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ABSTRACT

This comparative study was designed to provide information on some facets of mathematics education programs in Taiwan and the United States. The mathematics curriculum in middle and secondary schools was investigated and compared in order to encourage discussion and possible refinement. A long-range goal for mathematics education, especially for computer-based learning, is presented. Literature on international comparisons was first reviewed. Then a questionnaire was constructed in English, validated, and revised; it was next translated into Chinese and validated. In 1982-83, it was sent to 250 schools in the United States and to 250 in-service mathematics teachers in Taiwan. A response rate of 68 percent was achieved in the United States, and 95 percent in Taiwan. Results focus on comparisons regarding curricula, graduation requirements, learning centers, computer centers, instructional methods, teaching load, classroom management, teaching aids evaluation and achievement, faculty evaluation, remediation, teacher training, in-service training, and the future of the teaching profession. The discussion compares school systems in the two countries, curricula, teaching methods, and teacher training. Conclusions and recommendations are then given. Appendices contain recommendations from two professional associations, guidelines for teacher preparation, and the survey instrument. (MNS)

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A COMPARATIVE STUDY OF MATHEMATICS EDUCATION BETWEEN THE PROVINCE OF TAIWAN, REPUBLIC OF CHINA AND THE UNITED STATES

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Presented to
The Pacific Culture Foundation
Taipei, Taiwan
The Republic of China

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ABSTRACT

A comparative study of the education of the Province of Taiwan, Republic of China and the United States will provide up-to-date information on some of the facets of the mathematics educational programs of both countries. The information obtained from this study will benefit all teachers of mathematics.

This study was designed to achieve the following objectives:

(a) to investigate, compare and summarize mathematics curricula in secondary schools (middle schools and high schools).
(b) to encourage further investigation, discussion and possible refinement of the curricula in both countries.
(c) to improve and enrich mathematics education by comparison of the two countries' methods and goals.
(d) to present a long-range goal for mathematics education, especially for the rapidly expanding computer-based learning of the twenty-first century.
(e) to disseminate this information through a major mathematics education conference and also by publishing it in an appropriate journal.

A total number of responses representing sixty-eight percent of the sample space was received in the United States. This compared to a total number of responses representing ninety-five percent of the sample space received in Taiwan. From the data received, it can be assumed that the similarity of the two surveyed groups is evident. The data distribution in each country shows that the surveyed groups are representative of the general population of the school systems.

The literature search showed several articles dealing with international studies of achievement in mathematics and reform in mathematics education around the world during the 1960's and 1970's; however, the literature search produced no evidence of a study of this particular type between these two countries.

The result of the analyzed data was presented in a list of comparisons regarding school curricula, teacher training, teaching methods, school systems, differences between learners, new educational changes in the computer era, etc.

This paper was made possible by a Research Grant from the PACIFIC CULTURAL FOUNDATION SUBSIDY.

Dr. Chang was a Visiting Professor of Mathematics at National Taiwan Normal University during the summer of 1979.

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This paper was presented to the Fifth International Congress on Mathematical Education in Adelaide, Australia on August 24-30, 1984.

CHAPTER ONE

Introduction

As technology changes rapidly during the coming years, the need for educational training in basic skills will increase dramatically because our entire society is more dependent on science and technology than ever before. In order to meet the challenge of providing adequate training to our younger generations and to meet the minimum requirements of basic skills needed to satisfy today's complex society, our curriculum has to face drastic changes during the next century. This new educational system will be emphasizing more math-oriented skills, problem-solving abilities, and computer literacy. Therefore, mathematics and all the science-related courses will become extremely important in the educational training of all learners.

A study of school curricula, teacher training, in-service education, instructional methods, and school systems of the Province of Taiwan, Republic of China and the United States will be beneficial to all concerned. An appreciation and an understanding of differing cultures through cooperation in educational activities will give a comprehensive view of today's issues--such as the shortage of qualified, competent teachers, the best possible teaching techniques, the choosing of appropriate materials from the massive amounts available, the decline of the "Three R's" among high school graduates, the increasing number of underprepared students, and the lack of student interest in studying mathematics. These timely issues will give us an opportunity to adapt our present traditional classroom setting to meet the rapidly expanding new cradle-to-grave educational needs of the twenty-first century. These are some of the most critical educational problems facing these two countries.

A comparative study of mathematics education in the two countries will provide us with valuable information, thus benefitting the educators of both countries. The style and context of the mathematics in the two countries have significant differences due to traditional attitudes, social behaviors, and cultural heritages. There are also specific differences in the training of teachers, the developing of curricula, and the application of pure and applied mathematics. Even though there are many differences between the two countries, this study will enable us to work together to isolate effective methods of attack against the common problems facing both of us. We will not be able to suggest uniform sets of solutions for these issues, but at least we will be able to provide suggestions or recommendations. We will be able to share ideas and information, more importantly, we will be able to utilize the best available resources from both countries. Hopefully, we will be able to suggest alternative approaches for meeting the challenge of mathematics education in both countries.

Statement of the Problem

This paper attempts to examine issues in mathematics education in the Province of Taiwan, Republic of China and the United States. A

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comparison between these two countries should provide answers to the following questions:

(1) Are there any differences in the mathematics curricula of secondary schools between these two countries?

(2) Are there any ways to improve the curricula of the two countries?

(3) Can mathematics education be improved and enriched by a comparison of the two countries' methods and goals?

(4) Are there any ways to present a long-range goal for mathematics education, especially for the rapidly expanding computer-based learning of the twenty-first century?

The data are based on an analysis of survey material and also on personal interviews with mathematics educators of both countries.

Objectives of This Study

This study was designed to achieve the following objectives:

(1) to investigate, compare, and summarize mathematics curricula in the secondary schools (middle schools and high schools).

(2) to encourage further study, discussion, and possible refinement of the curricula in both countries.

(3) to improve and enrich mathematics education by comparison of the two countries' methods and goals.

(4) to present a long-range goal for mathematics education, especially for the rapidly expanding computer-based learning of the twenty-first century.

(5) to disseminate this information through a major mathematics education conference and also by publishing it in an appropriate journal.

Significance of This Study

This study will make the following significant contributions to the field of mathematics education in both countries:

(1) help in understanding the critical issues of mathematics in both countries at the levels of elementary, secondary, and teacher training levels.

(2) share ideas involving teaching methods,

classroom activities, educational materials, audio-visual aids, and individualized teaching activities.

(3) foster cooperation between the two countries in improvements of the learning environment.

(4) exchange information involving new technological hardware and improve the effectiveness of computer-based and computer-assisted instruction.

(5) update learning materials for use in the new educational system of the next century.

(6) compare the teaching methods and instructional goals of the two countries.

(7) recognize past failures in mathematics learning in both countries and eliminate ineffective programs.

(8) present a long-term goal of mathematics education, especially relating it to the high technology of twenty-first century education.

Limitations of This Study

This study has the following limitations:

(1) The study was limited to the examining and

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and analyzing of mathematics education through a survey of mathematics teachers and personal interviews with school administrators in both countries.

(2) The study was limited to secondary math education in both countries. However, for clarity purposes, data are also included about selected aspects of mathematics content in the elementary schools, the course requirements of mathematics majors in college, and mathematics training for elementary and secondary school mathematics teachers.

(3) The study was limited to information received during the 1982-1983 academic year.

(4) The study was limited to information obtained through the survey.

(5) The study was limited to the demographics surveyed.

Definitions of the Terms

The following terms are defined as they appear in this paper. For more detailed definitions, refer to "The Condition of Education--1983 Edition Statistical Report" (National Center for Education Statistics, 1983) and "Education in The Republic of China" (Ministry of Education, 1983).

advanced/honors courses--Special accelerated courses for students who have achieved a high standard of performance in a special subject area.

basic skills--The skills of readiness of the high school graduate who is prepared to go to college or enter the professional occupations.

classroom teacher--A teacher assigned the professional activities of instructing students in classroom situations for which daily student attendance figures for the school system are kept.

college--A postsecondary school which offers general or liberal arts education, usually leading to a first degree. Junior colleges and community colleges are included under this terminology.

comprehensive secondary school--A general secondary school offering programs in both vocational and general academic subjects, but in which the majority of the students are not enrolled in programs of vocational education.

compulsory education--Beginning in the 1968 school year, nine years of publicly funded education was enforced in Taiwan Province, the Taipei special municipality, Kinmen, and Maitzu. The first six years are compulsory elementary education. The three years of junior high school are available without tuition to all students, and they are compulsory at the present time.

computer--A general purpose machine with applications limited by the creativity of the humans who use it. Its capabilities are derived from its memory and the speed and accuracy with which it can process data.

computer-assisted instruction (CAI)--Direct

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interaction between a computer, acting as instructor, and a student.

computer literacy--A broad, general knowledge of how to use computers to solve problems, of the functioning of software and hardware, and an understanding of the societal implications of the computers.

elementary school--A school classified as elementary by state and local practice and composed of any span of grades not above grade eight. A preschool or kindergarten school is included under this heading only if it is an integral part of an elementary school or a regularly established school system.

Element.ry School Teachers In-Service Training Center--A permanent organization for the in-service training of elementary school and kindergarten teachers was established in 1956. About 200 teachers are recruited in each session for a training period of three to four weeks. Equal emphasis is placed on the improvement of teaching methods as well as on the strengthening of life education. In order to have a correct educational concept and thereby improve the methods of teaching, group planning, discussion, observation, experimentation, recommendation, evaluation, and criticism are necessary through hearing, seeing, speaking, and thinking. To nurture an ideal living attitude and a modern living habit, the participants are required to pay greater attention to their food, clothing, housing, transportation, education, and recreation. By mutual affection and revelation, the mission of "Good teachers building a better nation" may be achieved.

entrance examinations--In Taiwan, the student has to pass a severe examination to enter high school or college. This examination is usually held during the early months of summer. For the students who wish to further their studies, failure on the entrance examination means having to try again the next year or going to a supplementary school.

high school--A secondary school offering the final years of high schoolwork necessary for graduation, usually including grades 10, 11, 12 (in a 6-3-3 plan) or grades 9, 10, 11, 12 (in a 6-2-4 plan).

ill-prepared students--Students who do not have a thorough understanding of the basic skills necessary for school or college.

learning center--A place where students can go to get individual help from a tutor or some learning device. Usually, it is equipped with computer terminals, television sets, cassettes, programmed materials, videotapes, etc. This place has a nice environment in which to study and to learn.

microcomputer--A very small computer, often a special purpose or single-function computer.

primary school--A separately organized and administered elementary school for students in the lower elementary grades, usually including grades 1 through 3 or the equivalent, and sometimes including preprimary years.

private school or college--A school or college which is controlled by an individual or

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public school--A school operated by publicly elected or appointed school officials in which the program and activities are under the control of these officials and which is supported primarily by public funds.

remedial courses--Planned diagnostic and remedial activities for individual students or groups of students, designed to correct and prevent further learning difficulties which interfere with the student's expected progress in developing skills, understandings, and appreciations in any of several required courses.

school--A division of the school system consisting of students comprising one or more grade groups of other identifiable groups, organized as one unit with one or more teachers to give instruction of a defined type, and housed in a school plant of one or more buildings.

secondary school--A school comprising any span of grades beginning with the next grade following an elementary or middle school and ending with or below grade 12.

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Secondary School Teachers Research Centers--The Centers were set up in National Taiwan Normal University, National Tsinghu University, National Chengchi University, and Provincial Kaohsiung Normal College & Educational College to train secondary school teachers by rotation for a period of two weeks to seventeen weeks. The number of participants of each session varies according to the courses they are teaching. Emphasis is placed on the discussion of teaching methods and basic teaching materials in order to improve efficiency of teaching.

senior high school--A secondary school offering the final years of high schoolwork necessary for graduation and invariably preceded by a junior high school or a middle school.

special education (Taiwan)--At the present time, Taiwan's special education departments are only provided in elementary vocational, junior vocational, and senior vocational schools. The period of study is the same as in public schools. These departments

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provide special training for blind, deaf, physically handicapped, and mentally retarded youths.

special education (U.S.A.)--Direct instructional activities or special learning experiences designed primarily for students identified as having exceptionalities in one or more aspects of the cognitive process and/or as being underachievers in relation to the general level or mode of their overall abilities. Such services usually are directed at students with the following exceptionalities: physically handicapped, emotionally handicapped, culturally different, mentally retarded and learning disabilities. Programs for the mentally gifted and talented are also included in some special education programs.

supplementary schools--In Taiwan, supplementary schools are divided into two kinds (general and vocational) or four levels (elementary, junior high, senior secondary, and junior college). They are intended for those young men and women who have failed for

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to gain entrance into regular schools. The graduates of supplementary schools have the same status as graduates of regular schools if they successfully pass a government examination held for them upon graduation.

teacher education--In Taiwan, normal (teacher) education is divided into two levels. The junior normal colleges train elementary teachers in a five-year period of study. Students are admitted from the junior high schools. Normal colleges and universities train secondary school teachers in a four-year period of study, plus a one-year teaching internship. Students for the normal colleges and universities must be senior high school graduates. A full scholarship is given to all students.

Three Principles of the People--This is a required course for all high school students in Taiwan. This course describes the doctrine of Dr. Sun Yat-sen, father of the Republic of China. In this book, he urged for the consummation of his Three Principles of the People--Nationalism, Democracy, and People's Livelihood (Social Welfare) in order to complete the task of building the new China.

traditional teaching method--Situation in which the teacher lectures while the students listen. This is a teaching method that is centuries old.

vocational education--Originally, Taiwan's vocational education was divided into a three-year junior department and a three-year senior department. Since the implementation of a nine-year free education program, no junior high vocational students have been admitted. The senior vocational program still lasts for three years. There are seven categories of vocational schools: agriculture, industry, commerce, marine products, nursing and midwifery, home economics, and Chinese opera.

word processing--A program that allows text material to be entered, corrected, added or deleted, and printed in a desired form.

CHAPTER TWO

Review of Literature

A number of articles concerning international comparative studies on mathematics education appeared around 1961. Most of these articles were inspired by and arose from the International Congress of Mathematics Education which was held during August, 1958, at Edinburgh, Scotland (Fehr, 1965). During this conference, a number of papers were presented, most notably a paper entitled, Instruction in Mathematics Around the World to Youth Age 6 to 15 Years Old, which reviewed the effectiveness of mathematics education in various countries. This paper provided information on the mathematical competence of students in individual countries and also on the causes of changes in mathematics programs of secondary schools in these countries.

Husen (1967) reported on the mathematical achievement of the 13-year-old population of twelve participating countries. His findings created chaos and confusion within several countries. His findings also created a challenge to educators to rethink some of the educational practices within their own countries. It also encouraged educators to re-evaluate their curriculum, class sizes, teaching materials, etc. These factors are all crucial in any educational process (Lamon, 1971).

Lamon (1971) criticized such comparative studies claiming that they produced erroneous results and unrealistic interpretations of quantified data. He said that a comparative study cannot account for some possible variables such as class enrollment, individual differences, student's age of entry, instructional methods, teacher influence, and especially learning environment which plays such an important role in learning and achievement.

The release of the International Study of Achievement in Mathematics evoked strong criticism in leading American news media regarding the mathematical education provided for American students (Coxford, 1971). This report was sponsored by the International Association for the Evaluation of Educational Achievement (IEA). It could not be interpreted as an indictment of the mathematics programs in the United States. Coxford suggested that there be an increased study of the study habits of graduation age youth and achievement in mathematics.

Toward the IEA report, Becker and McKellar (1971) maintained, that from this comparative study, it seemed clear that many important variables were overlooked or were difficult to obtain. They suggested that certain measures of mental maturity, which mathematicians and math educators believe to be important in math achievement, should be included in the study.

Anderson (1967) reported that the lack of achievement for pupils in different nations have been called the missing links in comparative education. Lamon (1971) reaffirmed that, unless more significant data became available on how young people learn m ematical abstracts, concepts and ideas, the results produced by national or international comparative studies on achievement will yield little, if any, meaningful, useful, and realistic information.

In 1976, the 25th Annual Assembly, "Education for a Global Community", was held in Washington, D.C. There were 21 participating countries. Most of them recognized that educational systems aim at getting all citizens of our globe to live together in peace and harmony. This means that all the nations of our globe must learn to live together not only as good neighbors in peaceful co-existence, but as a people needing one another. Relating this to the role of education, they all admitted that it is the duty of educators to provide information which will enable pupils to better understand others.

The Joint-Executive Committee of the Associations of Headmasters, Headmistresses, Assistant Masters, and Assistant Mistresses in England (1976) declared that education should focus on the capacity to understand, to reason, and to draw conclusions which may be different when viewed from different standpoints. There is no single answer to complex world problems. Thus, it is important to make pupils aware of the difficulty of collecting data, the impossibility of gathering all relevant facts, and of the necessity of being willing to change their attitudes in the light of increasing knowledge and understanding.

Hurd (1982) reported on an overview of science education in the United States and and selected foreign countries. He presented his paper to an assembly of delegates representing 29 countries at the 1977 Annual Assembly of the World Confederation of Organizations of the Teaching Profession (WCOTP). He presented information on the status of compulsory education with regard to school attendance and examined the social expectations associated with compulsory education. For this WCOTP conference (1977), each participating member provided his country's education objectives, its criticisms, its reform proposals, and its expectations toward human rights and mutual understanding between the countries.

Gross and Dufty (1980) edited a number of papers dealing with social science education in 22 countries. The amounts and kinds of materials available for educational purposes are equally varied across the nations. In this volume, the editors pointed out that their intention was not to paint a comprehensive picture of social science education world-side, but rather to begin what they hope will be a continuing and expanding dialogue between the countries. Their intention was also to play a part in the effort to help educators around the world understand each other and, of course, themselves (1980).

Lee (1982) compared the higher education system of the Republic of China to the United States and saw the values of the international exchange program. The information on the educational systems will benefit education in both countries.

The literature review revealed no study dealing with this particular issue--A Comparative Study of Mathematics Education Between the Province of Taiwan, Republic of China and the United States. It would be an informative challenge to investigate, compare, and summarize the mathematics curriculum of the two countries and to compare the two countries' methods and goals. Hopefully, this will assist both countries as they prepare for the new educational activities of the 21st century.

CHAPTER THREE

Methodology

The first phase of this study began with a questionnaire. The questionnaire, in English, was constructed by the investigator prior to his field trip to Taiwan. This questionnaire was sent to seven mathematicians in the United States. The content, format, and validity of this questionnaire were evaluated by these mathematicians. After receiving their comments and recommendations, a revised copy was ready for more evaluations and comments. A final draft was constructed with advisement from the respondents in the study. (See Appendix E.)

The second phase of the study was to translate the questionnaire into Chinese. A Chinese version of the questionnaire was sent to five mathematicians in Taiwan. In order to achieve an accurate translation without losing the identities of the individual countries, certain terminology had to be altered because of the distinction of the educational systems. For example, questions dealing with entrance examinations for senior high schools (which seem strange to American teachers) and questions dealing with the S.A.T. (which seem strange to Chinese teachers) had to be altered to take into account the difference of the two systems. Both versions of the questionnaires were ready prior to the investigator's visit to Taiwan.

The third phase of this study was the distribution of the questionnaires. Two hundred and fifty public and private schools in the United States were randomly chosen from the list in Patterson's American Education (1981). The questionnaires were mailed during the fall of 1982. The information concerning the responses can be found in Table 1.

Table 1

Distribution of Responses in the United States

Location of Responses	Percentages
Midwest	20%
South	23%
Middle Atlantic	15%
Far West	25%
Northeast/New England	17%

Setting	Percentages
Metropolitan Area	38%
Rural Area	24%
City Area	38%

Type of School	Percentages
Public	68%
Private	32%

Level of School	Percentages
Junior High School	52%
Senior High School	36%
Vocational	12%

(Source: Data were collected by author during 1982-1983.)

Sixty-eight percent of the responses were received prior to May 1, 1983. Three percent of the questionnaires were returned after the cut-off date, and thus, were excluded from the study.

The Chinese versions of the questionnaire were distributed in the following manner. One hundred questionnaires were distributed by the investigator to in-service training classes of mathematics teachers at the Taiwan Normal University. The questionnaires were returned the next day with a one hundred percent response. The other one hundred fifty questionnaires were distributed through the Educational Bureau of the City/County. Ninety-five percent of the questionnaires were returned before the investigator departed from Taiwan on December 30, 1982. The high return rate in Taiwan was due to the assistance of the Department or Bureau of Education in the City/County which was involved in this project. Table 2 shows the information from the responses.

Table 2

Distribution of Responses in Taiwan, Republic of China

Location of Responses	Percentages
North (includes Taipei area)	37%
Central	30%
South	33%
Setting	**Percentages**
Metropolitan Area	35%
Rural Area	25%
City Area	40%
Type of School	**Percentages**
Public	79%
Private	21%
Level of School	**Percentages**
Junior High School	59%

Senior High School	34%
Vocational	77

(Source: Data were collected by author during 1982-1983.)

The fourth phase of this study was the separate compliation of data from the two countries. From the data received, it can be assumed that the similarity of the two surveyed groups is evident. The data distribution in each country shows that the surveyed groups are representative of the general population of the school systems.

CHAPTER FOUR

Results of the Survey

This section reports the results of the assessments obtained from the compiled data. Data were classified into the following catagories: curricula, graduation requirements, learning centers, instructional methods, teacher training, classroom management, evaluation of achievement, faculty evaluation, remediation, faculty development, and the future of the teaching profession.

Curricula

The curricula of the secondary school varies in content. In the United States, students have a chance to select their course of study. Usually in high school, there are three levels of mathematics courses for students to choose from. Starting in the seventh grade (or eighth grade), all students are required to take mathematics. They can select any level course work with the consent of their parent or counselor.

The first level consists of algebra, trigonometry, plane geometry, and sometimes, calculus, statistics, and computer science. The second level consists of elementary algebra and general mathematics. The third level consists of laboratory mathematics, consumer mathematics, and business mathematics. The students who choose the first-level are usually college-bound students. The students who choose the second-level are usually those who are weak in math and who don't plan to go to college. Most of the high-risk students take the third-level math.

According to "The Condition of Education" in the 1983 Statistical Report by the National Center for Education Statistics, years of coursework completed in mathematics by the high school seniors in the four regions (Northeast, South, Midwest, West) of the United States showed the Northeast contained a higher percentage of seniors who took at least 2½ years of mathematics beginning in the 10th grade. This is shown in Table 3.

Table 3

Years of Mathematics Coursework

Completed Since the 10th Grade

Region[1]	Total	None	½-1 year	1½-2 years	2½-3 years	3-on	Space Sample
Northeast	100%	3.0%	15.8%	28.5%	39.7%	13.0%	5622
South	100%	3.8%	21.9%	37.3%	29.6%	7.5%	9192
Midwest	100%	6.9%	28.0%	32.0%	25.3%	7.8%	8026
West	100%	4.8%	28.9%	36.0%	24.7%	5.7%	5088
Total	100%	4.7%	23.5%	33.5%	29.8%	8.5%	27928

[1]The regions correspond to Bureau of the Census definitions.
(Source: National Center for Education Statistics. (1983). (Plisko, V., Ed.) The condition of education. 1983 Edition Statistical Report, U.S. Department of Education, Washington, D.C.)

Table 4 shows the most frequently offered mathematics courses in secondary schools in the United States.

Table 4

Most Frequently Offered Mathematics Courses in Secondary Schools in the United States

Course	Percent of Schools Offering Course
(1) Advanced Level	
Algebra	50%
Advanced Algebra	5%
Trigonometry	50%
Calculus	6.8%
Analytic Geometry	5%
Probability & Statistics	10%
(2) Intermediate Level	
Intermediate Algebra	5%
Algebra II	42%
Plane Geometry	50%

(3) Beginning Level	
Algebra I	20%
Business Math	5%
Career Math	5%
Laboratory Math	10%
General Math I, II, III	70%
Consumer Math	5%
Pre-Algebra	5%
(4) Remedial Level	
Arithmetic	50%
Basic Skills Math	50%

(Source: Data were collected by author during 1982-1983.)

Table 5 shows the remedial and advanced mathematics programs taken by high school seniors by regions in Spring, 1980.

Table 5

Remedial and Advanced Mathematics by Regions

Program	Regions[1]				
	Total	Northeast	South	Midwest	West
	Percent of Seniors				
Remedial Mathematics (Sometimes called basic or essential)	30.6%	27.3%	30.1%	32.6%	32.2%

	Total	Northeast	South	Midwest	West
Advanced Mathematics (Sometimes called honors)	22.9%	24.2%	21.9%	23.8%	21.6%

[1]Regions correspond to Bureau of the Census definitions.
(Source: National Center for Education Statistics. (1983). (Plisko, V., Ed.) The condition of education. 1983 Edition Statistical Report, U.S. Department of Education, Washington, D.C.)

Table 6 shows the number of public elementary/ secondary schools with computers available for instruction and other major uses by grade level in the school year 1981-1982.

Table 6

Percentage of Distribution of Computers and Microcomputers

	All Schools	Elem. Schools	Jr. H. Schools	Sr. H. Schools	Other
Total Number of Schools	81,970	50,800	11,184	14,113	5,874
Schools with Computers					
Number	29,027	11,364	5,822	10,445	1,396
Percent of Total	35%	22%	52%	74%	24%

	All Schools	Elem. Schools	Jr. H. Schools	Sr. H. Schools	Other
Schools with Micro-computers					
Number	27,501	11,050	5,774	9,504	1,173
Percent of Total	34%	22%	52%	67%	20%
Major Uses:					
Compensatory and Remedial	14%	18%	20%	6%	19%
Basic Skills	19%	29%	11%	12%	6%
Learning Enrichment	19%	21%	19%	18%	4%
Computer Literacy	33%	29%	30%	39%	34%
Computer Science	23%	7%	10%	49%	15%
Schools with Terminals					
Number	898	958	978	620	343
Percent of Total	7%	2%	9%	26%	6%
Major Uses:					
Compensatory and Remedial	12%	23%	28%	6%	0%
Basic Skills	13%	20%	10%	13%	0%
Learning Enrichment	24%	28%	23%	21%	50%
Computer Literacy	22%	0%	23%	28%	15%
Computer Science	34%	0%	14%	47%	45%

(Source: National Center for Education Statistics. (1983). (Plisko, V., Ed.) The condition of education. 1983 Edition Statistical Report, U.S. Department of Education, Washington, D.C.)

In Taiwan, R.O.C., students also have a chance to select their course of study. There are only two levels of mathematics courses for them to choose from.

The first level consists of courses preparing students for majors in natural science or engineering. The contents include algebra, geometry, trigonometry, probability, combinations, permutations, matrices, and projective geometry.

The second level consists of courses preparing students for majors in liberal arts. The contents include similar areas with less emphasis on some of the advanced topics. For example, in the first level, topics such as three-dimensional space, vectors, infinite series, and limits are included. The second level does not include these topics. Both levels prepare students for college.

In Taiwan, mathematics courses are mandatory for all students. A student has to study three years of mathematics in order to graduate from high school.

Table 7 contains the most frequently offered mathematics courses in secondary school in Taiwan, R.O.C.

Table 7

Most Frequently Offered Mathematics Courses in Secondary Schools in Taiwan, R.O.C.

Course	Percent of Schools Offering Course
(1) Advanced Level	
Calculus	10%
Analytic Geometry	10%

High School Mathematics (Including Advanced Algebra, Trigonometry, Probability and Statistics)	95%
(2) Intermediate Level	
Algebra	10%
Secondary School Mathematics	95%
(3) Beginning Level	
Algebra	80%
Plane Geometry	20%
Advanced Mathematics	95%
(4) Remedial Level	
Review of Algebra	5%

(Source: Data were collected by author during 1982-1983.)

Graduation Requirements

The number of years of mathematics needed for graduation differs in the two countries. In most American schools (middle and secondary), students are required to take one mathematics course a year until the ninth grade and then at least two or three more years of mathematics until graduation. All three levels satisfy graduation requirements.

In Taiwan, 7th, 8th, and 9th grades (middle school) are required to take one mathematics course each year. In high school, first and second level 10th grade students must take one math course (four hours per week). First level 11th and 12th grade students must take six hours per week of mathematics as compared to four hours per week for the second level 11th and 12th grade students.

Table 8 shows the required number of years of mathematics for graduation in each country.

Table 8

Required Number of Years of Mathematics For Graduation in the U.S.A. and Taiwan, R.O.C.

U.S.A.	Taiwan, R.O.C.
Senior High	
For college-bound students--- 2 or 3 years (depending on state or school system) (required & elective)	For college-bound students--- 3 years (6 semesters of mathematics)
For non-college bound students--- 2 or 3 years (depending on state or school system) (required & elective)	For non-college bound students--- 3 years (6 semesters of mathematics)

Junior High (equivalent to 7th, 8th, & 9th grades)	
2 or 3 years (depending on state or school system)	3 years (6 semesters of mathematics)

(Source: Data were collected by author during 1982-1983.)

Learning Centers

Learning centers are receiving increasing attention in the United States as a place where students can go to get help from a tutor or some type of learning device. But in Taiwan, most schools do not have learning centers. Students get help in the library or from a member of the mathematics club.

Table 9 shows the distribution of learning centers in the United States.

Table 9

Distribution of Mathematics Learning Centers in the U.S.A.

	Percentages
Math learning center available	12%

No math learning center available	88%
Type of learning centers--	
Combination of English, Reading, & Math	50%
Combination of Science & Math	50%
Staff of learning centers--	
Tutor	50%
Math teacher	50%
Visual aids	10%

(Source: Data were collected by the author during 1982-1983.)

Computer Centers

In the United States, 81% of the responses indicated that the schools had computer centers containing either terminals or portable microcomputers. All the responses indicated that the teachers had free access to use the centers. They reported that the number of students taking computer courses increased dramatically during the past year.

In Taiwan, the majority of the responses (92%) indicated that the schools do not have computer centers. Most of them (around 70%) reported a limited number of personal microcomputers for instruction or demonstrational uses. Many of the public and private high schools are in the process of acquiring large quantities of microcomputers. During recent years, most of the high school students have taken computer courses during their last year of study.

Instructional Methods

Teaching methods in mathematics are similar in the two countries. The majority of teachers use the chalkboard/lecture method to teach their classes; however, individualized instruction and computer-assisted teaching are becoming increasingly popular in the United States.

Table 10 compares the teaching mathods between the two countries.

Table 10

Comparison of Teaching Methods in U.S.A. & Taiwan, R.O.C.

	U.S.A.	Taiwan, R.O.C.
Traditional Lecture/Demonstration	88%	82%
Individualized Instruction	56%	24%
Small-Group Instruction	44%	14%

	U.S.A.	Taiwan, R.O.C.
Student-Centered Discussion	19%	20%
Others (Laboratory Situations)	12%	02%

(Source: Data were collected by the author during 1982-1983.)

Teaching Load

In the United States, 60% of the teachers teach 5 mathematics classes per day, 5 days per week in high school. 69% of the teachers teach different mathematics subjects. In elementary school, teachers teach at least 6 classes consisting of mathematics, reading, spelling, language arts, social studies, science/health. The time per day of each subject varies with state requirements and teacher schedules.

In Taiwan, 55% of the teachers report that they teach 3 mathematics classes per day, 6 days per week. 57% of the teachers report that they teach different mathematics subjects.

In the United States, 31% of those responding state that they have to report to school before 7:30 a.m. 50% report between 7:30 and 8:00. 18% report between 8:00 and 9:00 a.m.. 81% of the teachers reported that they have to stay at school from 7 to 8 hours a day.

In Taiwan, 94% of the teachers report to school before 7:30 a.m. Only 6% report to school between 7:30 and 8:00 a.m. 90% of the teachers reported that they stay at school at least 7 to 8 hours a day.

Table 11 shows the subjects and weekly teaching hours in elementary and junior high school in Taiwan, R.O.C.

Table 12 shows the subjects and weekly teaching hours in senior high school.

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Table 11

TEACHING SUBJECTS AND WEEKLY TEACHING HOURS IN ELEMENTARY AND JUNIOR HIGH SCHOOLS
(Weekly Minutes for Elementary Schools)

Grade	Elementary School 1 2	Elementary School 3 4	Elementary School 5 6	Junior High School 1	Junior High School 2	Junior High School 3
Civics & Ethics	120	120 200	200	2	2	2
Health Education				2		
Mandarin	400	400	400			
Chinese				6	6	6
English				2-3	2-3	
Mathematics	120	160 200	240	3-4	3-4	3-4
Social Studies	80	120	120			
History				2	2	1
Geography				2	2	1
Natural Science	120	160	160	3	4	4
Singing & Playing	160					
Physical Education		120	120	2	2	2
Music		80	80	1	1	1
Fine Arts	80			1	1	1
Craft work		120	120			
Industrial Arts (Home Economics for girls)				2	2	2
Selective Subjects: Planting of Agricultural Products					2	
Drawing						
Abacus						
Agriculture						6-9
Industry						
Commerce						
Home Economics						
Marine Products						
English						
Mathematics						
Music						
Fine Arts						
Boy Scout Training				1	1	1
Group Activities	80	80	80			
Guidance Activities				1	1	1
TOTAL	1160	1360 1480	1520	30-32	31-33	31-35

Notes:

① The teaching hours of foreign language (English) and mathematics at junior high school are flexible in order to meet actual local requirements.

② In the second year of junior high school, planting of agricultural products, drawing, and abacus are electives. The student may elect any one of the three courses for two hours weekly.

③ In the third year of junior high school, electives are divided into two categories, namely, professional electives and other electives. The former is again divided into agriculture (including agricultural plantation, agricultural processing, poultry and animal raising courses), industry (including drawing, metal works, and electronic works courses), commerce (including abacus, bookkeeping, and statistical drawing courses), home economics (including meal management, dress-making, and home electrical appliances courses). The latter is subdivided into natural science, English, music and art courses. Industrial courses have four to six hours weekly, while other courses are two hours each week. The student must elect two courses out of the two-hour weekly courses with at least one professional course, or three courses with at least two professional courses. But only one elective from industrial courses is required.

④ One hour each week for weekly-meeting, and extracurricular activities in junior high school are not included in this list.

(Source: The Ministry of Education. (1983). Education in the Republic of China. Taipei, Taiwan: Author.)

Table 12

TEACHING SUBJECTS AND WEEKLY TEACHING HOURS IN SENIOR HIGH SCHOOLS

	(A) Major in Natural Sciences						(B) Major in Social Sciences					
Grade ▶	1		2		3		1		2		3	
Semester ▶	I	II	I	II	I	II	I	II	I	II	I	II
Chinese	6	6	5	5	5	5	6	6	7	7	7	7
English	6	6	5	5	5	5	6	6	7	7	7	7
Civics	2	2	2	2			2	2	2	2		
Three Principles of the People					2	2					2	2
History	2	2	2	2			2	2	2	2		
History of Chinese Culture											2	2
Geography	2	2	2	2			2	2	2	2	2	2
Mathematics	4	4	6	6	6	6	4	4	4	4	4	4
Physics					6	6					3	3
Chemistry			6	6					3	3		
Biology	3	3					3	3				
Earth Science					2	2						
Physical Education	2	2	2	2	2	2	2	2	2	2	2	2
Music	1	1	1	1			1	1	1	1		
Fine Arts	1	1	1	1			1	1	1	1		
Industrial Arts (Home Economics for girls)	2	2	2	2			2	2				
Military Training (Military Training & Nursing for girls)	2	2	2	2	2	2	2	2	2	2	2	2
Selective Subjects					2 ~ 6	2 ~ 6					2 ~ 5	2 ~ 5
TOTAL	33	33	36	36	32 ~ 36	32 ~ 36	33	33	35	35	33 ~ 36	33 ~ 36

(Source: The Ministry of Education. (1983). *Education in the Republic of China*. Taipei, Taiwan: Author.)

Classroom Management and Teacher Responsibility

Discipline is a critical problem in the United States. 31% of those responding indicated that they are having trouble in their classrooms. 94% reported that the most important factor in avoiding trouble in class is to inform students of their responsibilities. 88% of the teachers believe that well-prepared lessons would be another factor in avoiding trouble. 81% of the teachers indicated that encouraging and involving students in learning activities would be a third factor. Some teachers also suggested that keeping students busy with classwork and respecting them would be other factors in maintaining good discipline.

In Taiwan, 94% of those responding reported that discipline is not a problem in their classrooms. 54% feel strongly that having well-prepared lessons is the most important factor in a well-behaved class. 48% suggest that the students should be told their responsibilities and given reasons for studying.

In the United States, a teacher, besides having regular teaching duties, has to be a homeroom teacher, distribute and collect textbooks, participate in hall duty, supervise study hall and the lunchroom, and participate in other administrative duties.

In Taiwan, a teacher, besides having regular teaching duties, is assigned to serve as a homeroom teacher. In most of the Chinese schools, the function of the homeroom teacher is entirely different from the function of the homeroom teacher in the United States. The Chinese teacher supervises classroom activities, serves as a counselor to the students, and grades the students weekly diaries. Most other duties are voluntary.

Table 13 compares teachers duties in the U.S.A. to those in Taiwan, R.O.C.

Table 13

Percentage of Teachers Performing Non-Teaching Duties in U.S.A. & Taiwan, R.O.C.

	U.S.A.	Taiwan, R.O.C.
Homeroom	38%	76%
Daily Attendance Report	62%	8%
Midterm (Quarterly) Report Card	62%	12%
Lunchroom Duty	19%	2%
Study Hall Duty	3%	17%
Hall Duty	31%	3%
Distribution/Collection of Texts	50%	0%
Student Club Advising	25%	9%

(Source: Data were collected by the author during 1982-1983.)

Teaching Aids

In the United States, 81% of the teachers report that they use audio-visual equipment during presentations. 88% report that they have shown mathematics films during their learning activities. The most frequently shown films are: Donald in Math Magicland, Consumer Topics, Graphs of Functions, Decimal Percent, The Math Path, and Fractions.

In Taiwan, only 24% occassionally use audio-visual equipment during presentations. A majority of the teachers (97%) have not used any films at all during their presentations.

Evaluation & Achievement

In the United States, teachers regard evaluation as playing a major role in student learning activities. 88% of those responding indicated that the purpose of evaluation is to measure students' improvements and to locate students' weaknesses. 75% emphasized that evaluation reinforces student learning.

A midterm and a final examination constitute a major portion of the course grade. Of course, the teacher has a free hand to give daily or weekly quizzes. A majority of teachers (54%) responded that they give quizzes once a week. 88% of the teachers reported that they allow students with excuses to take make-up examinations. 19% of the teachers give make-up tests without requiring excuses. 69% of the teachers do not give "second-chance" retests.

In Taiwan, Republic of China, 58% of those math teachers responding regarded evaluation as a tool for measuring student improvement. 52% emphasized evaluation as a reinforcement for student learning.

47% regarded evaluation as a way of locating students' weaknesses and to give suitable remediation.

A mandatory monthly examination is required for all students. Of course, teachers have the flexibility to give weekly, twice weekly, or daily quizzes. In fact, 50% of the teachers give weekly examinations and 4% give daily examinations. 30% give twice weekly examinations.

A final examination is required for all students in Taiwan. 73% of those responding indicated that they allow students with excuses to take make-up exams. 80% of the mathematics teachers also gave retests, while 72% favored limited retesting. 28% indicated that unlimited retesting should be offered for students.

Faculty Evaluation

In the United States, the local or state Board of Education usually establishes guidelines for faculty evaluation. All the respondents in the survey reported that evaluations are conducted by supervisors, principals, and peers. The new teachers are evaluated by a set of criteria required by the local Board of Education. These evaluations vary among states.

In Taiwan, 86% of the teachers reported that their schools have a fair evaluation policy. 95% of the math teachers reported that they are evaluated by their principals. Also, a major portion of the criteria for evaluation comes from the credits on the teachers' in-service training, from years of experience, and from subject area training.

Remediation

In the United States, because of the flexibility of the selection of mathematics courses, remediation takes the form of dropping to a lower level course or taking a course over. For example, a student would go from a first-level to a second-level mathematics course or he would retake a first-level math course. Sometimes a teacher is willing to tutor a student. In some schools, federal assistance programs such as Title I and Chapter

I provide certain remedial help.

94% of those responding indicated that they identify remedial mathematics students through test scores. 65% of the teachers surveyed responded that they give extra help either in class or after class or school. 12% of the teachers referred students to mathematics resource centers. If the class was doing poorly, 69% of the teachers said that they would give extra help to the entire class. 31% of the teachers said that they would give no extra help.

In Taiwan, remediation is mostly handled by individual teachers. For example, a teacher may hold help sessions after class. 70% of the teachers surveyed said that they recognize mathematics remedial students through test scores. 85% said that they would give extra help to the class if needed.

Teacher Training

The training of mathematics teachers in these two countries is different in the following ways:

(1) Teacher-training schools in Taiwan are separate institutions from other colleges.

They are public-supported, tuition-free, and provide room and board for their students. Teacher education in the United States is provided by most colleges or universities. The curriculum for training teachers varies from state to state and from college to college.

(2) After graduation from a teachers' college a student has to teach in Taiwan for at least two years. Otherwise, tuition and room and board have to be repaid.

(3) Taiwan elementary school teachers are required to take more mathematics courses than United States elementary school teachers. High school mathematics teachers in Taiwan earn bachelor's degree in mathematics which consists of the calculus sequence, modern algebra, differential equations, linear algebra, plus more advanced topics. In some United States schools, 65 quarter hours, beginning with precalculus, is needed for mathematics education majors.

Table 14 shows the course offerings for mathematics education majors in the United States and in Taiwan, R.O.C.

Table 14

Comparison of Mathematics Courses in Teacher-Training Programs in U.S.A. & Taiwan, R.O.C.

U.S.A.	Taiwan, R.O.C.
For Elementary School Teachers (Minimum Requirements)	
College Algebra Arithmetic for Elementary School Teachers	Pre-Calculus Level Courses Math Analysis
For Mathematics Education Majors (Minimum Requirements)	
65 Quarter Hours Beginning with Pre-Calculus (Includes Pre-Calculus, Calculus I, II, III, Linear Algebra, Computer Programming, Differential Equations)	Calculus Sequence Mathematical Analysis Differential Equations Real Variables (elective) Complex Variables (elective) Topology (elective) (Most of the students in Taiwan graduate from high school with at least 6 years of advanced math training.)

(Source: Data were collected by the author during 1982-1983.)

The United States Commission on Preservice Education of Teachers of Mathematics of the National Council of Teachers of Mathematics (1979) developed guidelines for the preparation of teachers of mathematics. A complete set of these guidelines can be found in Appendix C.

Faculty Development/In-Service Training

In-Service Training in Taiwan, R.O.C.

The In-Service Training Program for mathematics teachers in the Republic of China has long been recognized as one of the finest, most successful, and comprehensive training programs for teachers' on-the-job development anywhere in the world. Its main goals are:

(1) to teach teachers more mathematics. This serves the function of continuing education for the classroom teachers of mathematics.

(2) to teach teachers how to establish a more creative, interesting environment for the learning of mathematics.

(3) to teach teachers the most up-to-date instructional methods.

(4) to teach teachers how to use mathematics to explain life situations to students.

(5) to teach teachers how to use mathematics to solve problems.

(6) to teach teachers how to improve skills and

how to raise professional standards.

(7) to familarize teachers with new curricula and new teaching materials.

(8) to focus teachers' attention on current events related to mathematics.

Two separate organizations are currently providing the in-service training for secondary school mathematics teachers and elementary school teachers. The secondary mathematics teacher in-service training is coordinated by the In-Service Training Center at the National Taiwan Normal University. There are satellite centers, which are the responsibility of the departments of mathematics, at the various teachers' colleges around the island. The elementary school teachers' in-service training program is provided by the Taiwan Provincial I[illegible]tute for Elementary School Teachers In-S[illegible]e Education (IETISE).

In-Service Program for Elementary School Teachers

The IETISE is the only organization for on-the-job training of elementary school teachers in Free China. The early mission of this institute was to provide professional training to all unqualified teachers. The reason there were so many unqualified teachers was that Taiwan was occupied by the Japanese for about fifty years before the Second World War. During this period, most of Taiwan's elementary school teachers (about 80%) were Japanese. After Taiwan was returned to China, the Japanese teachers left and the government of Taiwan had to draft substitute teachers to fill the vacancies. More than 70% of the teachers in Taiwan's school system were unqualified. After the establishment of the Institute in 1956, there were still many teachers who had not received professional training. A survey was conducted in 1961, and it was found that 8000 school teachers had only graduated from senior high school or vocational school. 5000 teachers had only graduated from junior high school. There were more than 800 teachers who had only graduated from elementary school. During this period, the main task of the IETISE was to provide training in education for these teachers.

The curricula of these classes were language, mathematics, social science, and art. The training period was four weeks for each class. By the

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end of March, 1975, a total of twenty-five thousand teachers, department chairmen, and principals, completed their training courses at the Institute (Chen, 1975).

The general classes dealt mainly with the subjects taught in elementary school. The special classes trained the people who held special positions, such as principal, department chairman, and early childhood teacher. Hence, the main missions of this Institute were not only for teacher training in education, but also for their continuing education and research.

The purposes of the Institute are to provide teachers a place to improve their teaching skills, to raise their professional standards, to allow them to study curriculum improvement, to learn new instructional techniques, to select teaching materials, to develop problem-solving skills, to learn to offer guidance to students, and to learn how to communicate with students.

Since its establishment in May, 1964, the IETISE has been conducting reserve-training classes for administrators of the elementary schools.

The selection of the reserve-training classes for directors and principals was recently changed from the nomination point system criteria to a qualification examination for all interested active elementary school teachers (Chen, 1975). This means that anyone can be an administrator if he or she passes the examination. This unique feature has produced many well-qualified and dedicated administrators (Chen, 1975).

During the first ten years, the number of trainees in the Reserve Directors and Principals classes were as follows:

May, 1964 ---- March, 1974	
Total Number	3165
Reserve Principals	1163
Reserve Directors	2002

(Source: Chen, M. (1975). SATCA Review)

Another feature of IETISE is the training of inspectors of the elementary schools. The Elementary School Educational Inspecting Team consists of about ten members who are selected from a group of well-qualified experienced teachers. They are divided into several small units according to their speciality. Besides regular teaching duties, each member contributes one day per week/two weeks to visit other schools and provide assistance to local teachers regarding teaching, curriculum, or other classroom activities relating to the teaching duties in their respective fields. Their visitations are mainly to provide assistance to local teachers, not to evaluate the teaching skills, therefore, the team is received enthusiastically by the local teachers.

IETISE provides one month of training for the inspectors. They receive subject area refresher courses and learn inspection skills and methods of guidance (Chen, 1975).

Another unique feature of the IETISE was the "Seed Team" training program for mathematics. During 1971, new mathematics textbooks were adopted for the elementary school. There were no teachers who could use them efficiently. In order to teach them how to use the books, a seed team training program was begun. Five of

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the best qualified teachers from each school district were brought in for a month of intensive training in mathematics. They returned to their districts and held workshops and seminars for all teachers to show them how to teach mathematics. In the school year of 1971, there were 15,000 teachers who received indirect training through the seed team members of IETISE. It was indeed a very successful program (Chen, 1975).

In 1972, a curriculum reform was begun for all the elementary schools. The first projects conducted by the Institute were in the science and mathematics areas. Both were large-scale and long-term projects in nature. Each used the same systematic approach. They involved extensive nationwide pilot studies and comprehensive in-service teacher training.

The most important aspect of the science project was the selection of the best school teachers in the district to participate in this program--the development and research of the elementary school science education in the Republic of China (Tsui, 1982).

First priority of this Institute was the production of mathematics textbooks for grades one through six, and accompanying materials, such as student workbooks, teacher resources handbook, reference books, and instructional aids, etc. The mathematics instructional materials were developed by members of the Math Unit at the Institute and also by members of the Advisor Board of the Math Unit who served as the Review Board to oversee the new materials.

The projects in science and mathematics were carried out in two phases (Tsui, 1982):

(I) PHASE I

(A) Planning Stage: The Research and Development Committee for natural science was established in 1972, followed by the Mathematics Committee in 1974. Both committees consisted of educators, psychologists, curriculum specialists, media experts, experienced school teachers, and prominent professors from different academic disciplines. The major tasks of the Math Committee were to:

(1) Collect data regarding current

mathematics curriculum from local school districts and from foreign countries.

(2) Conduct surveys and conduct interviews.

The results of the analysis of the data and reference materials determined the next stage.

(B) Design Stage:

(1) Set curriculum goals.

(2) Constructed basic curriculum model:

(a) Unit behavioral objectives.

(b) Unit content (selection criteria, organization criteria, structure criteria).

(c) Unit evaluation and its criteria.

(C) Development Stage:

(1) Draft of unit content and learning activities (unit behavioral objectives, teaching methods recommended).

(2) Draft of teacher's edition of the unit.

(3) First draft of student's and teacher's editions of the completed set of texts.

(4) Field testing and evaluation.

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(5) Revision and retesting.

(6) Provisional edition ready for pilot study.

(7) Instructional aids designed, produced, and evaluated.

(8) The approved instructional designs manufactured by selected vocational and technical schools around the country. This production program provided technical students hands-on experience and skills.

(D) Pilot and Evaluation Stage: After receiving the approval authorization from the Research and Development Committee, the provisional curricula was piloted, evaluated, and revised three times.

(1) (a) Selected schools for first pilot testing.

(b) First pilot testing by members of the Research and Development Committee.

(c) Evaluation of performance and result of first pilot testing, such as teacher reaction, student reaction, and any unforeseen problems regarding the new text were brought to the attention of the members of the Editorial Board.

(d) Revised provisional materials.

(2) (a) Selected schools for the extensive second pilot testing using revised text.

(b) Conducted second pilot study.

(i) Selected 48 schools to participate in the project.

(ii) One class in each experimental school did the experiments.

(iii) All the teachers involved in teaching the experimental classes attended three weeks orientation at the Institute to familiarize themselves with the revised text.

(iv) One year experimental study.

(c) After the revised texts were tested

for one year, a questionnaire was distributed to all people concerned to solict their reactions to the second revised text.

(d) An evaluation conference attended by the teachers from the experimental schools was held to analyze the data, as well as the comments from the teachers who had used the second revised text.

(e) Additions, deletions, and refinements were made in the second revision of the proposed new text.

(3) A third pilot testing

(a) 63 new schools were selected for both the natural science and the mathematics projects.

(b) All subject area classes in the participating schools used the second revision of the proposed text.

(c) All the teachers involved in the experimental schools received three weeks intensive training at the Institute prior to the opening of the school year.

(d) During the one year experiment, teachers received additional guidance and regularly attended demonstration classes provided by the Institute.

(e) By the end of the study, data was collected again. Data on students' performance and attitudes, and teachers' input were collected in order to revise the material for a third time. This was the last revision.

(f) Instructional aids such as workbooks, slides, laboratory kits, and resource books were tested. These tools were distributed to the teachers to use during their training sessions at the Institute.

(E) Implementation Stage:

(1) Full-scale implementation began with

a one-week seminar for mathematics faculty members of all the teachers' colleges in the nation.

(2) All teachers from previous experiments were trained at the Institute again for three weeks.

(3) Teachers from all other schools attended two-week seminars during the summer and winter breaks. These seminars were primarily to teach the teachers how to use the new text.

(4) Teachers received training on how to use some of the instructional aids, such as the audio-visual instruments.

The mathematics project was completed in the Phase I study from 1974-1982.

(II) Phase II

The main purposes of this Phase were:

(1) To insure the implementation of the new text.

(2) To develop suitable instruments for evaluating the performances of the students.

(3) To collect normative data on students'

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learning abilities in science and mathematics.

In order to make sure the teachers were actually using the proposed methods and knew how to use the final version of the new texts, as well as the instructional aids, the Institute provided the following assistance and guidance to ensure the proper implementation of the new reformed curriculum.

(A) There were 37 demonstration schools to serve as local centers for dissemination of information regarding the teaching of the new materials.

(B) Members of the Research and Development Committee made periodic visits to local schools to provide assistance and explanations regarding the new curriculum.

(C) Teachers were trained to serve as demonstration leaders.

(D) A PESTSC (Provincial Elementary School

Teachers Service Corps) was established in August, 1983. This corps serves primarily to make regular visits to local schools, to solve problems regarding new curricula, and to give guidance in cooperation with the mathematics supervisors at various levels of the countv, city, and provincial departments of education. The corps also serves as a liaison between teachers and the Institute.

(E) In order to make sure the implementation effort reach not only teachers and students in their classes, but other branches of the educational system, such as the elementary school, the teacher colleges, and all the auxiliary service networks, the Institute incorporated three other agents: Department of Education of Counties and Cities, the teachers' colleges, and the newest one, the PESTSC.

(F) Research continues at the Institute on assessment instruments, since the new curriculum emphasizes "learning by doing"

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rather than the traditional learning by "teacher talk" and "pencil and paper".

A curriculum reform is currently in progress for all subjects at the elementary level. Reaction to this process has been extremely favorable. Its success is due mainly to the following unique aspects (Tsui, 1983):

(1) The reform movement is currently under government sponsorship. The projects can call upon the best minds and vast manpower to maintain overall high standards and quality control. The standardization of the instructional aids not only reduces expenses, but also makes it easier for teachers to use them more accurately and more efficiently.

(2) The instructional design has progressed hand-in-hand wit. instructional practice. For example:

(a) Elementary school teachers participate in every stage of the design process in order to give practical experience from actual use of the new text

(b) Every teacher has been informed that his/her input can be extremely useful for the revision of the final version of the text. Their opinions can be brought out during the evaluation conference after each pilot study or through the questionnaires used during their training sessions.

(3) Every elementary school teacher receives several weeks of intensive training before the adoption of the new materials. After the adoption, the teacher receives training regularly regarding new teaching skills and methods, as well as the new content. In order for the teaching training institutes to incorporate the ideas of the new curriculum, the nine teacher training colleges around the country have been given instructions along with new materials and videotapes to help the professors familarize themselves

with the process and the new curriculum. Every college has 77 videotapes for science teacher education and 30 videotapes for mathematics teacher education.

(4) Instructional media have been developed. The development of audio-visual instruments goes through the following process: research, design, production and testing along with the teaching method, revision, and final product.

(5) The project has been piloted for many years.

(6) The choice of the representative schools for the first testing was carefully made.

(7) The choice of the schools for the second and third pilot studies and demonstration schools was carefully made. The schools are spread throughout Taiwan and over urban, rural, suburban, mountain, and coastal

districts. This diverse representation means that the materials developed have been tested and proven to be suitable for use in all parts of the country.

(8) The curriculum reform in the Republic of China is probably the most economical in the world. For the science and mathematics projects, the cost to produce the instructional aids, teacher's re-education, and the research and development was less than U.S. $5.00 per student.

Table 15 shows the number of teachers and classes during the curriculum reform.

Table 15

Number of Teachers and Classes During the Curriculum Reform

	Year of 1972	Year of 1983
Number of teachers	61,517	70,055
Number of schools	2,349	2,557
Number of classes	49,333	50,715
Number of students	2.4 million	2.2 million
Student/Teacher ratio	40 to 1	31 to 1

(Source: Tsui, G. (1983). Curriculum research development and implementation in elementary school science and mathematics in the Republic of China. Unpublished material.)

In-Service Program for Secondary School Teachers

Similiar to the In-Service Program for elementary school teachers, scheduled in-service training courses are offered during the summer semester for mathematics teachers through the In-Service Training Center at the Taiwan Normal University in Taipei, and also through the satellite centers at the teachers' colleges scattered around the island. Of course, teachers receive increment credits that adjust their salaries. The in-service training courses are free and teachers are provided with uniforms and a weekly allowance during regularly scheduled in-service courses.

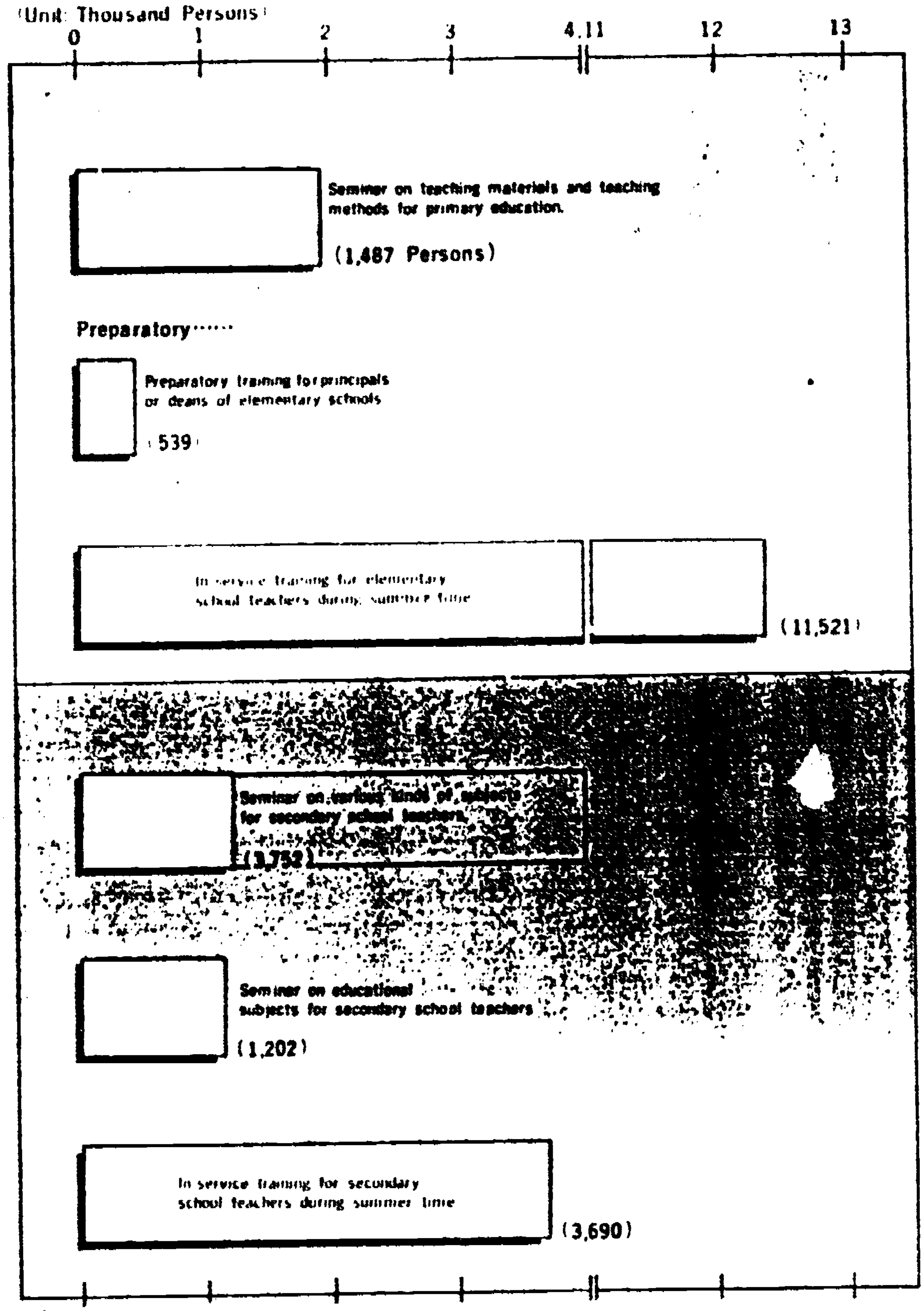
Besides the center at the National Taiwan Normal University, the other centers are located at National Tsinghua University, National Chengchi University, National Kaosiung Teachers' College, and National Educational College. Secondary school teachers are trained by a rotation system of two to seventeen weeks. The number of participants in each session varies according to the courses that are being taught. Emphasis is placed on teaching methods and teaching materials in order to improve efficiency of teaching.

Table 16 shows the number of secondary

and elementary school teachers having received in-service training during 1982-1983.

Table 16

NUMBER OF SECONDARY AND ELEMENTARY SCHOOL TEACHERS HAVING RECEIVED IN-SERVICE TRAINING SY 1982-83



(Source: Ministry of Education. (1983). Education in the Republic of China.)

In-Service Training in the U.S.A.

In-service training courses in the United States are usually provided by the local Board of Education or the nearby colleges. Some teachers attend college classes at night or in the summer. They receive staff development credits or advanced degrees.

Most of the courses provided for the teachers not only enrich their math knowledge and teaching instruction, but also give them new development in the area of science and technology. Of course, the teachers have to pay all the expenses of in-service training unless they receive a grant from the government or private sources.

U.S. educators (National Science Board Commission, 1983) recognize that integration of science and technology into the elementary and secondary curriculum will be essential for the present changing curriculum movement. At the present time, there are very little materials that can be used to address the desired objectives which are available to all teachers. Educational materials need to be carefully prepared by individuals who have the subject knowledge with diverse experiences and the ability to work with classroom teachers. The materials should be thoroughly tested before they are mass-marketed. The effective use of these teaching resources will require extensive training of the present teaching staff. A program was suggested by the National Science Board regarding staff development which would provide paid summer employment for junior and senior high school math teachers. This type of arrangement would enable teachers "to work directly with researchers and designers in engineering college and in industrial organizations" (National Science Board Commission, 1983). This cooperative arrangement would be a very effective in-service training for teachers in the United States.

Table 17 shows the type of in-service education training courses available to teachers in both countries.

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Table 17

Comparison of In-Service Training in U.S.A. & Taiwan, R.O.C.

U.S.A.

(1) In-service training provided by local college through individual needs. Participant pays for tuition.
(2) In-service training provided by local Board of Education through local schools. This is usually free.
(3) In-service training provided by professional organizations, clubs, etc. Participants attend short courses or mini-courses from one day to three weeks. There is usually a fee.

Taiwan, R.O.C.

In-service training for school teachers is provided by In-Service Educational Training Center. They provide scheduled training for teachers ranging from two months to six months. All participants receive an allowance, a uniform, and room and board for the entire training period. They attend class during the day and participate in various activities during the night. In-service training for secondary school teachers is provided at several centers in National Taiwan Normal University and some teachers' colleges in various counties. Normally, they have in-service training for subject content from twelve weeks to six months. During these times, participants have to stay in the dormitories. They dine together. They also wear uniforms. Every month, they receive an allowance for participating in in-service. The government pays for all travel expenses of the participants.

(Source: Data were collected by author during 1982-1983.)

Table 18 shows what United States and Taiwan teachers of mathematics would do to improve themselves.

Table 18

What United States and Taiwan Math Teachers Would Do to Improve Themselves

	Math Teachers	
	U.S.A.	Taiwan
Take an advanced course in mathematics	75%	20%
Do some research regarding teaching methods	56%	29%
Develop a new teaching method	31%	41%

(Source: Data were collected by author during 1982-1983.)

Future Teaching Profession

Changing the educational needs of today's school systems to meet the next decade's development is the most important step for us to face.

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Most of the curriculum models adopted in the past twenty years are being questioned (Adler, 1978). Professor Adler, in his introduction of PRIME-80 Proceedings (1978), emphasized that colleges have to meet entirely new challenges in education. He further stressed that the career motivations of students seem to be shifting. For example, in mathematical science, specialization has vastly increased and new disciplines are arising constantly. New areas of applications, partly in response to this new direction, will be developed, especially the interaction between mathematics and other sciences. He also recognized the fantastically rapid changes in computer technology that creates unexpected effects in college-level mathematics. The outline of the recommendations of the MAA is presented in Appendix A (PRIME-80, 1978).

The National Council of Teachers of Mathematics, the largest professional organization of math teachers in the U.S., published "An Agenda For Action". In this booklet, the NCTM listed eight recommendations which should be the focus of American mathematics education in the 1980's (See Appendix B).

How do teachers of mathematics see school mathematics in the world of rapid technological changes? Table 19 shows the teachers' opinions toward current issues in mathematics education in their countries.

Table 19

Teachers' Opinions Toward Current Issues in Mathematics Education

	U.S.A.	Taiwan
Students will need at least three years of mathematics	Yes-67% No -33%	Yes-85% No -15%
The curriculum will become more flexible with more options for students	Yes-50% No -50%	Yes-94% No - 6%
There will be a wider range of evaluation than just conventional testing	Yes-69% No -31%	Yes-94% No - 6%
Problem solving will be the focus of school mathematics in the 1980's	Yes-88% No -12%	Yes-85% No -15%

	U.S.A.	Taiwan
Calculators and computers will be available at all grade levels	Yes-75% No -25%	Yes-86% No -14%
In-service education will be given first priority in teacher-training programs	Yes-75% No -25%	Yes-91% No - 9%

(Source: Data were collected by author during 1982-1983.)

Table 20 shows the percentages of the most important math courses as teachers see them.

Table 20

Percentages of the Most Important Math Courses As Teachers See Them

	U.S.A.	Taiwan
Arithmetic	75%	70%
Plane Geometry	43.75%	46%
Analytic Geometry	25%	24%
Computer Science	62.50%	52%
Statistics	18.75%	16
Trigonometry	32.42%	34%
Calculus	43.75%	30%
Linear Algebra	18.75%	24%
Algebra	79%	80%

(Source: Data were collected by the author during 1982-1983.)

CHAPTER FIVE

Discussion

It is hoped that the survey presented in this paper will serve to make teachers aware of the fact that their colleagues in foreign countries are just as concerned as they are with modernizing of the mathematics curricula, improving teaching techniques, ard understanding the important issues of mathematics education. Even though there are differences in the cultural heritages, social systems, and local needs of both countries, mathematics education in these two countries is experiencing the biggest revolution in this century.

It is easy to see that our high-technology society will require an increasing number of math-oriented students. The curricula of the school systems in both countries will have to meet the challenge of providing sufficient training to our younger generations. Both countries are facing the same situations. They are experiencing a decline in the mathematics backgrounds of students, and many students are uninterested in math. Both countries are trying primitive experiments in computer-assisted learning. They are not providing enough money to compensate their teachers. Also, the school systems of both countries are facing financial crises.

In order to provide sufficient information for our mathematics colleagues in both countries, the following issues are discussed below: school systems of Taiwan, school systems of the United States, curricula, teaching method, and teacher training.

School Systems of Taiwan

The school system in the Republic of China is divided into three levels. The first level consists of nine years of free, compulsory education. The second level is secondary education. The third level is higher education.

Nine years of free education includes six years of elementary education, beginning at the age of six, and three years of junior high education. An elementary school and a junior high school (middle school) can be found in every administrative district.

The system of six years free and compulsory elementary education was extended in 1968 to include three years of junior high or middle school education. These nine years of education focus as much attention to the cultivation of morality as to knowledge. The goals of education, in fact, emphasize four basic requirements: morality, intelligence, physical fitness, and social adaptability. No entrance examinations are required for an elementary school graduate to enter a junior high school.

Secondary education includes the senior high school, the normal school and the vocational school. These schools require students to take entrance exams. Usually, the competition is fierce among students.

Teacher education is free in the Republic of China. It includes tuition, room and board, and incidentals. In the Republic of China, there are normal universities, two teachers' colleges, and nine junior teachers' colleges. These schools are established by the government. The junior teachers' colleges specialize in training teachers for elementary schools. Normal universities and teachers' colleges train teachers for secondary schools. These schools are included in the higher education system. The period of study is five years, with the fifth year being a period of internship teaching.

Table 21 gives an overview of the current school system of Taiwan, R.O.C.

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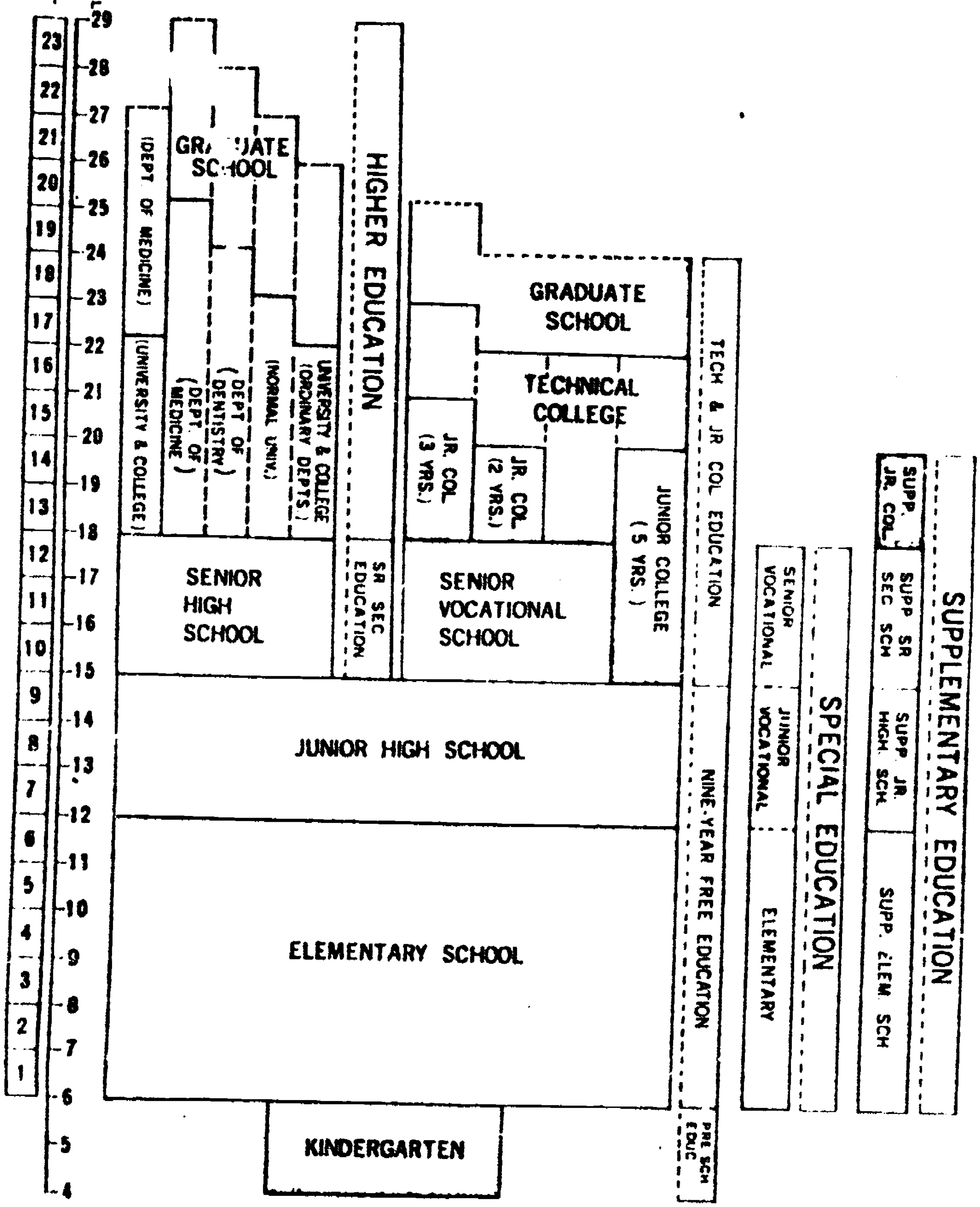
Table 21

THE CURRENT SCHOOL SYSTEM

of Taiwan, R.O.C.



School Systems of the United States

The school systems in the United States consist of four levels (as suggested by some educators): childhood education (traditional preschool and primary education), youth education (middle school, secondary school, and two-year junior college), higher education, and continuing education. Because of the differences among states, no single system exists. However, the most popular systems of basic American education involve the following types of systems:

(1) 6-3-3 systems (six years of elementary school, three years of middle school, and three years of senior high school)

(2) 6-6 systems (six years of elementary school and six years of secondary school)

(3) 6-2-4 systems (six years of elementary school, two years of middle school, and four years of senior high school)

(4) 8-4 systems (eight years of elementary school and four years of secondary school)

(5) 6-3-3-2 systems (six years of elementary school

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three years of middle school, three years of senior high school, and two years of junior college)

In most states, twelve years of education are free. In some states, such as California, students receive free education up to the 14th grade including the public community college.

The goals of education are different in every state. However, most secondary schools in America are comprehensive and prepare students for college or for vocational training.

There are no entrance exams to the elementary, middle, or secondary schools in the United States.

In the United States, teacher training is offered by most colleges and universities, both public and private. The requirements and curricula vary from state to state. The length of study varies for students training to be teachers in the U.S. It depends upon the college or university and upon the student. Usually, it takes four years of college education to become a teacher.

Table 22 gives an overview of the current school system in the United States.

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Table 22

The Current School System i. the United States

Entry Age					Grade Level
		Four Year			Doctorate
	Two-Year Junior & Community Colleges	Universities & Colleges	Technical & Vocational Schools		Masters
					Bachelor
18+					Associate
17	High School	Senior High School	Senior High School	Specialized High School	12
16					11
15					10
14		Junior High School			9
13	Traditional Elementary School		Middle School		8
12					7
11		Elementary School			6
10			Elementary & Primary School		5
9					4
8					3
7					2
6					1
5		Kindergarten			K
2-4		Nursery School			

From the descriptions of the school systems of both countries, we see differences in the following areas due to social and cultural factors, and to attitudes toward education: curricula, teaching methods, teacher training, and in-service education.

Curricula

In the United States, the lack of adequate achievement in the "Three R's" at all levels of education has created chaos within the educational system. Because of the variety of mathematics courses from which students may choose at the high school level, the mathematics achievement of the 13-year-olds ranked 11th among the twelve nations, the high school seniors placed last on the international achievement tests, and both 13-year-olds and high school seniors liked school and school learning less than the students of other countries (Coxford, 1971). Recently, a report entitled, A Nation At Risk: The Imperative for Educational Reform, was issued by the National Commission of Excellence in Education (1983). In this report,

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it was quoted that the international comparisons of student achievement, completed a decade ago, revealed that on 19 academic tests, American students were never first or second, and, in comparison with other industrial nations, were last seven times (The National Commission on Excellence in Education, 1983).

In the Republic of China, a new curriculum reform is underway for elementary and secondary school. The new curriculum will offer a greater variety of courses. Hopefully, the mathematics background of the high school graduate will be adequate should he/she plan to go to college.

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Teaching Method

The traditional lecture-demonstration method is the most common teaching method in each country. In the United States, new methods involving teaching techniques such as self-paced learning, audio-visual aided instruction, computer-assisted learning, and small-group methods are increasingly being used.

Because of the severe competitiveness of the entrance examinations of the senior high schools and colleges, the mathematics teachers in the Republic of China have no choice but to rapidly deliver lectures, show students how to take the tests, and give examinations. The teachers emphasize the test-taking technique instead of the content of the subject. Usually, they don't have any time at all to experiment with other instructional methods. However, they are currently trying to use computer-assisted learning in order to offer the students more chances to practice review tests before taking the actual entrance examinations for high schools or colleges.

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Teacher Training

The basic differences between teacher training in these two countries are:

(1) Teacher education in the Republic of China is the responsibility of the government. Students go to teachers' colleges or universities which are supported by the government. The students have more professional courses and subject area studies. The students can earn diplomas after they finish their coursework and do intern teaching satisfactorily for a year.

(2) In the United States, teacher training is provided by just about every public or private college and university. The contents of the courses are different from state to state and from school to school.

(3) In Taiwan, the elementary school teachers attend Teachers' Junior College after they have completed the 9th grade. They have to pass severely competitive entrance examinations in order to be chosen to receive five years of free teacher-training education. The Junior College requires all

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students to live on campus and follow the schedule of the study programs. Besides the educational courses and the regular subjects such as Chinese (Mandarin), social studies, natural science, civics and ethics, music, fine arts, mathematics, group activities, etc., the students are allowed to choose subjects of concentration for their major areas. They receive an associate degree upon their graduation.

(4) In the United States, students who want to be elementary or middle school teachers major in elementary education in college. They have to follow a sequence of coursework. The minimum level of mathematics they might take in their major concentration is one course of elementary school arithmetic and one course of teaching methods in mathematics (Chang, 1979).

(5) In Taiwan, teachers' college students receive full scholarships consisting of a monthly allowance, room and board, clothing, and transportation. They have a guarantee of employment after graduation.

(6) In the United States, students have to pay their own tuition. They have no guarantee of jobs after graduation.

CHAPTER SIX

Conclusions and Recommendations

The cause for the decline of achievement in the "Three R's" in recent years among high school graduates, especially in the United States, is undoubtedly the most controversial educational issue among parents, educators, and society in general. How to teach mathematics effectively to students who are having difficulty in learning, how to train our future teachers to utilize the full range of activities and materials available to them to deal with today's new curriculum, how to stimulate students' interests in learning mathematics, how to improve the teaching abilities of today's teachers, as well as, their knowledge of the subject matter are very important questions being asked within our educational communities.

Concern regarding the ill-prepared high school graduates in the United States has arisen among many people across the nation. They ask why our school systems are experiencing such difficulties in preparing students when they have modern equipment, up-to-date classrooms, advanced technology, and more professional personnel. Parents are also wondering about the qualifications of teachers in high schools. Is it because of the low-paying teaching profession that we don't have qualified teachers, or is it because of teacher-training institutions that have not tightened their standards in the respective subject areas, such as mathematics? Is it due to the advanced technological gimmicks of video games, television, and other electronic devices for entertainment, that students' behaviors in school and attitudes towards studying have changed? Are these kinds of activities at home competing with the school for the time needed to prepare the students educationally? Are the students' failures in school because of the parents' lack of guidance at home? These are the main questions facing the citizens of both countries.

The curricula of the elementary and the secondary schools should undergo changes to satisfy the needs of today's technological revolution. In the position paper on basic mathematical skills written by the United States National Council of Supervisors of Mathematics on January 7, 1977, the definition of basic skills was rewritten and the number of skills was expanded (NCSM, 1977). The Council said that basic skills must include more than computations because the present technological society requires use of such skills as estimating, problem solving, data interpretating, organizing, measuring, predicting, and applying mathematics to everyday situations. Furthermore, they emphasized that the explosive increase in the amount of quantitative data and the availability of computers and calculators demands a redefining of the priorities for basic mathematics skills. A similar position is also supported by MAA (1979) and NCTM (1980).

As technology changes rapidly during the coming years, the need for educational training will increase. The curricula of the school system will have to meet the challenge of providing adequate training to our younger generations. The new educational system for the next century will be emphasizing and requiring problem-solving ability, and more math-oriented skills. At the base of this new system will be the computer.

It is clear that the computer has changed our society, just as the Industrial Revolution changed it centuries ago. It is reasonable to suggest that a similar upheaval will occur in education. In particular, the microcomputer will challenge designers of school programs to take advantage of the simulation and graphics capacity and the "word processing" abilities of modern technology (Chang, 1983).

At the present, only primitive experiments in computer-assisted learning are available. However, these will expand rapidly during this decade to set the stage for computer-based learning. Just as books and printed materials are central to a modern educational system, so the education early in the next century probably will be based on the computer and other electronic-information devices (ICIUT, 1983).

Educating is a complex and delicate task, and its success is largely dependent upon the cooperation of all segments of society, not just the school, the teachers, and the parents. In order to provide the best education for our children, society, as a whole, must realize that the teaching profession is a job which demands sacrifice. Teachers provide not only knowledge of how to survive in today's world, but also education on how to become responsible citizens of the world.

The responsibilities of teachers are no less than those of physicians, lawyers, politicians, businesspersons, and the like, thus the compensation of the teaching profession should be comparative to and even higher than those professions. With the support of society and all segments of government, adequate compensation could be provided and, consequently, more well-qualified persons could be attracted to the teaching profession.

Since the educational systems will change, more funding should be available to modernize and upgrade equipment, improve the school environment, and make other necessary changes to satisfy the needs of the future. The educational enterprise should be the first priority and major concern of the governments.

The most important concern of education today, besides the school system, the curriculum, students' learning, and teachers' training, is the re-education of the current classroom teachers so that they may adapt to changes and acquire the necessary skills to teach. The amount of time spent on drill in arithmetic and algebra can be reduced drastically in order to provide more time for teachers to introduce new areas such as problem-solving, estimation, and finite mathematics including introductory graph theory, linear programming, elementary statistics, and computer programming. These should replace the classical topics which do not relate directly to the solution of real-world problems (Chang, 1983).

Learning centers, available to anyone, should be established in every community. In these centers, people can come to learn new skills, acquire new information, and get any other assistance they may need. Besides being a place for sharing information, exchanging new ideas, reviewing the past, and discussing changes of the future, the centers can also provide opportunities for promoting innovative and successful ideas and techniques, and cultivating principles on which effectiveness in basic skills is based.

The role of mathematics in future generations will increase the value and usefulness of the subject. Mathematical literacy will be required of every citizen in order to maintain a minimum standard of living. Computer-based learning will be realized early in the next century. Supersonic transportation will shorten the distance between countries, while space explorations will increase human knowledge regarding the mysteries of the universe. This will provice vast opportunities for young men and women to investigate and examine the natural phenomenona of space. With this in mind, we need to re-evaluate our present school systems, curricula, learning styles, functions of teachers, needs of learners and communities, and attitudes toward mathematics instruction.

At the present time, both countries are facing similar situations such as lack of qualified teachers of mathematics and computer science, the decline of the "Three R's" among high school graduates, the increasing number of high-risk students in the junior high schools, as well as, students' lack of interest in studying mathematics. The most critical issue is the growing amounts of ill-prepared students in both countries' school systems. The following questions are the major problems confronting these two countries:

--How do we upgrade the current educational system to meet the needs of the technological age?

--How do we train future teachers in the field of mathematics and computer science?

--How do we properly train students so that they will be able to apply knowledge learned in the classroom to the everyday situations of the technological age?

--How do we deduce the role of cultural and societal factors and their interaction with professional factors in determining the success of an educational, technological enterprise?

Cooperation between countries toward the solving of this complex educational problem should be more important than other issues of concern, such as economic issues, political issues, social issues, etc. These issues will become less important as they become linked to the huge educational enterprise. Without the cooperation of teachers and parents, our younger generations might have trouble coping with the technological advancements and the complexities of the twenty-first century.

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APPENDIX A

MAA RECOMMENDATIONS FROM PRIME-80

The recommendations of the conference fall naturally into five groups, as follows:

1. Recommendations directed toward educational goals defined in terms of needed mathematical skills.

   a. New efforts should be made to define, or redefine, the essential mathematical skills that are needed by every citizen.

   b. In order to advise high school students better about their study of mathematics, and to guide better the development of the mathematics curriculum, studies should be undertaken to determine the mathematical expectations of various industrial jobs and training programs that high school graduates may enter directly.

   c. The MAA and NCTM, in conjunction with other professional organizations, should continue and expand their efforts to publicize the mathematics needed for college, for later professional work, and for study in other fields. They should continue to encourage all high school students to take at least three years of high school mathematics.

   d. Every college graduate should have some minimal knowledge of the mathematical sciences.

   e. The MAA should undertake to reexamine and to publicize the training needed by elementary teachers of mathematics.

   f. The MAA should focus attention once again on the mathematics needed by prospective secondary school teachers of mathematics.

2. Recommendations directed to the establishment of college curricula to impart appropriate mathematical skills.

a. The MAA should undertake to describe and make recommendations on an alternative to the traditional algebra-calculus sequence as the starting point for college mathematics.

b. The MAA should support projects, along with NCTM and AMATYC, to develop materials that facilitate the teaching of applications, real problem solving and multidisciplinary model building.

c. The conference strongly recommends that instruction in the mathematical sciences maintain an appropriate balance between applications and fundamental mathematical principles.

d. The conference supports the mandate and initial groundwork of the CUPM Panel on a General Mathematical Sciences Program, and urges the completion of its work as quickly as possible.

e. University mathematics departments should offer a broad mathematical sciences Master of Science program.

3. Recommendations directed toward transition problems faced by students. Colleges are now admitting many students who have taken too few mathematics courses in high school or whose mathematical skills are inadequate for the normal beginning college courses.

   a. The MAA should study the problems faced by college mathematics departments in meeting the needs of entering students whose mathematical preparation and/or skills are inadequate for normal beginning courses.

   b. The MAA should study the special needs of "adult" students, i.e. those who return to college after a significant lapse in their formal education. The study should determine the differences between these students and those straight from high school, examine their impact upon education, and formulate recommendations

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about methods of instruction that would utilize the unique aspects of the "adult" learners.

c. Efforts should be made to improve communication between two-year and four-year colleges and to work toward better articulation of their programs.

4. Recommendations directed toward continuing education.

a. The continuing education needs of teachers of mathematics should be determined, and appropriate steps should be taken to assure that programs are available to fill these needs.

b. Efforts should be made to create and foster continuing education programs for two-year college mathematics faculty.

c. The practice of holding "short courses" at regional and national meetings of the MAA or at meetings of its Sections should be encouraged and supported. A significant number of such short courses should be appropriate for teachers in two-year colleges and those who teach the lower division courses in four-year colleges and universities.

d. The MAA should develop programs to assist college faculty who seek non-academic sabbaticals.

5. Recommendations directed toward the organization and responsibilities of the mathematics profession.

a. Efforts should be made to strengthen the relationships between mathematics education and industry.

b. Mathematicians should seek to preserve the unity of the mathematical sciences. To this end the MAA should develop a dialogue on issues of mutual interest with curriculum groups in the other mathematical sciences societies.

c. The mathematics profession should redouble its efforts to encourage women and minorities to study mathematics and to enter careers that make substantial use of mathematics.

d. The conference urges in the strongest terms that the mathematics profession define the goals of a public relations program, employ a public relations officer, and provide a central public relations agency.

(Source: The Mathematical Association of America. (1978). Prime-80: Proceedings of a conference on prospects in mathematics education in the 1980's. Washington, D.C.: Author.)

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APPENDIX B

AN AGENDA FOR ACTION

RECOMMENDATIONS FOR SCHOOL MATHEMATICS OF THE 1980'S

The National Council of Teachers of Mathematics recommends that--

1. problem solving be the focus of school mathematics in the 1980's;

2. basic skills in mathematics be defined to encompass more than computational facility;

3. mathematics programs take full advantage of the power of calculators and computers at all grade levels;

4. stringent standards of both effectiveness and efficiency be applied to the teaching of mathematics;

5. the success of mathematics programs and student learning be evaluated by a wider range of measures than conventional testing;

6. more mathematics study be required for all students and a flexible curriculum with a greater range of options be designed to accommodate the diverse needs of the student population;

7. mathematics teachers demand of themselves and their colleagues a high level of professionalism;

8. public support for mathematics instruction be raised to a level commensurate with the importance of mathematics understanding to individuals and society.

(Source: The National Council of Teachers of Mathematics, Inc. (1980). <u>An agenda for action: Recommendations for school mathematics of the 1980's</u>. Reston, Virginia: Author.)

APPENDIX C

GUIDELINES FOR THE PREPARATION OF TEACHERS OF MATHEMATICS

Academic and Professional Knowledge

A prospective teacher of mathematics at any level should know and understand mathematics substantially beyond that which he or she may be expected to teach. The teacher should be able to relate that mathematics to the world of the pupils, to the natural sciences, and to the social sciences. The teacher should be aware of the role of mathematics in our culture.

The teacher should also possess a knowledge of the philosophical, historical, psychological, and sociological aspects of education.

Mathematical content

Knowledge and Competency in Mathematics

Early childhood and primary grades

Teachers of early childhood and primary grades (ages four to eight) should be able--

1. to use and explain the base-ten numeration system;

2. to distinguish between rational (meaningful) counting and rote counting;

3. to perform the four basic operations with whole numbers and with positive rationals with appropriate speed and accuracy;

4. to explain, at appropriate levels, the usual algorithms for the four operations;

5. to use equality, greater-than, and less-than relations correctly with their symbols;

6. to relate the number line to whole numbers and positive rational numbers;

7. to describe and illustrate basic concepts of measuring such quantities as length, area,

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weight, volume, time, and temperature;

8. to illustrate concepts of two- and three-dimensional geometry from the real world of the child, to discuss the properties of simple geometric figures such as line, line segment, angle, triangle, quadrilateral, circle, perpendicular and parallel lines, pyramid, cube, and sphere, and to determine one-, two-, and three-dimensional measures of common figures;

9. to use a protractor, compass, and straightedge for drawing, constructing, and measuring;

10. to use the metric system and to estimate measurements in metric units;

11. to construct and interpret simple bar, picture, circle, and line graphs;

12. to use a calculator to help solve problems and to teach mathematical concepts;

13. to use all the preceding competencies (1-12) to construct, recognize, and solve problems;

14. to discuss on an elementary level the history, philosophy, nature, and cultural significance of mathematics, both generally and specifically.

Upper elementary grades

Teachers of upper elementary and middle school grades (ages eight to twelve)--

1. should have all the competencies listed in the preceding section on the early childhood and primary grades, for such competencies will be needed for remedial work as well as for the understanding of some more advanced topics;

2. should be able to name and write large and small numbers and to provide physical examples of approximations for such numbers;

3. should be able to recognize and construct reasonable, consistent, and logical proofs;

4. should be able to perform the four basic operations with positive and negative rational numbers using decimal notation and fractional notation and give a mathematical explanation at appropriate levels of the usual algorithms;

5. should be able to recognize new algorithms for the four basic operations;

6. should be able to solve practical problems in two- and three-dimensional geometry relating to congruence, transformations, parallel and perpendicular lines, similarity, symmetry, incidence, areas, volumes, circles, spheres, polygons, polyhedrons, and other geometric figures;

7. should be able to use probability and statistics to solve simple problems pertaining to measures of central tendency and to the dispersion, expectation, prediction, and reporting of data;

8. should be able to graph polynomial functions and relations and to make appropriate selection and use of such relations in the solution of problems;

9. should be able to write flow charts for simple mathematical problems and for other activities;

10. should be able to use quantitative skills to help recognize, create, and solve problems similar to those encountered by students at that level;

11. should be able to illustrate and explain the concepts involved in measurement.

Junior high school

Teachers of junior high school mathematics (ages twelve to fourteen)--

1. should have all the competencies listed in the preceding section on upper elementary grades (for remedial work as well as for an understanding of more advanced work);

2. should be able to use appropriate mathematical procedures to solve problems relating to the physical, biological, and social sciences and to relate these processes to junior high school mathematics;

3. should be able to illustrate and explain the differences and similarities between the rational and the real number systems at appropriate levels of sophistication;

4. should be able to use the methods of probability and statistics to solve reasonably difficulty problems of inference and hypothesis testing;

5. should be able to use the methods of linear algebra to solve problems relating to the physical, biological, and social sciences and to business;

6. should be able to relate the axioms, definitions, and theorems of abstract algebra to the number systems, algebra, and geometry found in secondary school mathematics curricula;

7. should be able to use the methods of number theory and algebra to discover or analyze unusual and standard algorithms and other interesting properties of the systems found in school mathematics;

8. should be able to write a computer program to solve problems of appropriate level and complexity;

9. should be able to understand the language and procedures of at least one quantitative science (physics, chemistry, economics, biometrics) sufficiently well to be able to select the appropriate mathematics needed to solve problems in that science in which the level of mathematics required is not

above that of elementary calculus.

10. should be acquainted with library resources that can be used to broaden the mathematical knowledge of pupils;

11. should be acquainted with the literature available to aid a teacher in organizing a mathematics club, books that are helpful for participants in a mathematics club, and types of activities that may make such a club successful.

Senior high school

Teachers of senior high school mathematics (ages fourteen to eighteen)--

1. should have all the competencies listed in the preceding section on junior high school (for remedial work as well as an understanding of more advanced work);

2. should be aware of various outside resources such as lectures, contests, local industries, and journals that might enrich the mathematical curriculum of high school students;

3. should have sufficient understanding of analysis, abstract algebra, linear algebra, geometries, topology, probability and statistics, logic and foundations of mathematics, and computer science to be able --

    a) to understand, recognize, and construct proofs in these branches of mathematics,

    b) to discuss with some degree of facility the structure of these branches of mathematics with some emphasis on the related axiom system and theorems and to relate these to elementary and secondary school mathematics,

    c) to relate the given branch of mathematics to other aspects of mathematics and to other disciplines;

4. should have sufficient depth of understanding of at least one quantitative science so as to be able to build mathematical models and to solve problems (with quantitative as well as nonquantitative solutions) in that science which requires mathematics substantially above the level of elementary calculus.

Ability and Desire to Grow

1. Teachers of mathematics should be able to recognize the mathematical aspects of situations thay have not studied previously. This requires a wide background in other disciplines so as to be able to relate mathematics to these disciplines.

2. Teachers of mathematics should be willing and able to formulate and solve, given a reasonable amount of time and effort, quantitative problems thay have not studied previously.

3. Teachers of mathematics should be willing and able to learn mathematics that they have not previously studied with the aid of appropriate books or other materials and through discussion with their peers.

4. Teachers of mathematics should be able to evaluate their knowledge of, and competency in, mathematics in light of curricular requirements of courses they teach and of recommendations of professional groups, and they should be able to determine what further study (formal or informal) they need to increase their competence.

5. Teachers of mathematics should have sufficiently positive attitudes and good academic backgrounds to be able to learn appropriate further mathematics and to relate the advanced information to increasing their effectiveness as teachers.

Contributions of humanistic and behavioral studies

Human development

Teachers of mathematics should understand human development and the nature of learning mathematics sufficiently well so that they are able--

1. to recognize how existing conditions are related to learning and how models for teaching and learning are related to these existing conditions, to understand such models, and to recognize under what conditions each is most effective;

2. to select and adapt strategies and materials that are consistent with professional knowledge about learning and are also appropriate for the special immediate situation (in relation to the children, the content, the teacher, the environment, etc.);

3. to evaluate conditions, strategies, and materials used to teach mathematics;

4. to recognize stages of cognitive, affective, and psychomotor development in children and individual differences between children as these differences pertain to the learning of mathematics;

5. to diagnose and prescribe remedies for common disabilities in the learning of mathematics and to know what tools and techniques are available to help with diagnosis and correction;

6. to identify the mathematically talented students and design learning activities to facilitate their mathematical growth;

7. to recognize developmental and behavioral problems that require special help the teacher cannot provide and to know what special help is available, how it can be obtained, and the teacher's role in referral cases;

8. to judge the significance of behavioral, educational, and mathematical studies for improving mathematics education;

9. to keep up to date on standard summaries of research in mathematics education and to be able to identify areas of research with their implications for the teacher's current teaching assignment or study;

10. to participate in curriculum development, textbook selection, evaluation, and professional group activities;

11. to use major theories of motivating children from different backgrounds to learn mathematics by showing its relevance to social situations, expressed personal needs, and children's future.

Cultural backgrounds

Teachers of mathematics should have sufficient knowledge of the variety of cultural backgrounds from which children in the schools originate in order to be sensitive to--

1. variables affecting the learning processes of children of different ages, races, ethnic backgrounds, languages, geographic origins, and living conditions;

2. positive and negative nonschool influences on the students' learning of mathematics.

History of education and mathematics

Teachers of mathematics should have sufficient knowledge of the history of education and mathematics and of the institutions in one's society to be able--

1. to relate educational ideas and experiments of the present to those of the past;

2. to be aware of decisions made at the local, state, and federal level that may influence teachers' capacities to teach mathematics well and to determine the nature of that influence;

3. to plan and carry out means of influencing decisions that may affect mathematics education;

4. to show how these decisions have affected both mathematics and the total of society in order to make certain that students see the cause-and-effect relationships between mathematics and society.

Philosophies of teaching

Teachers of mathematics should be able to formulate their own philosophies of teaching mathematics and should be able--

1. to relate their philosophy to philosophies held by well-known educators and mathematics educators of the past and present;

2. to draw inferences from their own philosophy that can be translated into specific learning and teaching activities in mathematics;

3. to evaluate results of practices inferred from their own philosophy and to establish systematic evaluation procedures for such evaluation and make appropriate adjustments;

4. to reevaluate and modify, if necessary, their philosophy in light of any new information or insight gained from any source.

Professional Competencies and Attitudes

Teachers should demonstrate positive attitudes toward mathematics, children, and teaching. They should have a realistic concept of their own personal characteristics and be able to instill in others a realistic concept of themselves through their concern for them. They should demonstrate, through extensive work with children, an ability to encourage two-way communication with them concerning mathematics and related areas.

Teachers should also demonstrate the ability to relate well to children of different interests and backgrounds. They should recognize individual differences and be able to prescribe appropriate activities to build on these differences.

Teachers should use their academic and professional knowledge to improve their teaching. They should demonstrate the ability and desire to evaluate their own professional competencies. They should grow in their knowledge and teaching competencies as well as in their concern for others.

Teaching and learning theory with laboratory and clinical experiences

The prospective teacher of mathematics should study the theories of teaching and learning concurrently with laboratory and clinical experiences, direct and simulated, so as to be able to relate theory and practice. This combined study and experience should begin as early as practicable (at least by the sophomore year) in the preparation of the teacher and continue throughout his or her career. This study and activity should integrate what the prospective teacher has learned about the mathematical, humanistic, and behavioral sciences.

The practicum or student-teaching experience should be a natural extension of earlier laboratory and clinical experiences. These experiences should be accompanied by continued study of all aspects of teaching mathematics. The prospective teacher should gradually take on the various responsibilities of the cooperating master teacher.

The total range of all these field experiences should provide the prospective teacher with a wide variety of school experiences, such as inner-city, suburban, and rural schools as well as open ahd highly structures schools.

Prospective teachers should, with a decreasing amount of supervision, be able--

1. to discuss and evaluate the standard mathematics curricula and new curricular developments both for grade levels in which they may teach and for several grade levels earlier and later than

those in which they are certified to teach;

2. to participate in curricular development and selection of materials for instruction;

3. to state long-range goals and specific objectives for teaching situations;

4. to consider and evaluate alternative means of achieving these goals and objectives;

5. to plan a program to achieve the desired objectives for children of different abilities and backgrounds. Such planning should take into account both mathematical and pedagogical considerations and the interactions between them;

6. to implement the program successfully, making use of their mathematical, professional, and personal competencies so that desired results are realized;

7. to evaluate the progress of individual pupils and prescribe appropriate remedial and enrichment work for them in light of this evaluation;

8. to use various techniques to evaluate and improve their own teaching methods;

9. to develop measurement devices to supplement standard instruments and to measure those characteristics unique to particular programs;

10. to perform some simple educational experimentation designed to develop new procedures as well as evaluate the effectiveness of other people's recommendations for a particular situation;

11. to evaluate the entire program and form goals as a result of the evaluation procedures.

The continuing education of the teacher

A continual reevaluation by teachers--

using appropriate instruments--of their own philosophy and competencies should be made in order--

1. to relate effectively to their pupils and enhance their learning;

2. to be aware of recent developments in behavioral studies and relate them to their own teaching situations;

3. to increase their understanding of the mathematics that they are expected to teach and to be able to discuss its relation to society, the sciences, and the rest of mathematics at appropriate levels for students and parents;

4. to diagnose the variations in the learning abilities of each of their students and then prescribe for each student appropriate learning materials, laboratory experiences, sources of information, sources of supporting help, and processes to be used to meet the student's needs in each section of mathematics;

5. to increase their understanding of the role, responsibilities, and services of other educational personnel, such as guidance counselors, department chairmen, supervisors, coordinators, and principals, as they relate to the student in the mathematics class and of the function of the mathematics teacher as a part of the total educational team, and to be aware of the potential pitfalls of differentiated staffing, team teaching, and other administrative techniques for grouping children for the improvement of instruction.

Programs

Teachers should plan and implement programs to strengthen their competencies. Such programs might include--

1. continued study in formal university course work in appropriate areas;

2. participation in informal study either in cooperation with colleagues or individually;

3. membership in appropriate professional associations (e.g., NCTM, MAA, AAAS, local and state mathematics education groups), including participation in their meetings and they study of their published materials;

4. visits with other teachers, usually of recognized excellence, and studying their methods with a view to evaluation and possible modification of their own;

5. carrying out of, or participation in, research projects to develop and evaluate new methods and programs;

6. dissemination through speeches or articles of those procedures they find promising, of problems they believe need solutions, or of issues they believe need resolution.

(Source: The National Council of Teachers of Mathematics, Inc. (1979). Guidelines for the preparation of teachers of mathematics. Reston, Virginia: Author.)

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APPENDIX D

NATIONAL SCIENCE BOARD COMMISSION PROPOSALS

The National Science Board Commission has proposed a plan for making U.S. precollege education in mathematics, science, and technology the world's finest by 1995. The recommendations of the Commission include:

1. Retraining and upgrading of the 1.16 million elementary and secondary school teachers who presently are less than fully qualified to teach these subjects.

2. Rigorous standards for certifying mathematics and science teachers, together with improved training, recognition, and compensation.

3. Establishment of 1000 elementary and 1000 secondary exemplary schools and programs throughout the nation to serve as "landmarks of excellence".

4. Formulation of a set of "new basics" to establish a new standard of scientific and technological literacy and a more coherent pattern of K-12 mathematics and science education.

5. Substantially increased time devoted to these academic subjects, through increases in the school day, week, or year, as well as through increased discipline in the classrooms.

6. Increased time for mathematics and science: 60 minutes per day for mathematics, 30 minutes per day for science; a full year of mathematics and science in grades 7 and 8.

7. Increased use of computers and other modern educational technologies for student instruction, teacher training, and classroom management.

8. Increased requirements for high school graduation: 3 years of high school mathematics, including 1 year of algebra and 3 years of science and technology, including one semester of computer science.

9. Increased requirements for college admission: 4 years of high school science, including physics, chemistry and 1 year of computer science, and 4 years of mathematics, including a second year of algebra and coursework covering probability and statistics.

(Source: NSB Commission proposes plan to make U.S. precollege math and science education finest in world by 1995. Focus: The Newletter of the Mathematical Association of America, Nov-Dec 1983, pp. 1-2.)

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APPENDIX E

SURVEY OF MATH PROGRAM

Sponsored by PACIFIC CULTURAL FOUNDATION

I. General Information

A. Classification of School

1) Location: (check one)
Metropolitan area ____
Rural area ____
City ____

2) Type of School (check one)
Public supported ____
Private ____

B. Level of School: (check one)
1) Elementary ____
2) Jr. High ____
3) High ____
4) Vocational ____
5) College ____
6) Other (specify) ____

C. Population of Student Body:
(estimate is sufficient) ______________(number)

D. Population of Faculty
1) Total number of teaching faculty ____________ (number)
2) Total number of teaching faculty in Math ____________ (number)

E. Qualifications of faculty teaching Math (estimate is sufficient)
1) Number of faculty with BA in Math or Math Ed. ________
2) Number of faculty with BA minor in Math ________
3) Number of faculty with Masters in Math or Math Ed. ________
4) Number of faculty with Masters minor in Math ________
5) Number of faculty with Doctorate in Math or Math Ed. ________
6) Number of facutly with other degree ________

F. Math Learning Center
1) Yes ____ (If yes, please answer G & H)
2) No ____ (If no, please answer I)

G. Type of Learning Center
1) Combination with English, or other subjects _____
2) Science and Math only ____
3) A part of Library _____

H. Staff of Learning Center (you may check more than one)
1) Tutor _____
2) Counselor _____
3) A. V. Coordinator _____
4) Student Assistant _____
5) ________________________
6) ________________________

I. Does your school have plans to establish a Math Learning Center
1) Yes ____
2) No ____

J. Does your school have a Computer Center?
1) Yes ____
2) No ____
(If yes, please answer K, L, & M)

K. How many terminals are in your Computer Center? _______

L. Do you have access to the computer?
   1) Yes ____ 2) No ____

M. Does your school offer computer courses to your students?
   1) Yes ____ 2) No ____
   (If yes, please answer N)

N. Are the computer courses offered by the Math Dept.?
   1) Yes ____ 2) No ____
   (If no, please indicate which dept. ____________________)

O. Number of students taking computer courses ________
   (estimate is sufficient)

P. Average Math class enrollment ______________ (number)

II. Curricula

A. Please indicate the names of courses offered in your Math Department
   1) Advanced level:

   ______________________ ______________________

   ______________________ ______________________

   ______________________ ______________________

   ______________________ ______________________

   2) Intermediate level:

   ______________________ ______________________

   ______________________ ______________________

   ______________________ ______________________

   ______________________ ______________________

   3) Beginning level:

   ______________________ ______________________

   ______________________ ______________________

   ______________________ ______________________

   ______________________ ______________________

   ______________________ ______________________

   ______________________ ______________________

4) Remedial Level:

B. Graduation Requirements: (If Senior high, please answer 1 & 2)

1) For college-bound students(If the course is required, place "R" following the subject)

Suggest electives

2) For non-college-bound students (If the course is required, place "R" following the subject)

Suggest electives

3) For Junior High students (If the course is required, place "R" following the subject)

______________________ ______________________

______________________ ______________________

4) For elementary school students (If the course is required, place "R" following the subject)

______________________ ______________________

______________________ ______________________

______________________ ______________________

______________________ ______________________

5) Others (please specify)

______________________ ______________________

III. Instruction

A. How many classes do you teach? ______________

B. Are they in different subjects? Yes ____ No _____
If yes, please give the courses you are currently teaching in your school.

______________________ ______________________

______________________ ______________________

______________________ ______________________

C. What time do you have to report to school?

1) 7:00 a.m. _____
2) 7:30 a.m. _____
3) 8:00 a.m. _____
4) 8:30 a.m. _____
5) 9:00 a.m. _____
6) 9:30 a.m. _____
7) Other _____

D. How long do you have to stay in school?

1) 6 hours _____
2) 7 hours _____
3) 8 hours _____
4) Other _____

E. What kind of instructional methods do you use?
1) Traditional lecture demonstration _____
2) Individualized instruction _____
3) Small group method _____
4) Student-centered discussion method _____
5) Other (please specify) ______________________

____

F F. Do you use audio-visual equipment during your presentation?
1) Yes ____ 2) No ____

G. Have you employed "self-paced" type instruction to your Math student? 1) Yes ____ 2) No ____

H. Have you ever used a Math film in your class?
1) Yes ____ 2) No ____

I. If Yes, how many times have you shown Math movies to your class? ____________

J. What kind of Math movies do your students enjoy seeing? List the appropriate title of the movies

____________ ____________
____________ ____________
____________ ____________

IV. Teacher

A. What kind of Mathematics courses did you have in college?

____________ ____________

____________ ____________

____________ ____________

____________ ____________

B. Do you think your training in Mathematics is sufficient to handle the subjects you teach in school?
1) Yes ____ 2) No ____(If No, answer C)

C. Do you plan to take more Mathematics courses for improvement?
1) Yes ____ (Answer D, E & F) 2) No ____ (Answer G)

D. How will you take your Math courses?
1) Near -by college ____
2) Your school system's Learning Center ____
3) College course offered in your school ____
4) Other (please indicate) ____________
____

E. What type of Mathematics courses do you like to take? (You may check more than one)
1) A major area subject - content oriented course ____
2) A teaching method course ____
3) New subject, such as Computer Science course ____
4) Other refreshment course (please specify) ____________
____

F. Do you plan to pursue a higher degree?
   1) Yes _____ 2) No _____

G. If you do not plan to take additional math courses, how do you improve your skills?
   1) Self-study _____
   2) Other (please specify) ______________________________

H. Does your school system require a new teaching faculty member to complete staff developmental credit course?
   1) Yes _____ 2) No _____
   (If yes, please answer I)

I. How often are these developmental credit courses offered? (you may check more than one)
   1) Once a year for new teachers _____
   2) Once every semester for new teachers _____
   3) Other (please specify) ______________________________

J. If your school has a tenure system, how long is your successful performance required before you are granted tenure?
   1) Two years _____ 2) Three years _____
   3) Four years _____ 4) Other (specify number of years)_____

V. Classroom Management

A. Besides your regular teaching duties, what other kinds of administrative duties do you perform in your school? (check all that apply)
   1) Home room teacher _____
   2) Daily attendance record _______
   3) Midterm or quarterly report card_____ (If you are a homeroom teacher)
   4) Lunch room duty _____
   5) Study Hall duty _____
   6) Hall duty _____
   7) Distribute & collect textbooks _____
   8) Student club advisor _____
   9) ____

   ____

B. Do you have any discipline problems in your classes?
   1) Yes _____ 2) No _____
   (If yes, please answer C)

C. What do you do to cope with classroom behavior problems? (check all that apply)
   1) Understand why a student wants to disrupt the class _____
   2) Set an example of concern, courtesy, industry and fairness _____
   3) Give students detention slips _____

4) Send students to see principal or assistant principal _____
5) Other (specify) ____
____

D. How do you avoid trouble in class? (check all that apply)
1) Have lessons well prepared _____
2) Involve students in all learning activities _____
3) Let students know their responsibilities _____
4) ____
5) ____
6) ____
7) ____
8) ____

VI. Evaluation of Achievement

A. What is the purpose of evaluation?
1) Measure a student's improvement _____
2) Reinforce a student's learning _____
3) Locate a student's weakness _____
4) ____
5) ____
6) ____
7) ____
8) ____

B. How often do you give tests?
1) Once a week _____ 2) Twice a week _____
3) Daily _____ 4) Other (specify) _____________
____

C. Do you allow students to take make-up examinations?
1) Yes _____ (with excuse)
2) Yes _____ (without any excuse)
3) No _____

D. If yes, do you also allow your students to have repeatable tests?
1) Yes _____ 2) No _____

E. If yes, do you set a limit on the number of times students can take the retests?
1) Yes _____ How many _____
2) No _____

VII. Faculty Evaluation

A. Does your school have a faculty evaluation policy?
1) Yes _____ (if yes, answer B)
2) No _____ (if no answer D)

B. What kind of faculty evaluation does your school employ? (check all that apply)
1) By your supervisor (or principal) _____
2) By your colleagues _____ (peer evaluation)
3) By your students _____
4) By various criteria _____
(if you check this item, please answer C)
5) Other ____

C. What kind of criteria? (you may check more than one)
   1) Number of years of teaching ______
   2) Number of developmental courses, or advanced courses, you have had ______
   3) ______
   4) ______

D. If "no", then how do you receive evaluation? (please explain)

______

______

______

______

VIII. Parent-Teacher Association (PTA)

A. Does your school have a PTA?
   1) Yes ______ 2) No ______

B. If yes, how often does the PTA meet?
   1) Once a semester (quarter) ______
   2) Once a month ______
   3) No regular meeting, might be once a year ______
   4) ______
   5) ______

C. Besides PTA meetings, do you contact the parents regularly informing them of their child's progress?
   1) Yes ______ 2) No ______

IX. Remediation

A. How do you identify the remedial students in your class?
   1) Test score ______
   2) ______
   3) ______

B. How do you help your remedial students? (check all that apply)
   1) Extra help in class ______
   2) Extra help after class or school ______
   3) Other (specify) ______

C. Do you receive any compensation for your extra help?
   1) Yes ______ 2) No ______

D. If the average of your class is poor, will you give extra helpsessions to the whole class?
   1) Yes ______ (if yes, please answer E)
   2) No ______

E. Is this required by the school or are you just volunteering?
   1) Yes, it is required by school, I am not volunteering ____
   2) Yes, it is required by school, and I am volunteering ____
   3) No, it is not required by school, and I am volunteering ____
   4) Other (specify) ____________________

X. Faculty Development
   A. If you had a chance to improve yourself, what would you do? (check all that apply)
      1) Take an advanced math course ____
      2) Do content research, such as solve problems ____
      3) Develop a new teaching method ____
      4) Do some research regarding teaching methods ____
      5) ____________________
      6) ____________________
      7) ____________________

   B. If you were given an opportunity to do something regarding current issues in education, what would you like to do? (check or complete as many items as necessary)
      1) To abolish the one-time entrance examination ____
      2) Create a more flexible examination ____
      3) ____________________
      4) ____________________
      5) ____________________
      6) ____________________

   C. Do you participate in any professional association meetings (or teaching method seminars) (if yes, please answer D)
      1) Yes ____ 2) No ____

   D. How many times do you attend these kind of meetings?
      1) Once a year ____
      2) Once a semester ____
      3) Depends on the opportunity ____
      4) Other ____________________

   E. Are you required to participate in in-service training programs by the school system?
      1) Yes ____ 2) No ____

   F. If yes, how many in-service training classes do you have to attend each year?
      1) One course ____
      2) Two courses ____
      3) Three courses ____
      4) ____________________

XI. Our future teaching profession
   A. How do you rate yourself as a teacher?
      1) excellent ____ 2) Very good ____
      3) good ____ 4) fair ____
      5) poor ____

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B. Do you agree that the students in grades 9-12 need more than one year of mathematics?
1) Yes _____ (if yes, please answer C)
2) No _____

C. Do you agree that at least three years of mathematics should be required in grades 9 - 12?
1) Yes _____ 2) No _____

D. Do you agree that the curriculum should become more flexible, permitting a greater number of options for a diversified student population?
1) Yes _____ 2) No _____

E. Do you agree that the success of mathematics programs and student learning should be evaluated by a wider range of measures than conventional testing?
1) Yes _____ 2) No _____

F. Do you agree that problem solving should be the focus of school mathematics in the 1980's?
1) Yes _____ 2) No _____

G. Do you agree that mathematics programs should take full advantage of the power of calculators and computers at all grade levels?
1) Yes _____ 2) No _____

H. Do you agree that in-service education for teachers should be given first priority in teacher training programs?
1) Yes _____ 2) No _____

I. How do you rate your high school or junior high school mathematics courses?
Use 1 as the most important subject
Use 2 as an important subject
Use 3 as a less important subject
Use 4 as the least important subject
1) Arithmetic _____ (give No. 1-4 please)
2) Algebra _____
3) Plane Geometry _____
4) Analytic Geometry _____
5) Computer Science _____
6) Statistics _____
7) Calculus _____
8) Linear Algebra _____
9) Trigonometry _____
10) Other (please specify) _____

J. How do you suggest that good teachers be discouraged from the teaching profession?
1) _____
2) _____
3) _____
4) _____
5) _____

K. What recommendations do you have for our future generations regarding mathematics?

1) ______________________________

2) ______________________________

3) ______________________________

4) ______________________________

5) ______________________________

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Thanks very much for your patience and generosity in completing this questionnaire. This survey is a part of a project supported by a grant from the Pacific Cultural Foundation. All of the questions for this survey were written by the investigator.

Respectfully yours,

Dr. Ping-Tung Chang,
Investigator

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FOOTNOTES

(1) A portion of this paper was presented at the 63rd Annual Meeting of the Mathematical Association of America, Southeastern Section at Tennessee Technological University, Cooksville, Tennessee from April 6-7, 1984, under the same title.

(2) This paper was presented to the Fifth International Congress on Mathematical Education in Adelaide, South Australia from August 24-30, 1984, under the same title.

(3) A portion of this paper was presented to the Fifth International Congress on Mathematical Education in Adelaide, South Australia on August 26, 1984 in the Theme Group--The Professional Life of Teachers, under the title, "Mathematics In-Service Program in the Province of Taiwan, Republic of China--Its Development, Implementation, and Evaluation".

(4) A portion of this paper was presented to the Fifth International Congress on Mathematical Education in Adelaide, South Australia on August 25, 1984 at the first session of Section 1 of A2 Elementary School (Ages 7-12) Action Group, under the title, "An Overview of Basic Facts, Computation with Natural Numbers and Estimation in the Elementary School of Taiwan, Republic of China".