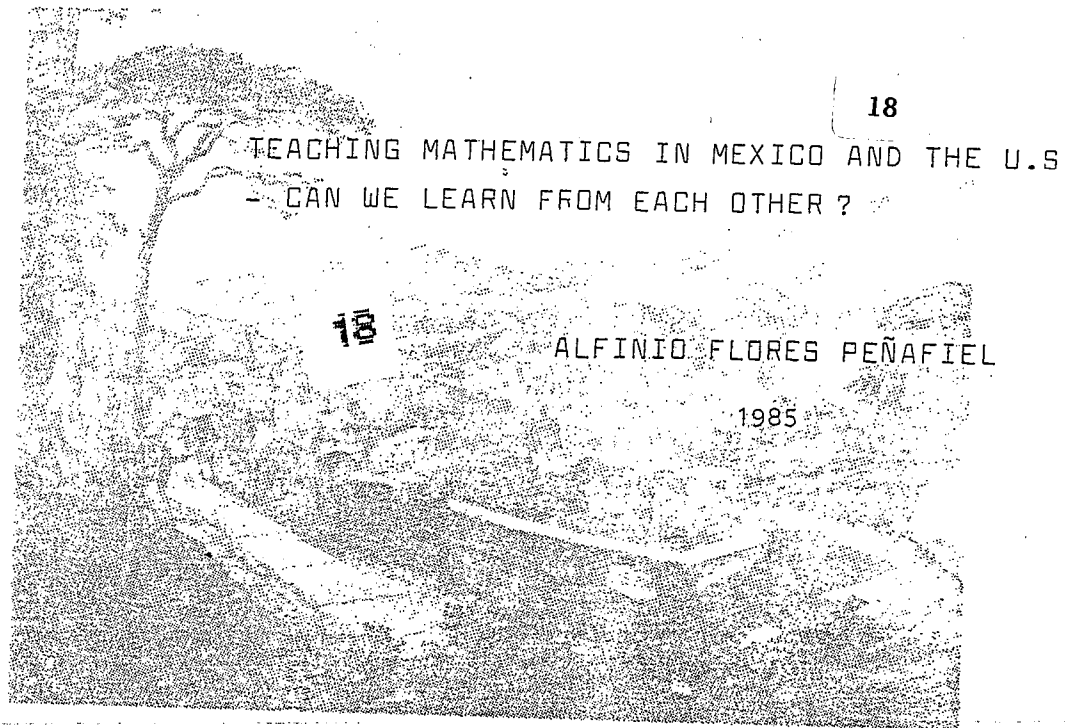


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TEACHING MATHEMATICS IN MEXICO AND THE U.S.
- CAN WE LEARN FROM EACH OTHER ?

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1. Striking differences, striking similarities.

Mexico and the United States share a border of about 2000 km. More people cross this border than any other in the whole world. However, for many people in the U.S., Mexico is still a "distant neighbour". One of the most striking facts is that when crossing the border one is immediately aware that one is in a different country. Not only the buildings and towns are different, what people do and value are also different. Although both Mexico and the U.S. share a Western heritage, the cultural differences are very great. This is reflected in all aspects, particularly in education. However, there are also many striking similarities of schools, teachers and students in both countries. I think that by being aware what are those similarities inspite of the cultural differences, and by just being aware that things are done differently elsewhere can result in an improvement of the teaching of mathematics. I have worked with teachers in Mexico for ten years, done workshops for students in all sorts of school from elementary to university. I also spent two years doing graduate studies at Ohio State. My job as teaching assistant was mainly to supervise prospective teachers of mathematics in their practice in the schools. This was an excellent opportunity to visit many schools, inner city and suburban, elementary, middle, high-school, and to observe many teachers in their classrooms. This experience made me aware that many of the teaching practices we take for granted in Mexico are different in the U.S. This had the effect of making me re-think many of those practices. At the same time, I realized that teachers in Mexico and the U.S. have many common problems, inspite of the cultural differences.

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.

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

2. Educational System in Mexico.

2.1 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
Bachilletaro	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) has a central role in educational policies in Mexico.

2.2 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

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.

3.1 Preparation of teachers of mathematics.

3.1.1 Preservice.

In spite 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 Prescolar. 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.	parallellims 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.

3.1.2 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.

3.2 Mathematics content in the curriculum.

The mathematics content is fixed by the ministry of education for the elementary grades. Reforms are centrally promoted, but the system is not very receptive to changes. Mexico was not spared by the new math, although many interesting topics were introduced as a consequence of that movement. Although there are programs for each level, in practice it is the textbook that determines the content that is taught.

3.3 The textbooks.

In elementary school textbooks are edited and distributed by the government. In secondary school commercial publishers have to get their books approved by the ministry of education before the books can be used in the schools. In higher levels the teacher has more freedom to choose a textbook.

4. In the school

In the same way that one cannot form a correct image of mathematics teaching by just reading the Arithmetic Teacher or the Mathematics Teacher, it would be impossible to describe Mexican schools in a talk. Moreover, the differences between two Mexican schools can be as big as between schools in different countries. However, there are some practices that are very common in Mexican schools that would strike any visitor from the U.S.

- groups are frequently big (40 - 50)
- schools have two (sometimes 3) shifts
- many teachers work two shifts
- teacher is addressed as MAESTRO (teacher) by students
- ritual conducts are common for disciplinary purposes
- worksheets are not common

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