profesores de Matemáticas.

3. Needed research.

Decisions that affect great number of students and teachers are taken continuously. It is important to give the persons who make those decisions a better preparation, to make studies of many types to gather information as to what decisions will benefit most.

Types of research needed.

Action research.

Survey

status

correlational

Experiment (scientific experimentation).

Case Study (clinical research, teaching experiment).

Evaluation.

Historical.

4. Institutions where research in Mathematics Education is done (or curriculum development).

Although there are many ways of conducting research in mathematics education and each can contribute to gain some knowledge about the learning process, each kind of research has its limitations. Perhaps the greatest danger is that many investigations are conducted without being fully aware of the type of conclusions that can be made and what generalizations one can infer from the study. Part of the problem is that there is no agreement among the institutions that form researchers as to what preparation is necessary to do valid research. Some have research oriented courses at licenciatura, some others at maestría, very few researchers get preparation at the doctoral level. To make things more complex, there is little agreement as to what is the level that a master's program should have.

Consejo Nacional Técnico de la Educación.

Needed research (Abugaber et al, 1984).

- What are the factors that affect the low achievement of students.
 - Studies of differential psychology.
 - Difficulties of slow learners.
 - Influence of authoritarian attitude of teacher on the learning of students.
 - Effective comprehension of mathematical structures by students of different levels.
 - Difficulties of children to understand and solve problems.
 - Experimental programs.
 - Efficiency of supervision.
 - Attitudes of teachers with respect to curricular innovations.
 - Determination of "essential minimum contents" of school mathematics.
 - Profile of students in basic school.
 - Impact of computers and electronic technology on the teaching of computations and problem solving.
 - Influence of active, inductive or heuristic methods on the development of intellectual skills and scientific attitude.
- Prospective studies to match the mathematics curriculum to the needs of the scientific and technologic al development of the country.

Universidad Pedagógica Nacional.

This university was founded a few years ago to give teachers a university level preparation. currently the staff of the mathematics department if of 27. Presently they work in curricular development designing a program for teachers of th Normal. They also design educational materials. A recent area is on the use of the computer for educational purposes (not only math).

Dirección General Adjunta de Contenidos y Métodos Educativos. A small interdisciplinary group (mathematicians, psychologists and teachers) select contents and methods for the mathematics curriculum K - 9.

CINVESTAV

Sección de Matemática Educativa.

One of the groups that have worked longer in mathematics education. Some of them worked on the official textbooks for elementary school that appeared in 1972. At present there are about 20 persons. The main areas where they do research are:

- measurement
- proportional thinking
- probabilistic thinking in children
- history of mathematics
- experimental topics in elementary school

They work also in connection with several universities in programs for inservice teachers.

Departamento de Investigaciones Educativas (Laboratorio de Psicomatemáticas).

The staff is formed by 3 professors, 5 assistants and 1 teacher. They work mainly in three areas:

- teacher preparation, workshops for teachers, publications for in-service teachers.
- experimental teaching of mathematics in elementary school
- use of computers to teach mathematics in elementary school

Centro de Investigación en Matemáticas.

Staff formed by 8 mathematicians, 1 computer scientist, and 1 math educator. Main areas of interest are teacher preparation, and the use of computers to teach mathematics.

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