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ABSTRACT

The Mathematics Study Bulletin series of the International Association for the Evaluation of Educational Achievement (IEA) is intended to serve a number of purposes: (1) to consolidate the decisions of the International Mathematics Committee; (2) to provide a historical record of the development of the Project; and (3) to provide working instructions for National Centers and National Mathematics Committee members. This bulletin elaborates upon the design for the Study, provides a detailed timetable, and summarizes sampling and instrument specifications. It is intended that this document contain sufficient information for National Centers to prepare proposals and proceed with other arrangements preparatory to participation in the Study. (MP)

INTERNATIONAL ASSOCIATION for the
EVALUATION of EDUCATIONAL ACHIEVEMENT

SECOND
Study of
MATHEMATICS

Bulletin No. 3

December 1978

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Addenda for Second Study of Mathematics, Bulletin No. 3

Page 59: Israel

Dr. Perele Nasker to read Dr. Pearla Nesher

Page 60: Netherlands

T. Plomp to read Dr. T. Plomp

Page 65: Add to list of consultants for "Items and Pilot Testing" James Fernandez, John Del Grande, Lawrence Myerson, Terence Seethoff

December 1978

The IEA International Mathematics Coordinating Unit is located in the Curriculum Development Division of the Department of Education, Wellington, New Zealand. Editorial work on this bulletin was prepared at the University of Illinois, Urbana, Illinois, and at Research for Better Schools, Inc., Philadelphia, Pennsylvania. Editorial and publication phases of production were prepared at Research for Better Schools by Ann Graeber and Richard M. Weisman.

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SECOND STUDY OF MATHEMATICS: BULLETIN NO. 3

The Mathematics Study Bulletin series of the International Association for the Evaluation of Education Achievement (IEA) is intended to serve a number of purposes:

1. To consolidate the decisions of the International Mathematics Committee.
2. To provide a historical record of the development of the project.
3. To provide working instructions for National Centers and National Mathematics Committee members.

Although the bulletins are written primarily for use within the framework of IEA countries and committees, they may at times be found useful for general informational purposes.

Two previous Mathematics Study bulletins have already been published. Bulletin No. 1, published in October 1976, described the background and evolution of the Second IEA Mathematics Study, the issues to be addressed, and the procedures proposed to address those issues, and outlined a tentative timetable for the Study.

Bulletin No. 2, published in September 1977, reported on developments concerning the Study, including funding and organizational details, discussed activities of the International Mathematics Committee, provided an international grid summarizing initial responses from countries about their mathematics curricula, and presented an updated timetable for the Project.

This bulletin elaborates upon the design for the Study, provides a detailed timetable, and summarizes sampling and instrument specifications. It is intended that this document contain sufficient information for National Centers to prepare proposals and proceed with other arrangements preparatory to participation in the Study.

I. IEA COUNCIL MEETING

The 19th Session of the IEA Council was convened in Tokyo, Japan, January 23-27, 1978, under the auspices of the Japanese National Institute for Educational Research. This meeting provided the first opportunity for members of the International Mathematics Committee to interact personally with representatives from countries planning to participate in the Study. The International Mathematics Committee expresses its gratitude to Professor Masunori Hiratsuka, Director General of the National Institute for Educational Research, and to the staff of the Institute for contributing to the costs of bringing the International Mathematics Committee to this important meeting, and for their hospitality during the Committee's stay in Tokyo.

II. FORMATION OF MATHEMATICS PROJECT COUNCIL

On January 27, 1978, immediately subsequent to the IEA Council Meeting in Tokyo, an organizational meeting of the Mathematics Project Council was held, at which time Mr. Roy W. Phillipps was elected Chairman of the Project Council. The Mathematics Project Council consists of representatives of each institution participating in the Second Mathematics Study. A list of current members (one from each country) is found in Appendix B. Although there is some uncertainty as to the exact number of countries that will actually take part in the Study, approximately twenty are in some stage of planning for participation.

III. LATIN AMERICAN SEMINAR

In May 1978, the government of Venezuela, through FONINVES, a foundation devoted to promoting scientific and technical education, and CENAMEC, the Venezuelan National Center for the Improvement of Science Teaching, supported a conference attended by representatives of nine Latin American countries seeking information about the Study. The conference was endorsed by CAIEM, the Inter-American Committee on Mathematics Education in Latin America, whose Executive Committee—Professor Luis A. Santalo (Argentina), Professor Ubiratan D'Ambrosio (Brazil), and Dr. Saolo Rada (Venezuela)—attended and took active part in the deliberations of the meeting.

A great deal of enthusiasm for the Mathematics Study was expressed by those attending. Dr. Enrique Góngora, Vice Rector of Universidad Estadel a Distancia in San José, Costa Rica, offered the services of his institution as a clearinghouse and translation center (from English into Spanish) for documents related to the Study. Limited support for a follow-up meeting of the Caracas Seminar has been offered to the International Mathematics Committee by the Organization of American States. This meeting, which will provide further training in various preparatory aspects of the Study, will be held at Campinas, Brazil, in mid-February 1979, in conjunction with the Fifth Inter-American Conference on Mathematics Education. Appendix E provides further details on the Caracas meeting.

The International Mathematics Committee and the IEA express their appreciation to Dr. Vladimir Yackovlev, Executive Secretary of FONINVES, and to Estrella Benaim de Bello, Director of CENAMEC, for their support and kind hospitality while the Committee was in Caracas, and look forward to concrete steps toward Latin American participation in the Study.

IV. INTERNATIONAL CURRICULUM SYMPOSIUM

As is discussed in detail in pages 13-15, the first phase of the Mathematics Study consists of an international curriculum analysis. This analysis is now under way. Many countries have already provided, through questionnaires in Working Papers I and VI, initial data to be utilized in the analysis. These responses, together with information soon to be sought about other aspects of the curriculum, will serve as a basis for discussion and deliberation at an international symposium on the mathematics curriculum to be held, it is hoped, at the Institute for Mathematical Didactics, Bielefeld University, Federal Republic of Germany, in mid-1979. Professor Hans G. Steiner has graciously agreed to coordinate the meeting. Funding for the meeting (travel and per diem expenses) appears likely to be forthcoming from within the Federal Republic of Germany.

V. MEETINGS OF THE INTERNATIONAL MATHEMATICS COMMITTEE (IMC)

The IMC has met on four occasions since the publication of Bulletin 2 in September 1977. Only two sessions, however, were dedicated wholly to work of the IMC, those at Kentucky and Illinois. On all but one of these occasions, the full committee (for names, see Appendix C) has been in attendance. Unfortunately, due to scheduling difficulties, Dr. Sven Hilding (Sweden) was unable to attend the Caracas meeting.

Dr. Hans Steiner resigned from the committee in late 1977, but continues to work with IMC on curriculum analysis.

November 14-18, 1977, Lexington, Kentucky, USA

This meeting, hosted by the University of Kentucky, was devoted to the following tasks:

1. Editing draft collections of cognitive items for international pilot testing.
2. Reviewing results of attitude trials in United States and preparing scales for international pilot testing.
3. Presenting a symposium on minimal mathematical competencies for the University of Kentucky community.
4. Planning for working sessions at the Tokyo meeting in January 1978.

January 23-27, 1978, Tokyo, Japan

The IMC met only briefly as a committee at the Tokyo meeting. However, it met for five days with the entire assemblage, or with small working groups, on various aspects of the Study. Important outcomes of the Tokyo meeting included:

1. Overview of the purposes and design of the Study.
2. Revision of the timetable for the Study as reflected in Appendix A of this document.
3. Detailed consideration of cognitive instrument development.
4. Critique of the classroom processes instrument.
5. Outline of sampling specifications.
6. Initial consideration of data processing matters, including a discussion of the location of the international data processing unit.

May 8-11, 1978, Caracas, Venezuela

Although the days were committed to the seminar (see III above), three evenings were devoted to other IMC matters, including:

1. Adaptation of the time schedule for the Study in light of decisions made at Tokyo.
2. Development of specifications for the cognitive instruments.
3. Review of the contents of the proposal for international funding (delivered in draft form in late May 1978 to all members of the Mathematics Study Council).
4. Outline of plans for the international Curriculum Symposium (see IV above).

August 21-25, 1978, Urbana, Illinois, USA

Key outcomes of this meeting included the following:

1. Modification of international grids on the basis of additional responses received from national centers. These revised grids appear on pages 4-7 below.
2. Planning for the final round of pilot testing of cognitive and affective items for both populations. This is to be held in October-November 1978.
3. Review of work on classroom processes done by groups at the University of Georgia (USA) and in New Zealand. A draft was sent to countries for comment in November 1978.
4. Discussion of plans for the International Curriculum Symposium scheduled for Bielefeld, Federal Republic of Germany, in August 1979.
5. Planning for the conference on methodological aspects of the Study, scheduled for February 1979 at Michigan State University.

TABLE 1

Population A: Importance For Instrument Construction Of Content Topics And Behavioral Categories

Content Topics	Computation[a]	Comprehension[a]	Application[a]	Analysis[a]
000 Arithmetic				
001 Natural numbers and whole numbers	V	V	V	I
002 Common fractions	V	V	I	I
003 Decimal fractions	V	V	V	I
004 Ratio, proportion, percentage	V	V	I	I
005 Number theory	I	I	—	—
006 Powers and exponents	I	I	—	—
007 Other numeration systems	—	—	—	—
008 Square roots	I	I	—	—
009 Dimensional analysis	I	I	—	—
100 Algebra				
101 Integers	V	V	I	I
102 Rationals	I	I	I	I
103 Integer exponents	I_s	—	—	—
104 Formulas and algebraic expressions	I	I	I	I
105 Polynomials and rational expressions	I	I_s	—	—
106 Equations and inequations (linear only)	V	I	I	I_s
107 Relations and functions	I	I	I	—
108 Systems of linear equations	—	—	—	—
109 Finite systems	—	—	—	—
110 Finite sets	I	I	I	—
111 Flowcharts and programming	—	—	—	—
112 Real numbers	—	—	—	—

[a] Behavioral Categories. The following rating scale has been used: V = very important; I = important; I_s = important for some countries. A dash (—) indicates that the topic was not considered important enough to warrant trial items being found or constructed.

TABLE 1 (Continued)

Content Topics	Computation	Comprehension	Application	Analysis
200 Geometry				
201 Classification of plane figures	I	V	I	I_s
202 Properties of plane figures	I	V	I	I
203 Congruence of plane figures	I	I	I	I_s
204 Similarity of plane figures	I	I	I	I_s
205 Geometric constructions	I_s	I_s	I_s	—
206 Pythagorean triangles	I_s	I_s	I_s	—
207 Coordinates	I	I	I	I_s
208 Simple deductions	I_s	I	I	I
209 Informal transformations in geometry	I	I	I	—
210 Relationships between lines and planes in space	—	—	—	—
211 Solids (symmetry properties)	I_s	I_s	I_s	—
212 Spatial visualization and representation	—	I_s	I_s	—
213 Orientation (spatial)	—	I_s	—	—
214 Decomposition of figures	—	—	—	—
300 Probability and statistics				
301 Data collection	I_s	I	I	—
302 Organization of data	I	I	I	I_s
303 Representation of data	I	I	I	I_s
304 Interpretation of data (mean, median, mode)	I	I	I	—
305 Combinatorics	—	—	—	—
306 Outcomes, sample spaces and events	I_s	—	—	—
307 Counting of sets, $P(A \cap B)$, $P(A \cup B)$, independent events	—	—	—	—
308 Mutually exclusive events	—	—	—	—
309 Complementary events	—	—	—	—
400 Measurement				
401 Standard units of measure	V	V	V	—
402 Estimation	I	I	I	—
403 Approximation	I	I	I	—
404 Determination of measures: areas, volumes, etc.	V	V	I	I

Behavioral Categories: Computation, Comprehension, Application, Analysis

TABLE 2

Population B: Importance For Instrument Construction Of Content Topics And Behavioral Categories

Content Topics	Behavioral Categories[a]: Computation	Comprehension	Application	Analysis
1 Sets, relations and functions				
1.1 Set notation	I	I	—	—
1.2 Set operations (eg. union, inclusion)	I	I	—	—
1.3 Relations	—	—	—	—
1.4 Functions	V	V	V	I
1.5 Infinite sets, cardinality and cardinal algebra (rationals and reals)	—	—	—	—
2 Number systems				
2.1 Common laws for number systems	I	I	I	—
2.2 Natural numbers	I	I	I	I
2.3 Decimals	I	I	I	I
2.4 Real numbers	I	I	I	—
2.5 Complex numbers	V	I	I	I
3 Algebra				
3.1 Polynomials (over $\mathbb{R}$)	V	V	V	I
3.2 Quotients of polynomials	I	I	I	—
3.3 Roots and radicals	V	V	I	—
3.4 Equations and inequalities	V	V	V	I
3.5 Systems of equations and inequalities	V	V	V	I
3.6 Matrices	I_s	I_s	I_s	I_s
3.7 Groups, rings and fields	—	—	—	—

[a] The following rating scale has been used: V = very important; I = important; I_s = important for some countries. A dash (--) indicates that the topic was not considered important enough to warrant trial items being found or constructed.

TABLE 2 (Continued)

Content Topics	Computation	Comprehension	Application	Analysis
4 Geometry				
4.1 Euclidean (synthetic) geometry	I	I	—	—
4.2 Affine and projective geometry in the plane	—	—	—	—
4.3 Analytic (coordinate) geometry in the plane	I	I	V	I
4.4 Three-dimensional coordinate geometry	—	—	—	—
4.5 Vector methods	I	I	I	I
4.6 Trigonometry	V	V	V	I
4.7 Finite geometries	—	—	—	—
4.8 Elements of topology	—	—	—	—
5 Analysis				
5.1 Elementary functions	V	V	V	V
5.2 Properties of functions	V	V	V	I
5.3 Limits and continuity	I	I	I	—
5.4 Differentiation	V	V	I	I
5.5 Applications of the derivative	V	V	V	I
5.6 Integration	V	V	V	I
5.7 Techniques of integration	V	V	I	I
5.8 Applications of integration	V	V	V	I
5.9 Differential equations	I_s	I_s	I_s	I_s
5.10 Sequences and series of functions	—	—	—	—
6 Probability and statistics				
6.1 Probability	V	V	I	—
6.2 Statistics	I	I	I	—
6.3 Distributions	I	I	I	—
6.4 Statistical inference	I_s	I_s	—	—
6.5 Bivariate statistics	—	—	—	—
7 Finite mathematics				
7.1 Combinatorics	I	I	I	—
8 Computer science	I_s	I_s	—	—
9 Logic	—	—	—	—

Behavioral Categories: Computation, Comprehension, Application, Analysis

VI. INFORMATION BROCHURES

Two brochures have been produced by IEA that may be of interest to persons seeking information on various aspects of the work of the Association.

IEA Activities

This document, prepared by Professor Neville Postlethwaite, Chairman of IEA, contains a description of IEA, summaries of past IEA projects, overviews of current IEA projects (including the Second International Mathematics Study), and information concerning participating institutions from each country. Copies of this brochure may be obtained from:

Dr. T. Neville Postlethwaite
Department of Comparative Education
University of Hamburg
Sedanstrasse 19
2000 Hamburg 13
Federal Republic of Germany

The Second International Mathematics Study

This brochure describes in nontechnical terms the purposes and plans for the Study. The booklet has been prepared particularly for use in presenting to governments or other agencies seeking support for the Study. Such support might include authorization for access to schools, collection and publication of results, and other national costs of participating in the Study. Copies of this brochure may be obtained from:

Mr. Roy W. Phillipps, Chairman
Mathematics Project Council
Private Bag
Department of Education
Wellington, New Zealand

VII. POPULATIONS

Two major concerns have guided the identification of populations to be included in the Mathematics Study. First, for countries that participated in the First Study, it should be possible to make comparisons on selected measures with comparable groups in the Second Study. Furthermore, since the classroom is the focus of the Second Study, the populations are defined by class or grade in school.

POPULATION A—All students in the grade level where the majority has attained the age of 13.00-13.11 by the middle of the school year.

This definition is very similar to that used in the first survey for the Population 1b. If any doubt arises in a country as to which is the appropriate grade, preference should be given to the grade level tested as Population 1b in 1964 (for countries that took part in the First Study) and the grade level at which the tests are considered to be most appropriate. In each such case, the decision will be refereed by the International Mathematics Committee. Such situations should arise only where the age group is evenly spread over more than one grade.

POPULATION B—All students who are in the normally accepted terminal grade of the secondary education system and who are studying mathematics as a substantial part (approximately five hours per week) of their academic program.

This definition is broader than that used in the First Study, which referred to "preuniversity" courses. A country that took part in the First Study should, however, have no great difficulty in identifying the equivalent First Study population as a subset of the new definition. In all cases, a country's definition will be refereed by the International Mathematics Committee.

VIII. PURPOSES AND DESIGN OF THE MATHEMATICS STUDY

Why Devote a Study to Mathematics?

Throughout the world, the study of mathematics occupies a central place in the primary and secondary school curriculum. It is estimated that in most school systems in the world at least one-fifth of student time is devoted to mathematics. Only mother tongue, reading, and literature are given as much time.

The importance of mathematics in the school curriculum reflects accurately the vital role played by mathematics in contemporary society. At the most basic level, knowledge of mathematics is essential in the conduct of everyday living. More advanced mathematical concepts and techniques are indispensable tools in commerce, engineering, and the natural and social sciences. Thus, from the individual student's point of view, the learning of mathematics in schools represents, first, a basic preparation for adult life and, second, an entrée into a vast array of career choices. From the societal perspective, mathematical competence is essential for the preparation of an informed citizenry and necessary to ensure the continued production of the highly skilled personnel required by industry, technology, and science, without whom a nation in the modern world is severely handicapped—if not hopelessly crippled.

Beyond these purely practical considerations, it is generally believed that mathematics provides an exemplar of precise, abstract, and elegant thought. And whereas the generalized effects of mathematical studies on a student's overall intellectual development are difficult to analyze, let alone measure, there does appear to be a universal consensus that the study of mathematics helps to broaden and hone one's intellectual capabilities.

In view of the importance of mathematics in society and in the schools, it is essential that mathematics teaching and learning receive continued and sustained scrutiny. The purpose of the Second International Mathematics Study is to compare and contrast the varieties of curricula, instructional practices, and student outcomes (both attitudinal and cognitive) in an international context. By portraying each country's school mathematics programs and attainments against a cross-national backdrop, it is expected that each individual country will be afforded the opportunity to understand better the relative strengths and shortcomings of its own endeavors in mathematics education.

Mathematics in an International Study. The first of the International Association for the Evaluation of Educational Achievement (IEA) studies was Mathematics. The mathematics achievement, interests, and attitudes of students were studied at ages 13, 16, and approximately 18 in each of twelve nations. The data from students, teachers, and schools were collected in 1964, thus preceding the large-scale implementation of new curricula in mathematics in many countries.

Since the early 1960s, many countries have invested great resources in the development of new mathematics curricula, new instructional methods and materials, and preservice and inservice training of mathematics teachers. Probably no other part of the school curriculum has had the work, resources, and changes as mathematics has had during this period of time.

Since IEA collected baseline data on mathematics in 1964, these data can be useful in determining the effects of some of the many changes that took place in the intervening decade and a half in some of the countries. In view of the changes that have occurred, what are the student outcomes in terms of attitude and achievement? Have students developed greater interests in and more positive attitudes toward mathematics? Do students now learn mathematics to a higher cognitive level? Do students develop greater interests and more positive attitudes toward mathematics? How do students today compare with students fifteen years ago on these criteria?

The Second Mathematics Study will also profit from the experience gained by IEA in doing large-scale studies over the past decade and a half. This experience includes work in data collection, file building, and instrument construction; it also includes reporting the study to the many communities of interest, such as policymakers, researchers, curriculum developers, teacher educators, and classroom teachers.

Implications and Consequences of the Mathematics Study for Countries. Perhaps the most important consequence of the Mathematics Study (as was true of all the previous IEA studies) is the extent to which teachers, school administrators, supervisors, teacher trainers, and educational research specialists come to view mathematics education against an international view of the subject. As each country prepares a national report on the results of the Study, in light of the international findings, all concerned with education should find an important new framework for viewing the nation's schools, students, and teachers, with a special focus on mathematics education.

As is discussed in detail in a later section, the first component of the Study consists of an international curriculum analysis, which will portray the intended objectives and methodologies for mathematics teaching and learning in the participating countries. The second component of the Study, called the "classroom process" phase, seeks to describe instructional practices used by the teacher in the classroom. In the third component of the Study, student attitudes and achievement are examined in light of curricular emphases and classroom practice.

The comparison within each country of the curriculum as planned and the curriculum as actually taught in the classroom should shed new light on the relations between curriculum specification and instruction. It is to be expected that the degree of the fit between the curriculum as planned and as actually taught may be useful for curriculum makers and teachers as they attempt to understand and interpret the student outcomes for their own countries.

It is to be hoped that preparation for the Mathematics Study in each country will include educational planners, researchers, mathematics educators, and teachers who can contribute to the planning of the specific questions and special features of the Study as it relates to the particular needs of their country. In the past, it has been just such planning that has enabled each country to determine which additional features should be included in the International Study in order to enable the national group to answer its most basic questions about its mathematics education in its own country.

IEA, by its history and affiliations, is well placed to organize and conduct such a study. It has learned much over the past fifteen years about the art and science of international research. Areas such as sampling (both what to do and how to do it); data collection, processing, and analysis; reporting; and dissemination have all advanced since the first round of IEA studies, and fortunately there has been rather careful documentation for the benefit of subsequent investigators. Furthermore, considerable training activities have accompanied all

IEA investigations, and personnel are now available in the various countries to promote the work of IEA and help train new personnel as the Second Study gets under way.

The Second International Mathematics Study as a Cooperative International Project. The principle behind the Second Mathematics Study follows the general principle of all IEA studies, and it is a principle that makes these studies unique in educational research. Unlike research conducted by persons from one country looking at a number of other countries, an IEA research project is a cooperative venture. The cooperation begins with the joint decisions of the national committees to undertake the Study. Then, an international specialist committee is formed to develop the major purposes of the Study, its central questions, its design, and the various tests and questionnaires. At the same time, each participating country through its national center creates its own specialist committee. The international and national committees interact until a common understanding is reached and the central questions, instruments, and procedures are determined.

Each national committee is free to add national options to the central core, so that it can address specific issues of national concern. In some cases, these may be questionnaires or tests pertinent to a particular country's needs. In others, observations may be included to supplement the data provided by the tests. Each country abides by the common decisions, however, just as each country agrees both to a timetable and to internationally agreed upon procedures for sampling students, teachers, and schools. The common core exists as a basis for comparisons across countries.

Finally, all countries cooperate in an international report prepared by the international committee, and each country is encouraged to undertake a national report. It is the series of national reports, in which each country analyzes and interprets its own strengths and weaknesses in the teaching of mathematics against an international backdrop, that provides the greatest value of an IEA study to each participating country. In the past, these reports have led to curriculum reform, to reform of the examination system, or to new directions in teacher education.

Unlike most international studies, an IEA study offers a country a chance to participate as a full member in a research partnership with other countries. The individual countries bear their own internal costs of development, administration, and analysis, as well as the travel costs of their representatives to international meetings. The international costs are supported internationally. All countries share in the labor; each country reaps its own reward of knowledge about itself.

Distinctive Features of the Second International Study. The Second Mathematics Study is more than a survey; it is a research project that proposes to conduct an intensive investigation composed of three components: curriculum analysis, classroom process, and student outcomes. Through the curriculum analysis, it is expected that a context can be constructed in which the data from subsequent questionnaires and examinations can be interpreted. The focus upon the classroom, and what teachers do when they teach mathematics, is expected to help better understand and interpret the attitude and achievement data to be collected.

Countries are urged to devise subinvestigations to pursue lines of inquiry that have emerged or to elaborate upon the international design of the Study. An example of the former might be a detailed study of clusters of classrooms that emerge from the analyses as "high growth" on a problem-solving scale. An example of the latter type of investigation might be the conducting of case studies to validate data provided in self-reporting sections of the classroom processes instrument.

Finally, in this study great importance is attached to the subject-matter dimension. Issues have been identified that reflect cross-national concerns of mathematicians and mathematics educators. Countries, in turn, are encouraged to appoint national mathematics committees that are in tune with their own issues in mathematics education and to have on their committees persons who genuinely reflect the concerns of the classroom teacher, the mathematics educator at the university level (teacher educator, curriculum developer, and researcher), and the professional mathematician. The following sections of this bulletin, which delineate the purposes and design, are intended to exhibit the centrality of mathematics teaching and learning in the Second International Study of Mathematics.

Background

A decade and a half ago, in 1964, the International Association for the Evaluation of Educational Achievement (IEA) conducted a survey of mathematics achievement in the schools of twelve countries (Husén, 1967). This project was the first of its kind in international education, involving a dozen national research institutes, several different languages, thousands of teachers, and a total of some 130,000 students. In that pioneering study, the primary aim was to examine differences among various school systems and how these differences relate to the achievement, interests, and attitudes of students (Husén, 1967, Vol. I, p. 28). For several reasons, mathematics was chosen as the subject area to be investigated. The curriculum reform movement, epitomized perhaps by the "New Mathematics," had begun to have an impact in many countries, stimulating activity in curriculum research and development in the area of mathematics. At that time, most participating countries were concerned with the improvement of scientific and technical education and, hence, were greatly interested in the status of mathematics teaching and learning in the schools. Furthermore, since mathematics was viewed more than other school subjects as a "universal language," it was believed that its use would minimize problems of translation and adaptation in the various countries (Husén, 1967, Vol. I, pp. 33-34).

The first international mathematics survey was of more interest to the community of international and comparative educators than to mathematics educators. A special issue of the *Journal for Research in Mathematics Education* (Vol. 2, March 1971), however, was devoted to reviews and critiques of the survey. Some attention was paid to the survey by the press, but the focus was on the project as an "international contest," in which some countries were quite naturally dubbed "winners" and others "losers."

Subsequent to the mathematics survey, IEA examined six other school subjects in some twenty-three nations in the time period 1966-1973. Reports on findings in each of the subject areas have been published, and two summary volumes are particularly useful to those interested in the "Six Subject Survey" as a whole rather than in findings in particular curricular areas. The volume by Peaker (1975) provides a clear description of the technical aspects of the survey, and the work by Walker (1976) provides a comprehensive summary of the entire project in nontechnical form. Two recent critiques of the IEA surveys have identified important problem areas in the previous surveys and have added to the collective wisdom generated by IEA in the international education arena (Coleman, 1975; Freudenthal, 1975).

Problem

The Second International Mathematics Study will examine the teaching and learning of mathematics in schools. That is to say, there will be an analysis of the mathematics curriculum in order to ascertain the curricular emphases that are determined by official educational bodies in each country. There will be a survey of instructional practices at the classroom level as these curricular goals are implemented by the teacher. Finally, there will be a study of student outcomes—attitudes toward mathematics and achievement in mathematics—in light of the curriculum and teaching practices. The following model illustrates a conceptualization of the Study.

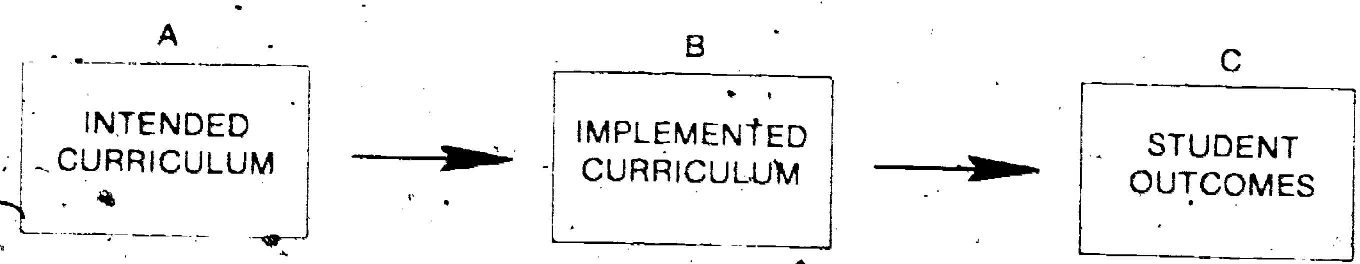


Figure 1. Conceptualization of Mathematics Study.

This model illustrates a link between official syllabi (A) as set by ministries of education or other educational agencies. Textbooks and other instructional material are devised based on the official statements as to what (and how) mathematics is to be taught in the schools. These instructional materials are used to a greater or lesser extent by teachers, as the educational goals are actually implemented in day-to-day instruction (B). Finally, student outcomes are measured (C). One important class of information to be provided by the Study is an examination of the degree of congruence, or match, between the various components of the model. To what extent do textbooks and examinations reflect the intended educational goals of the ministries of education? Such information will be provided as part of the curriculum analysis. To what extent does the curriculum as implemented in the classroom reflect the curricular emphasis intended by the ministries? This information is contained in the "opportunity-to-learn" data gathered in the classroom processes component of the Study. Finally, student outcomes can be analyzed in light of curricular emphases and opportunity-to-learn measures.

The Mathematics Curriculum

The survey and analysis of the mathematics curriculum will be conducted in order to determine what mathematics is being taught, the relative importance attached to the various content areas and behavioral levels involved, and how different mathematical emphases (such as theoretical as compared to applied points of view) are reflected in the curriculum. The Study will attempt to obtain information on how the intended curriculum—as reflected in courses of study, department of education statements of objectives, national or regional examinations, textbooks, and so forth—compares with the actual, or realized, curriculum—as reflected by teacher and student reports on amounts of time spent on various topics (opportunity-to-learn) and classroom activities. The following three issues elaborate upon our investigation of the mathematics curriculum.

The Nature of the Curriculum. Curricula differ in various countries for many reasons. While some countries may have imported new curricula virtually en bloc, particularly during the reform movement of the 1960s, other countries invested large amounts of time and energy in devising their own syllabi, courses of study, and textbooks. What is the end result, after nearly a generation of this activity, both in terms of the objectives and content of the curriculum and the student outcomes (both cognitive and affective)?

As a first step in finding answers to these questions, each country will be asked not only about the status of the curriculum today, but for assessments of how the curriculum came to be what it is — the various factors that came into play to produce the present objectives, subject matter emphases, pedagogical practices, and evaluative procedures.

The Role of Mathematical Applications. To what extent does the curriculum reflect the use of mathematics in such fields as physics, biology, economics, and political science? In our increasingly technological society, the importance of mathematics in providing techniques for analyzing and solving problems in a variety of areas is increasing. The Second Mathematics Study will attempt to determine the extent to which different countries emphasize the applied aspects of mathematics in the curriculum and in classroom instruction. For example, applications of mathematics can be illuminated by organizing the curriculum around broad interdisciplinary themes in which mathematics emerges incidentally. Or, the mathematics curriculum might be developed in accordance with accepted beliefs about the scope and sequence of the subject matter. Other fields of study, such as science or social studies, might be integrated with mathematics in order to illustrate its use in those fields.

It is likely that practices vary greatly across countries in the emphasis placed on uses of mathematics. In some countries, the influence of "pure" or "theoretical" mathematics may be great. The textbooks may focus on mathematics as a self-contained body of knowledge, with little reference to its usefulness or application in the real world. Other countries may promote a study of mathematics that emerges from the child's experience and includes extensive classroom activity involving experimenting, exploring, and collecting and analyzing data.

Should differences in curricular approaches be found, it is of interest to attempt to relate these to such pupil outcomes as interest, attitude, understanding, and problem-solving capabilities.

Minimal Mathematical Competence.* In the wake of the curriculum reform movement of the 1960s, there is great interest in many countries in the competence of students who are products of these new curriculums. To what extent are today's students able to deal with mathematical tasks required to function effectively in our technological society? As Fey has noted (1976, pp. 333-336), the expression "mathematical competence" has many meanings. To some, dismayed by reported declines in achievement test scores, "mathematical competence" may imply a command of the arithmetic skills essential for survival in daily life and occupation in business or skilled trades. To others, "mathematical competence" means minimal levels of performance required at various levels of schooling. In certain countries, this issue is taking on grand dimensions, and is manifesting itself both in demands from parents' groups for a "return to the basics" (reading, writing, and arithmetic) and for the necessity of passing tests of minimal skills before high school graduation diplomas are granted.

In the Second Mathematics Study, countries will be asked to provide statements on minimal mathematical competence, together with sample examinations or test items of minimal competencies. If statements on mathematical competence do not exist, the individuals responding will be encouraged to provide their own views as to what is meant by minimal competence in their countries and to provide examples, perhaps in anecdotal form, of mathematical "literacy."

*Much of the discussion here is based upon the report of the Working Group on Minimal Mathematical Competence, which took place at the meeting of the U.S. National Advisory Panel of the Second International Mathematics Study, Urbana, Illinois, USA, January 1978.

Among the IEA countries, differing socioeconomic-political traditions lead to differing expectations from mathematics education and differing approaches to the minimal competence issue. A survey and critical synthesis of national responses to the following questions should provide extremely useful insight for each IEA country.

1. At what age and school levels are minimum competence levels being specified?
2. Is competence for "functional literacy" or "further schooling" or some other criterion the goal?
3. Are competencies defined in broad goal terms or specific performance objectives?
4. How is a criterion of competence set?
5. What percent of students currently attain desired competence?
6. How is competence attainment measured?
7. What are the decision processes by which minimal competencies are defined? Who is involved—the public, mathematicians, teachers, business and industry? Are competency definitions related to carefully assessed career opportunities?
8. What programs are designed specifically to induce minimal competencies? How effective are remedial efforts of this type?
9. What are the perceptions of minimal mathematical competence held by various groups—students, teachers, lay public, etc.?
10. How does calculator power affect perceptions of minimal competence?

An end product of this aspect of the curriculum analysis may be a test of minimal mathematical competence. This test could be administered by countries at whatever level is deemed most appropriate to the countries. For example, some countries may wish to have a measure of minimal competence for students at the school-leaving age. Other countries may wish to have the measure from a representative sample of all students in the final year of secondary school.

In summary, the international curriculum analysis will be conducted in an attempt to answer questions such as the following:

1. What content and behaviors are viewed as having greatest importance by the various countries?
2. What educational philosophies, or other rationales, appear to be reflected in the importance attached to these areas of content and behaviors?
3. What major developments in curriculum and in curricular emphases have come about in the countries since the First Study in 1963?
4. What forces (influences) have come to bear in bringing about these developments?
5. What is the position of each country with respect to the issue of minimal competence?

Classroom Processes

Teaching consists of sequences of teacher behaviors designed to bring about intended outcomes in students. The Second IEA Mathematics Study is placing major emphasis upon the classroom.

This emphasis reflects a firm belief in the importance both of teaching and the classroom in the educational enterprise. There is the desire to know more about what teachers do as they teach mathematics. This information is important from a descriptive point of view, so that the varieties (or lack thereof) of instructional strategies can be portrayed, thus expanding knowledge of the status of mathematics instruction. There is also the hope that some teaching behaviors will account significantly for variance in student outcomes.

Opportunity-to-Learn. This construct was devised for use in the First IEA Mathematics Study as an index of the extent to which the intended curriculum was implemented by the teacher in the classroom. The measure has subsequently been refined and is currently being piloted for use in the classroom process questionnaire. It is planned that both teachers and students will be asked questions concerning the extent to which opportunity has been provided in class to learn the various topics on the cognitive tests.

Teaching Behavior. Since teaching consists of sequences of teacher behaviors, those behaviors engaged in by teachers as various topics were taught will be categorized. These behaviors are of two general kinds: topic-specific and topic-general.

Topic-Specific Teaching Behaviors. These behaviors are engaged in by teachers as particular items of subject matter are taught. The following examples are from topics at the Population A (13 year old) level.

COMMON FRACTIONS

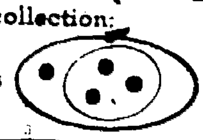
1. Various interpretations of fractions are depicted on the left below. For each interpretation (a–k), place a check in the box by the response that best describes your use of that interpretation.

a. Fractions as quotients:

$\frac{3}{4}$ means "3 divided by 4"

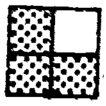
I do not use	I use occasionally	I use frequently
☐	☐	☐

b. Fractional parts of a collection:

$\frac{3}{4}$ means 

I do not use	I use occasionally	I use frequently
☐	☐	☐

c. Fractions as regions:

$\frac{3}{4}$ means 

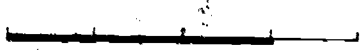
I do not use	I use occasionally	I use frequently
☐	☐	☐

d. Fractions as ratios:

$\frac{3}{4}$ means 

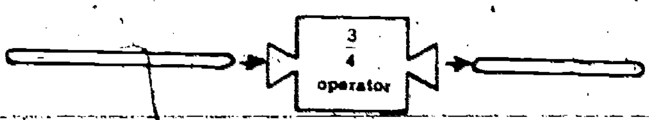
I do not use	I use occasionally	I use frequently
☐	☐	☐

e. Fractions as segments:

$\frac{3}{4}$ means 

I do not use	I use occasionally	I use frequently
☐	☐	☐

f. Fractions as operators:



I do not use	I use occasionally	I use frequently
☐	☐	☐

g. Fractions as repeated addition of the unit:

$\frac{3}{4} = \frac{1}{4} + \frac{1}{4} + \frac{1}{4}$

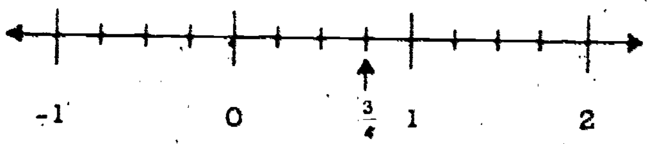
I do not use	I use occasionally	I use frequently
☐	☐	☐

h. Fractions as decimals:

$\frac{3}{4} = .75$

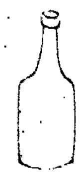
I do not use	I use occasionally	I use frequently
☐	☐	☐

i. Fractions as points on the number line:

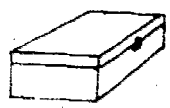


I do not use	I use occasionally	I use frequently
☐	☐	☐

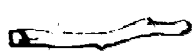
j. Fractions as measurements:

this container holds $\frac{3}{4}$ ℓ 

or

this box weighs $\frac{3}{4}$ kg 

or

this stick is $\frac{3}{4}$ m 

I do not use	I use occasionally	I use frequently
☐	☐	☐

k. Fractions as number pairs:

three fourths as (3,4)

I do not use	I use occasionally	I use frequently
☐	☐	☐

2. Which one(s), if any, of the above interpretations of fractions do you use most frequently? (Circle)

none a b c d e f g h i j k

3. Which one(s) if any, of the above interpretations do you use:

a. only with your brighter students? (Circle)

none a b c d e f g h i j k

b. only with your slower students? (Circle)

none a b c d e f g h i j k

4. Of those interpretations that you use in teaching fractions, which one(s), if any, do your students use most frequently in working exercises? (Circle)

none a b c d e f g h i j k

5. For those interpretations that you use, indicate which of the following are reasons why you do use them. (You may check more than one.)

_____ a. Their use is emphasized or recommended in the syllabus.

_____ b. They allow the students to associate meaning with fractional symbols.

_____ c. Other _____

6. For those interpretations that you do not use, indicate which of the following are reasons why you do not use them. (You may check more than one.)

_____ a. Their use is not emphasized or recommended in the syllabus.

_____ b. They confuse my students.

_____ c. I do not think they are appropriate interpretations of fractions.

_____ d. I do not have time to present them all.

_____ e. Other _____

THE PYTHAGOREAN THEOREM

1. Indicate which of the following are techniques that you use in teaching the Pythagorean Theorem.

   a. I present my students with a variety of right triangles and have them measure and record the lengths of the legs and hypotensure. The pattern is discussed and then we state the theorem. .... Yes No

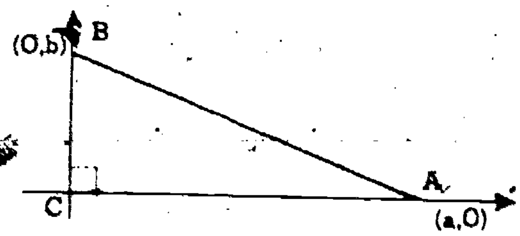
Example:

leg	leg	hypotenuse
3	4	5
9	12	15

$3^2 + 4^2 = 5^2$

$9^2 + 12^2 = 15^2$

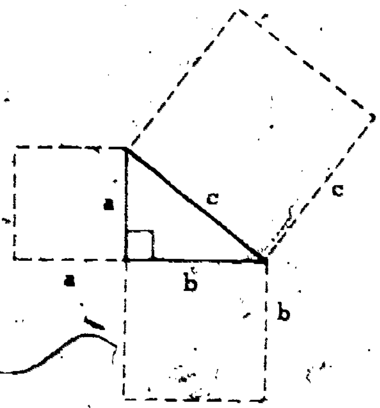
   b. Using Cartesian coordinates, we develop the Pythagorean rule by placing a right triangle in standard position and then use the formula for the distance between two points to find the length of the hypotenuse. .... Yes No



$\overline{AB} = \sqrt{(a-0)^2 + (b-0)^2}$

$\overline{AB} = \sqrt{a^2 + b^2}$

   c. I use diagrams like the following to show that $c^2 = a^2 + b^2$: Yes No



   d. I give my students the formula and have them use it in working examples. Yes No

   e. I use the geoboard to establish the relation between the hypotenuse and the two legs of any right triangle. .... Yes No

   f. I emphasize applications of the Pythagorean rule to real-life situations. Yes No

General Teaching Behaviors. These are behaviors exhibited by the teacher that do not entail specific mathematical subject matter. During the pilot testing phase of the classroom processes instrument, it will be determined whether these general teaching behaviors appear to vary across mathematical topics. Examples of general teaching behaviors are as follows:

PATTERNS OF CLASSROOM ORGANIZATION

	Never or Seldom	Occasionally	Frequently
a. All students in the class work on the same topics at the same pace.			
b. Students are grouped and each group works at its own pace.			
c. Each student learns and works at his/her own pace using his/her own individual material.			

USE OF INSTRUCTIONAL MATERIALS

	Never or Seldom	Occasionally	Frequently
a. Manipulatives (models, weights, sticks, rods, etc.)			
b. Games or puzzles			
c. Films or filmstrips			
d. Television or radio			
e. Computer facilities			
f. School library			
g. Community facilities (specify)			
h. Other (specify)			

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Student Outcomes

The final component of the Study will focus upon the end products of the educational enterprise—what students are like, in terms of attitudes and achievement, in view of the curriculum and instructional practices. Interest will reside in finding answers to such questions as: "What level of achievement has been attained in various categories of the subject matter of mathematics (number properties, solution of equations, trigonometry, and so forth)?" "What are the profiles of student achievement at various levels of cognitive behavior: computation, comprehension, and problem solving?" "What differences in achievement and attitudes of these populations compare with those of similar groups fifteen years ago?" And, "to what extent does pupil growth occur on these dimensions of achievement and growth?"

Procedures

Each of the three main components of the Mathematics Study requires its own method of analysis, and hence its own design. The curriculum analysis will be performed largely through exposition, based upon written communications between the Curriculum Analysis Group* and the National Mathematics Committee in each country, and culminating in an international symposium on the curriculum scheduled for mid-1979 in the Federal Republic of Germany. The classroom process component will utilize a longitudinal and correlational methodology. The profiles of student outcomes will employ scores reconstructed at the country level.

Curriculum Analysis. The following schema will be utilized as a guide in identifying the aspects of the mathematics curriculum that are to receive special attention in the analysis and are to guide the deliberations at the symposium. For individual countries, however, adaptations and modifications will be introduced to take into account unique perspectives and priorities.

		GOALS	CONTENT	METHOD	EVALUATION
	I	1	2	3	4
Level	II	5	6	7	8
	III	9	10	11	12

Figure 2. Curricular Elements.

The columns of the above matrix provide a working definition of the term "curriculum" (following Griffiths & Howson, 1974, p. 156). That is, each country will be asked to provide statements reflecting national perspectives on the following:

GOALS or purposes of mathematics education: Such statements may not be explicit, but are assumed in the formulation of syllabi, in the writing of textbooks, in the purposes of mathematics instruction, and in evaluative procedures. These statements are expected to include references to emphases on levels of cognitive behavior, from low (computational skills and recall of information) to high

*Members of the Curriculum Analysis Group are identified in Appendix D (application and problem solving). References to attitudinal aspects of mathematics education may also be included in such statements.

CONTENT of the curriculum: Statements concerning emphases to be placed upon various categories of subject matter.

METHOD: Statements about the pedagogical approaches most likely to be effective in realizing the goal and content dimensions of the curriculum.

EVALUATION: Procedures to be employed to assess the degree to which the goals of mathematics education have been attained.

The rows of the matrix refer to levels at which the curriculum can be viewed.

Level I: Includes educational traditions in a country, the nature of schooling, the intended purposes of secondary education, and the relationship of mathematics to other subjects in the curriculum. This "highest level" of the curriculum provides the context in which the mathematics curriculum is formulated.

Level II: Here the curriculum is embodied as national syllabi, courses of study, prescribed textbooks, and other "official" expressions of what the curriculum shall be.

Level III: Concerns the level at which the curriculum is implemented in the classroom. That is, this level deals with how the curriculum becomes embodied in day-to-day instruction.

The curriculum analysis focuses upon levels I and II only. Level III will be examined in the other parts of the Second Mathematics Study (that is, in the description and analysis of classroom processes and in the examination of student attitudes and achievement).

Areas for Data Collection. By considering each of the cells 1 through 8, we have a heuristic for identifying the kinds of information to be sought and discussed at the symposium. Sample questions are provided to illustrate each cell.

Level I (highest level)

1. GOALS: What are the fundamental goals of mathematical education in your country?
2. CONTENT: How is mathematical content selected and organized in the curriculum?
3. METHOD: What is the relationship between content and method?
4. EVALUATION: What is the nature and purpose of examinations?

Level II (official embodiments of the curriculum)

5. GOALS: What formulations of goals of mathematics education are provided in your syllabi, courses of study, etc.?
6. CONTENT: What content is in the curriculum, syllabi, etc., how is it organized, and how was it selected?
7. METHOD: What pedagogical approaches are prescribed or suggested in the courses? What instructional methods are implied?
8. EVALUATION: What is the match between the content and behavioral dimensions of the examinations and of the syllabi?

The above framework will provide a basis for the paper to be presented by each participant at the symposium. We do expect, however, that a detailed outline to be followed in preparation of the paper will be provided each national committee by February 1979.

Furthermore, for those countries that have already submitted data in some of the categories, the Curriculum Analysis Group will summarize and send back to the countries the pertinent data to provide opportunities to validate the information that has been gathered.

The International Symposium on the Mathematics Curriculum.* On the basis of the information received from the national centers, a draft report will be prepared that summarizes the curricular situation in each country. In response to this statement, as a validating and communicative mechanism, an international symposium on the curriculum will be held. The purposes of the Symposium are as follows:

1. To receive from a mathematics curriculum specialist in each country participating in the Second International Mathematics Study an authoritative statement concerning the mathematics curriculum in that country.
2. To provide opportunity for countries to react to initial drafts of the international curriculum report, which have been prepared by the Curriculum Analysis Group at the University of Illinois.
3. To provide opportunity for the IMC and the Curriculum Analysis Group members to interact firsthand with the national curriculum specialists concerning curricular issues from a cross-national perspective.
4. To provide opportunities for the curriculum specialists to interact with each other on curricular problems and issues.
5. To prepare a report on the mathematics curriculum, which will address from an international perspective such issues as: the role of mathematical applications, uses of hand calculators and computers in instruction; minimal mathematical competencies for effective citizenship in a technological society; and the influences of tradition, society, and developments within mathematics upon the content of the curriculum.

Classroom Process Instrumentation. In this component of the Study, there is interest both in obtaining descriptive information on what teachers do when they teach mathematics, and in determining whether such teaching behaviors account for variance in student outcomes (cognitive and affective).

Undoubtedly, the most direct and reliable data for classroom process would be those provided by trained observers in the classroom. Since this is not feasible in a study of the magnitude proposed, alternative approaches are being developed.

A document that provides details of the classroom processes, conceptualization, and instrumentation was sent to national centers for comment and suggestions in mid-December 1978. What follows is a condensed, preliminary version of what is proposed.

Five aspects of classroom process will be considered.

Coverage by Teacher. This measure, called "opportunity-to-learn," is an index of the degree to which the announced or envisaged curriculum (as appears in courses of study or syllabi) has actually been taught in the individual classroom.

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*The International Mathematics Committee expresses its deep appreciation to Professor Dr. Hans G. Steiner, Institute for Mathematical Didactics, University of Bielefeld, FRG, for his willingness to coordinate this meeting.

The measure is obtained by asking the classroom teacher to rate each of the items on the cognitive test by responding to this question:

When is the first time that the majority of the students in your class were taught the subject-matter on which this item is based?

A. Prior to this school year
B. During this school year
C. Has *not yet* been taught this year
D. Taught in subsequent years
E. Not in curriculum

Allocated Time.

How many class periods did you spend on this topic? (Give number of periods equivalent to the total time spent.) ____________

Emphasis.

Assume that the number of items on an examination reflects the emphasis you have placed on the topic that the items are testing. If you were putting together a 100-item test to cover the work done *this year* by all the students in your survey (from most to least able), how many questions on this topic (which the item above is testing) would you be willing to include in the test?

______ More than five
______ Four or five
______ Two or three
______ One
______ None

General Teaching Behaviors. In this component of the questionnaire, there is interest in obtaining an impression of the pattern of teaching behaviors exhibited by the teacher in the classroom. The set of activities listed is intended to cover all the types of activities that are likely to occur with significant frequency. A sample question is:

When you taught this topic to the target class, how much time (in minutes) did *you and the class* spend on each of the following activities?

A. *Lecturing:* Teacher explaining, talking, and lecturing to class or group of students with students listening.

Total Time ________ (minutes)

B. *Conference:* Explaining, talking to, and instructing individual students one or two at a time.

Total Time ________ (minutes)

C. *Remedial:* Providing additional *remedial* instruction to individual students with personal or mathematical difficulties.

Total Time ________ (minutes)

D. *Discussion:* Questioning, asking, and discussing with the whole class or group of students, with students participating by replying, commenting, reporting answers, etc.

Total Time ________ (minutes)

E. *Seat Work:* Students working on their own on written assignments, exercises, workbooks, or materials.

Total Time ________ (minutes)

F. *Large Group Work:* Students working together in several large (six students or more) groups talking, discussing, and helping each other on problems, assignments.

Total Time ________ (minutes)

G. *Small Group Work:* Students working together in small (two through five students) groups talking, discussing, and helping each other on problems, assignments.

Total Time ________ (minutes)

H. *Demonstration:* Teacher or student demonstrating audiovisual materials and models, showing films, etc. Students watching, touching, etc.

Total Time ________ (minutes)

I. *Copying:* Teacher reading or writing on blackboard, showing projected image, with students copying, writing in their books.

Total Time ________ (minutes)

J. *Management:* Teacher or students arranging furniture, preparing audiovisual equipment, moving to new groups, etc.

Total Time ________ (minutes)

Topic-Specific Teaching Behaviors. In this section of the questionnaire, teachers are asked to provide information about instructional activities engaged in that are specific to a particular mathematical topic. Following is a sample from the draft questionnaire on ratio and proportion.

RATIO AND PROPORTION: PROBLEM SOLVING AND APPLICATIONS

1. Various applications of ratio and proportion are listed below. For each application, place a check in the box by the response that best describes your use of that application.

Application	I do not use	I use occasionally	I use frequently
a. trigonometric ratios (tangent, sine, cosine)	☐	☐	☐
b. Map reading	☐	☐	☐
c. Scale models (airplanes, automobiles)	☐	☐	☐
d. Similar triangles	☐	☐	☐
e. Gear ratios	☐	☐	☐
f. Estimation of population size using a sample size	☐	☐	☐
g. Scale drawings	☐	☐	☐
h. Percent	☐	☐	☐
i. Interest problems	☐	☐	☐
j. Problems involving buying decisions based on cost rates ex.: 3 for $1.00 or 35¢ each	☐	☐	☐
k. Other (identify)	☐	☐	☐
l. Other (identify)	☐	☐	☐

2. Which application(s), if any, do you use most frequently?

none a b c d e f g h i j k l

3. Which application(s), if any, do you use only with your brighter students?

none a b c d e f g h i j k l

4. Which application(s), if any, do you use only with your slower students?

none a b c d e f g h i j k l

5. For those applications that you use, indicate which of the following are reasons why you do use them. (You may check more than one.)

_____ a. They are emphasized or recommended in the syllabus.
_____ b. They provide a meaningful context for proportions.
_____ c. It is important for the students to be able to recognize situations that call for the use of proportions, so that they know when to apply them correctly.
_____ d. They are the applications that my students are most likely to encounter in the future.
_____ e. Other. _____________________

6. For those applications that you do not use, indicate which of the following are reasons why you do not use them.

_____ a. Their use is not emphasized or recommended in the syllabus.
_____ b. They require background knowledge that my students do not have.
_____ c. They are applications that my students are unlikely to encounter in the future.
_____ d. I do not have time to present them all.
_____ e. Other. _____________________

7. Of those applications that you do use either occasionally or frequently, what is (are) the source(s) of the applications?

_____ a. Published textbook or workbooks.
_____ b. The syllabus.
_____ c. Worksheets or exercises that I designed.
_____ d. Worksheets or exercises other teachers designed.
_____ e. Supplementary textbooks.
_____ f. Articles or papers published by professional educational associations.
_____ g. Other. _____________________

Research Questions. Two categories of data will be gathered in the classroom processes investigation: descriptive and explanatory. The descriptive data are of interest in their own right. It is important to know, for example, the extent and nature of teacher uses of applications of ratio and proportion in the classroom. Such information has implications for preservice and inservice teacher education, for curriculum developers, and for textbook authors. One might expect, say, that the kinds of applications reflect the nature of the curriculum—the extent, for example, that the curriculum has its roots in applied mathematics rather than pure mathematics. The reasons for teachers' choices of applications, or for not using them, is also important knowledge.

Explanatory data are important because they account in a statistical sense for variation in dependent measures (such as pupil achievement or attitudes). Past IEA studies have shown, for example, that allocated time accounts for significant proportions of variance in achievement.

Student Outcomes: Cognitive. As a blueprint for constructing the cognitive instruments, international grids have been developed: Tables 1 and 2 on pages 4-7. These grids are revised versions of corresponding tables appearing in Bulletin 2.

Design of the Cognitive Test: Population A. The cognitive test for population A must serve two purposes. It must be comprehensive enough to range over the cells of Table 1, and it also must provide a criterion measure for growth during the school year. This growth measure will, among other things, serve as a dependent variable for the classroom processes measures. In order to meet both of these specifications, it has been decided to use rotated test forms to provide coverage of the cells of Table 1 and to use a common core of items (common, that is, to the pre- and posttest during the school year) to provide the growth measure.

The core (growth measure) test will consist of items selected according to these criteria:

1. Range adequately over the V cells in the international grid.
2. Sample low and high behavior levels.
3. Judged by national committees as sampling behavior with a likelihood of showing growth between pre- and posttest.

It is proposed that the core test consist of forty items (five subscores at eight items each). Subscores suggested as meeting the above criteria are: fractions; ratio, proportion, and percent; geometry (plane figures); algebra (integers and linear equations); and measurement (area and volume).

The rotated forms (in four forms of some thirty items each) will be used for descriptive purposes only. The first purpose will be for estimating mean and variance of mathematics achievement at the national level. Another purpose will be for estimating item difficulty and, where possible, for comparing this with item difficulty in the First Mathematics Study. They cannot be used to measure growth.

The 120 items will be used to measure the following objectives:

1. Those objectives rated V but not included in the common test.
2. Those objectives rated I and Is.
3. Other objectives relating to issues in mathematics education.

Only 25 percent of the children in a class will take one rotated form. Item difficulties will be calculated only on these children; that is, all children in the country taking any one item will be used for the item analysis for that item.

The International Mathematics Committee also considers it desirable to calculate subscores at the national level. Thus, it is desirable that those items constituting a subscore are taken by the same children. Therefore, the items covering subscores must be so distributed that they are within any one form. The following distribution is very tentatively suggested:

FORM AR1	FORM AR2
arithmetic/whole and natural numbers	arithmetic/common fractions
algebra/formulas	arithmetic/decimal fractions
geometry/transformational	algebra/equations
	statistics/data

FORM AR3	FORM AR4
arithmetic/ratio and proportions	algebra/integers and rational numbers
algebra/functions	geometry/plane figures
measurement/estimation	measurement/areas and volumes
measurement/standard units	

Depending upon which Vs enter the common test, subscores from the above list can be deleted. This will then allow decisions on which cells (within a subscore) can be allocated 1, 2, or 3^+ items. No subscore should have fewer than six items in order to have an acceptable reliability.

With careful allocation of items by subscore into forms, it is hoped that there will be such a distribution that two behavior subscales (low level and high level) can be obtained from each form.

If there is interest in scores across forms (e.g., a total arithmetic score, or a scale constructed by adding items from the common core to one or more of the rotated forms), some kind of item calibration must be employed.

Design of the Cognitive Test: Population B. Due to limitations of time and resources on the part of the International Mathematics Committee, and in light of comments from national centers, the Committee has decided to provide a longitudinal component in the Study at at Population A only; for Population B, a posttest design will be utilized. That is, growth measures will be obtained only for Population A and not for Population B. Hence, there is no need for a core of items in Population B. Instead, eight rotated forms of fifteen items each will be devised. Seven of the forms will contain items that range over the international grid and therefore are to be taken by all countries. The eighth form will be a calculus test, whose use will be optional by countries.

Subscores to be provided will include: arithmetic/number systems, algebra/polynomials, algebra/equations and inequations, geometry/trigonometry, analysis/functions, analysis/differentiation, and analysis/integrations. The last two subscores will be available only to countries utilizing the eighth rotated form, the calculus test.

It is expected that subscores reflecting low- and high-level behaviors will also be available.

Student Outcomes: Attitudinal. Affective responses to instruction and experience in the school are of major concern to the educational community. Just as the First IEA Mathematics Study included an investigation of attitudes, so does the Second Study. These affective measures are important both as independent entities (How do students react to mathematics?) and as variables that can be related to characteristics of classrooms and teachers, and to the subject matter.

The focus of the measures in the Second Mathematics Study will be somewhat different from that of the First Study. Where previously items and scales that measured affective responses to school and societal phenomena in their broad terms were included, the intent of the Second Study is to measure those aspects of attitudes that are specifically related to mathematics, mathematics teachers, and mathematics instruction. Not only will the content of the scales be more narrowly limited to the domain of mathematics, but there will also be scales that are targeted on content dimensions of the mathematics curriculum. This narrow focus is preferred because we believe it can help provide more precise description of what is happening in mathematics classrooms; it therefore has the potential for being more directly translatable into findings of interest and benefit to mathematics educators.

The following scales have been selected for study.

Mathematics in School. This scale elicits from the students their feelings about a variety of activities in the mathematics classrooms, such as estimating answers to problems; measuring lengths, weights, or volumes; and solving inequalities. Since this scale is subject-matter specific, separate forms will be devised for each population. Three aspects of the student's feelings will be examined: how important the student feels the activity is, how easy it is, and whether the student likes the activity. It is hypothesized that these aspects of attitude will be related positively to achievement.

How do you feel about each of these mathematics activities?

Checking the answer to a problem by going back over it.

1.	very important	important	undecided	not important	not at all important
2.	very easy	easy	undecided	hard	very hard
3.	like a lot	like	undecided	dislike	dislike a lot

Mathematics and Society. This scale is designed to measure the student's perception of the role of mathematics in society. This scale is hypothesized to reflect curricular emphases. That is, those curricula that stress the importance of the study of mathematics for its role in society are expected to communicate such a view to the students.

It is important to know mathematics such as algebra or geometry in order to get a good job.

strongly disagree	disagree	undecided	agree	strongly agree

Mathematics as a Process. This scale is intended to obtain a measure of the student's perceptions about the nature of mathematics. This scale is hypothesized to reflect differences in curricula and in classroom processes. For example, emphases on mathematics as a creative enterprise, and classroom approaches that encourage open-ended investigations on the part of students, are expected to impart a view of mathematics to students that is dynamic and creative.

Mathematics is a good field for creative people.

strongly disagree	disagree	undecided	agree	strongly agree

Mathematics and Myself. This scale is intended to obtain a measure that the student has about his or her own ability to do mathematics. It is hypothesized that performance on this scale will relate to certain classroom process measures as well as to cognitive measures.

It makes me nervous to do mathematics.

strongly disagree	disagree	undecided	agree	strongly agree

Computers and Mathematics. This scale is designed to measure the student's perceptions of roles the computer can play in the study of mathematics. Since computers are used only on a very limited basis in the schools of many, if not most, countries, this scale may serve primarily as providing baseline data for future studies.

Computers can help make mathematics more interesting.

strongly disagree	disagree	undecided	agree	strongly agree

Teachers' Attitudes. A subsample of the affective items will be administered to teachers. Having common items for teachers and students reflects a generally accepted notion that through interactions and activities in the classroom, teachers convey to students not only knowledge of the subject matter, but also affective responses to it. The congruence or lack thereof among responses of students and teachers on these common items could produce important information for the teaching of mathematics.

Scales planned for teacher data are: "Mathematics in School" and "Mathematics as a Process." Scores on these scales are hypothesized to relate positively with those of the teacher's students.

International Option: Like School. Countries that participated in the IEA Six Subject survey were pleased with the results of the "Like School" scale from those surveys. Countries that wish to try out the scale may do so. Both the tryout and the actual administration of the "Like School" scale are international options.

> **The most enjoyable part of my life is the time I spend in school.**
>
> **A. agree**
> **B. disagree**

Benchmark Comparisons. In many IEA countries, a major concern is a comparison of the status of mathematics education now with that of fifteen years ago, the date of the first survey. Although many changes have taken place in mathematics education in the past decade and a half, there are little empirical data to document the extent and magnitude of these changes from an international perspective.

Achievement Measures. "Anchor items," that is, items used in the first survey, will be selected for the purpose of comparing student achievement then and now. Criteria for selecting items from the first survey will include representation of V cells on current grid, and satisfactory psychometric properties. Items will be sought that can be classified as follows:

		Low Level	High Level
POPULATION A:	Arithmetic		
	Algebra		
	Geometry		
	Measurement		
	Probability/Statistics		
POPULATION B:	Number		
	Algebra		
	Geometry		
	Analysis		
	Statistics		

Attitudinal Measures. The change of focus for the affective responses has implications for how the new Study will dovetail with the old one. A narrowing of focus implies the need to generate new scales rather than simply readminister the old ones. Still, it is desirable to have items common to both surveys to provide a basis for comparisons between what exists now and what was found fifteen years ago. Although the old scales have a different focus, there are items in those scales that can be utilized in the new survey. A goal in the construction of affective scales is to include those items that have functioned well in the past but to supplement them with items and scales that more closely fit the goals of the new survey.

Sex Differences. Many investigations have revealed differences in mathematics achievement and attitudes between males and females. Scores on the above-mentioned scales may be reported by sex. The magnitude and direction of differences in scores between the first survey and this Study in the various countries may also be examined in light of the changing roles of women in various societies.

Pupil Growth. One distinctive feature of this Study is its longitudinal nature for Population A. That is to say, the nature and extent of pupil growth that occurs during the school year will be analyzed. Hence, a pretest and a posttest on selected cognitive and affective measures will be administered. The growth measures (using class means for, say, arithmetic computation) may be reported for various countries in terms of curricular emphases and may also be used within countries to help identify schools and classrooms of particular interest. For example, a national committee may wish to do case studies on classrooms exhibiting pupil growth that is higher than expected statistically; however, the primary importance of the growth measure will be its link with the classroom processes measures, as explained in the next section. As variations are found in ways in which teachers go about their instructional tasks, the extent to which these classroom behaviors can be used to explain variation in pupil growth in achievement and attitude will be investigated.

School Questionnaire. Two types of information are requested from schools.

1. Character of the school

   Type of school
   School enrollment
   Socioeconomic indicators
   Total number of full-time equivalent teachers
   Total number of full-time equivalent mathematics teachers

2. Organization for teaching mathematics

   Mathematics department structure
   Extent to which mathematics teaching is coordinated in the school
   Who makes the decisions concerning syllabus, textbooks, teaching methods, evaluations, equipment, etc.
   Availability of special mathematics equipment
   School policy toward hand calculators
   School policy toward integration of mathematics with other subjects

Teacher Questionnaire. In addition to responding to the classroom processes instrument and rating the items for opportunity-to-learn, teachers will be asked for the following information:

Sex
Age
Years of teaching experience
Qualifications in mathematics
Time spent per week in preparation for teaching mathematics
Opportunity to react with other mathematics teachers

Information on the size and type of class will be requested in the classroom processes instrument.

Student Questionnaire. To augment the data collected on student achievement and opportunity-to-learn, the students will be asked to supply the following data:

- Sex
- Age
- A socioeconomic measure (such as "Father's Occupation")
- A sociocultural measure (still to be determined)
- Aspirations for more education
- Time spent on learning mathematics at home (in a manner that distinguishes between homework and self-directed activities)

Testing Times—Population A. It is suggested that National Centers organize 100 minutes of pretest time at the beginning of the school year and 150 minutes of posttest time at the end of the school year to be allocated as follows:

Pretest: To be administered as soon as possible, and not later than 8 weeks after the beginning of the school year.

a. Session 1 (75 minutes)

A 40-item cognitive test: 5 minutes of administration instruction and 1 hour 10 minutes for the test.

b. Session 2 (25 minutes)

An attitude scale, "Mathematics in School," and a short Student Questionnaire.

Posttest: To be administered as late as possible, and not earlier than 12 weeks before the end of the school year. The posttest time could be divided as follows:

a. Session 1 (75 minutes)

A 40-item cognitive test: 5 minutes administration instruction and 1 hour 10 minutes for the test.

b. Session 2 (45 minutes)

A 30-item cognitive test. There will be four rotated forms of this test.

c. Session 3 (30 minutes)

Five attitude scales.

More detailed information regarding posttesting will be made available as pilot testing is completed. Time estimates for the tests will be obtained during pilot testing. It may prove desirable to reduce the length of each session to, say, a maximum of 50 minutes, in order to maximize the quality of test responses and to minimize intrusion into school schedules. The timing of these sessions (i.e., whether on the same day, or within a given number of days) is to be uniform within countries, and decided by the national committees.

Testing Times—Population B. Since it is expected that a posttest design will be used in most countries for Population B, sampling may be done by students rather than by classes at this level, with testing done at only one time during the school year. A total of 90 minutes of testing time is requested of all countries.

a. Session 1: 60 minutes

Five minutes for administration and 55 minutes for the 15-item tests. There will be seven rotated forms of the test plus an optional form on the calculus.

b. Session 2: 30 minutes

Five attitude scales and a student questionnaire.

IX. SAMPLING PLAN

The International Mathematics Committee has appointed a team of sampling experts (see names on page 65) to draw up detailed sampling plans and to act as international sampling referees. The documents will be sent to the participating countries, which will return proposed sampling frames for approval by the sampling referees. What follows is only a brief overview of what is entailed in the sampling design for the Study.

Sampling Plan for Population A

In view of the interest in this level in the classroom, and the desire to separate classroom effects on student outcomes from school effects, the sampling plan will call for at least two classrooms per school. An appropriate sampling plan will include:

1. Stratification by appropriate variables within countries, for example, size of school, type of school, and geographic area.
2. Selection of at least seventy schools per country with probability of selection being proportional to the enrollment of the school.
3. Selection of two classrooms at random from each of the schools selected in 2. The total number of classes, therefore, will be about 140.

This implies a complex sample size of about 4,000 students per country, assuming an intraclass correlation coefficient of between 0.2 and 0.4, or design effects between 6 and 9. This will give the equivalents of simple random samples of students between 450 and 700, given standard errors of about 2 to 3 percent.

This sampling plan gives about 140 classrooms per country with which to do an inferential analysis of growth in mathematics achievement. Such a sample size is sufficient to estimate between 30 and 40 parameters in any analysis with classroom process, student background, and contextual explanatory variables.

Sampling Plan for Population B

Since there will not be a focus on the classroom at this level, except as a national option, there will be sampling of students within schools, as was done previously in IEA studies. For example, a country may take a sample of schools with probability proportional to the number of students in the population of interest within the school. The second stage will be to select pupils with probability inversely proportional to the number of students, so as to provide errors comparable to those of the primary sampling plan but with substantially fewer students.

X. ANALYSES

Curriculum Analysis

This is largely expository, with supporting tabular data in the form of a report scheduled for publication in July 1980.

Classroom Processes

In Population A, where the focus is on the classroom, teachers and students will be linked. Class means will be calculated for items and subscores for both the pretest and posttest. The primary research question to be asked in the classroom process component of the Study is, "What variables, or classes of variables, account significantly for student achievement and attitudes (calculated at the classroom level) on the posttests?"

Independent Variables. The following blocks of variables will serve as independent measures: pretest, socioeconomic, school characteristics, and classroom processes. Subscores on the posttest (expressed as class means) will be regressed, in turn, on the independent variables.

Other analyses will include an examination of within-class variance from pretest to posttest and of regression slopes as indices of classroom process.

The longitudinal aspect of the Study is an essential component, albeit a new direction for IEA studies. The following features of this Study are noteworthy:

1. Most longitudinal studies have conducted analyses on a school level, with generalized process measures used as correlates. In contrast, our analyses are conducted at the classroom level, with classes of students held intact and linked to the teacher.
2. Most longitudinal studies use a generalized measure as a dependent variable. On the other hand, we use a small number of well-defined topics that are responded to by the ~~teacher and are included in the student test. These topics are to be selected as having~~ a high probability internationally of reflecting growth in that grade or class.
3. Much of the classroom process data collected will be of importance for its descriptive worth alone, as providing needed information about what teachers do as they teach mathematics.

Difficulties associated with a longitudinal study of the sort proposed here include the following:

1. Attrition of students from pre- to posttest is likely to be a problem. Steps must be taken to minimize this and, hence, to maximize the number of students represented in the class means.
2. The problems of measuring change have been well studied. The use of several models for measuring growth will be encouraged in subsequent analyses. However, the International Committee recommends the use of residual scores when the posttest has been regressed onto blocks of independent measures (pretest, school measures, pupil attitudes, etc.).
3. The classroom process measures place heavy demands upon teachers. Hence, every effort must be made to seek only an essential minimum amount of information. As national options, this base of information may be expanded.

Descriptive Measures

In this component of the Study, the emphasis will be on describing the findings in as thorough yet simple manner as possible for the primary target audiences: mathematics educators, supervisors, policymakers in ministries of education, and classroom teachers.

Cognitive Measures. At the item level, proportion correct, standards errors, and profiles of scores by items for countries will be reported. The analysis of anchor items (comparisons between first and second studies) will involve item profiles. For subscores (as defined on pages 28-30 above), means, standard deviations, and frequency distributions are required. For profiles of subscores by countries, and for certain subinvestigations (e.g., examination of minimal competencies), classroom level data will be utilized.

Attitude Measures.

Mathematics in School Scale. Frequency distributions by items for countries on pre- and posttests are reported. Profiles of proportions of students endorsing items are prepared. Simple correlations between attitude and achievement for particular content areas and correlations between teacher and student attitudes are computed.

Other Attitude Measures. Frequency distributions by items for countries and profiles of proportions endorsing items, by countries, and correlation with achievement scores are prepared.

General characteristics.

School Data. Frequency distributions and profiles are given at country level.

Teacher Characteristics. Frequency distributions and correlations between characteristics and student measure (attitude and achievement) will be produced.

Student Characteristics. Frequency distributions and correlations between characteristics and outcomes (attitudes and achievement) will be generated.

XI. FUNDING

Funding of the Study has two dimensions—international and national. Each country is responsible for securing necessary financial support for covering the national costs of participating in the Study. Such costs include translation of instruments from English, duplication of instruments, data collection, and postage. In most cases, costs of attending international meetings must also be covered, although in some cases there may be exceptions.

The Chairman of the Mathematics Project Council, together with support from the Chairman of IEA, the Chairman of the International Mathematics Committee, and others, is committed to locating funding for the international costs. To this end, a detailed technical proposal has been prepared in draft form outlining the various components of the Study and the international costs associated with each component.

Maintenance of the International Coordinating Unit in Wellington, New Zealand, is provided by the Department of Education, Wellington. Meetings of the International Mathematics Committee and support of the office of the chairman of the Committee have been made possible through grants from the National Institute of Education, Washington, D.C., and the Ford Foundation, and have been supplemented by funds from the Scottish Council for Research in Education, the Bank of Sweden, and the Universities of Georgia, Illinois, and Kentucky in the United States. Currently, the Chairman of IEA is exploring funding sources to support training sessions and the curriculum symposium, and to establish the international data processing facility.

XII. FINAL REPORTS

Primary reponsibility for each volume will be assumed by the member of the International Mathematics Committee indicated in parentheses.

Volume I The first major report of the Mathematics Study will be the international curriculum analysis volume, scheduled for publication by July 1980. Major responsibility for this document is assumed by the Illinois Curriculum Analysis Group.

Volume II: Report for mathematics educators, researchers, and policymakers (coordinator: Travers). This volume will give a comprehensive report on the findings of the Study.

Volume III: Technical Report (coordinator: Kifer). In addition to addressing the many technical issues raised by the Study, this volume will present a variety of models for analyzing the data.

Volume IV: Communication of the Second Mathematics Study (coordinator: Wilson). A series of nontechnical, popularized accounts of the findings of the Study, aimed at the lay audience. A newsletter format may be utilized.

IEA PAPERS RELEVANT TO THE SECOND MATHEMATICS STUDY

Bulletins

Number 1: October 1976
Outlines issues to be addressed by the Study.

Number 2: Second Study of Mathematics. September 1977.
Discusses aspects of research design for the Study. International Grids (content x behaviors) are outlined in preliminary form.

Number 3: December 1978
Presents details of Study, including updated timetable.

Working Papers

I. Tables of Specifications for IEA Mathematics Tests
Explicates content and behavior dimensions of mathematics achievement.

II. Attitudinal Scales
Discusses aspects of mathematics attitude (pupil and teacher) to be addressed in the Study, delineates scales, and provides items for each scale.

III. Opportunity-to-Learn
A preliminary discussion of this measure. Subsequently incorporated into Working Paper VIII.

IV. Minimal Mathematical Competencies
A preliminary statement developed by the International Mathematics Committee. Postponed until after Curriculum Seminar, 1979.

V. Classroom Processes
A preliminary discussion of this aspect of the Study. Subsequently incorporated into Working Paper VIII. Teacher and Pupil Questionnaires.

VI. National Case Study Questionnaire
Outlines preliminary background information required from National Mathematics Committee regarding various issues to be addressed in the Study.

VII. Hand Calculators
Discusses potential significance of hand calculator and proposes ways in which consequent issues may be addressed in Study. To appear by October 1978.

VIII. Classroom Processes Revisited
Provides a conceptualization of classroom processes, incorporating findings of pilot studies arising from Working Papers III and V. Expected to appear by October 1978.

IX. Sampling Specifications (sent out to National Centers as IEA Memoranda MATHS—MZ/A/).
Outlines sampling design and procedures to be employed. Expected to appear by October 1978.

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APPENDIX A

Timetables*

*As of December 1978, certain dates, particularly those pertaining to the Southern Hemisphere and Japan, were still in doubt. Readers requiring firm advice should consult with Roy Phillipps for the current status of the schedule for the Study.

TIMETABLE OF KEY DATES

August 1978	Meeting of IMC at University of Illinois • Review plans for curriculum analysis • Review progress on classroom processes • Finalize international grids • Draft sampling design specifications for national committee comment
January 1979	Meeting of IMC at Michigan State University • Finalize drafts of all instruments • Review plans for curriculum • Finalize plans for sampling specifications
March 1979	NTO meeting*
Early August 1979	Curriculum Symposium, Bielefeld, FRG*
September 1979	IMC meeting
November/December 1979	NTO meeting*
January 1980/December 1980	Data collection: Southern Hemisphere and Japan
September 1980/July 1981	Data collection: Northern Hemisphere
May 1982	Drafts of international reports
December 1982	Publication of international reports

*Not funded as of December 1978.

TIMETABLE FOR SECOND IEA MATHEMATICS STUDY

	Start	Complete
Curriculum Analysis		
Preliminary analysis	October 1976	January 1977
National responses to international grid	January 1977	August 1978
IMC Meeting	August 1978 January 1979 September 1979 February 1980	September 1978 February 1979 September 1979 March 1980
Planning of Curriculum Analysis Model	May 1978	August 1978
Preparations for Curriculum Analysis Symposium—Committee to write up national statements from Working Papers I and VI, textbooks, examinations, etc.	September 1978	December 1978
National Centers to identify key national mathematics experts	September 1978	January 1979
Curriculum Analysis Symposium		August 1979
International Report: data analysis, editing of Symposium proceedings and papers	September 1979	January 1980
Publication of Volume I, Curriculum Analysis Report	January 1980	July 1980
Cognitive Test Construction		
Identify International Test Grid		September 1977
National responses to International Grid	September 1977	July 15, 1978
Field Trial of item collections	May 1978	January 1979
IMC and National Centers write new items to fill gaps in grid	May 1978	August 1978
Review trial data and extra items	May 1978	August 1978
IMC report on trial data and final chance for National Centers to contribute items for trial	September 1978	September 1978
Response to IMC report	September 1978	December 1978
Additional field trials as necessary	October 1978	December 1978
Review of field trial data and synthesis of item pool by New Zealand Coordinating Unit	January 1979	January 1979
Final draft of cognitive instruments by IMC	February 1979	February 1979
Initial review and comment on draft of cognitive instruments by National Centers	March 1979	March 1979
Preparation of manuals	September 1978	February 1979
Dry Run all instruments (includes translation and refereeing of national options)	April 1979	July 1979

	Start	Complete
Final instruments		October 1979
Printing and distribution of instruments	October 1979	December 1979
Administration of pretest		
Southern Hemisphere	February 1980	April 1980
Northern Hemisphere	September 1980	October 1980
Administration of posttest		
Southern Hemisphere	October 1980	April 1981
Northern Hemisphere	April 1981	July 1981
Classroom Processes Instruments		
Initial development of combined opportunity-to-learn and classroom processes instrument	June 1977	August 1978
New Zealand pilot trial of growth scores and classroom instrument	March 1978	December 1978
Consultations on instrument	May 1978	August 1978
Draft of instrument		August 1978
Limited national trials	August 1978	December 1978
Data analysis of trials plus New Zealand data	January 1979	February 1979
International trial as part of Dry Run	April 1979	July 1979
Finalize instrument	July 1979	October 1979
Translation, refereeing, and printing	October 1979	January 1980
International Mathematics Committee meetings		August 1978 February 1979 October 1979
Manuals	April 1979	October 1979
Administration of classroom instrument		
Southern Hemisphere	February 1980	January 1981
Northern Hemisphere	September 1980	July 1981
Attitude Scales		
Rationale, and identification and development of affective scales	January 1977	June 1977
Pilot trial affective scales in USA	June 1977	October 1977
International trials of affective scales	March 1978	June 1978
Data analysis of trials	June 1978	August 1978
IMC report on field trials	September 1978	September 1978
Review of National Center comments	October 1978	October 1978
Additional field trials (if necessary)	October 1978	December 1978
Final draft of affective scales		February 1979
Translation, refereeing of problems	February 1979	March 1979
Dry Run	April 1979	July 1979
Final instruments		October 1979

	Start	Complete
Completion of manuals		October 1979
Printing and distribution of instruments	October 1979	December 1979
Administration of pretest		
Southern Hemisphere	February 1980	April 1980
Northern Hemisphere	September 1980	October 1980
Administration of posttest		
Southern Hemisphere	October 1980	January 1981
Northern Hemisphere	April 1981	July 1981
Student, Teacher, and School Questionnaires		
Draft questionnaire items for student, teacher, and school questionnaires	January 1977	July 1978
Draft questionnaires		August 1978
International Trial in conjunction with trial of additional cognitive items	September 1978	December 1978
Analysis of final data	January 1979	February 1979
IMC settle final draft instruments		February 1979
IMC report data to national centers	February 1979	March 1979
Questionnaires finalized		October 1979
Completion of manuals	February 1979	October 1979
Translation and refereeing	November 1979	December 1979
Administration of questionnaires		
Southern Hemisphere	February 1980	January 1981
Northern Hemisphere	September 1980	July 1981
Sampling		
Discussion of sampling specifications and consultation	January 1977	May 1978
International Sampling Committee prepare draft paper for IMC	May 1978	August 1978
Final sampling design settled	August 1978	September 1978
Sampling manual prepared	September 1978	February 1979
Manual approved IMC		February 1979
National Centers draw samples and consult International Sampling Committee	February 1979	October 1979
International Sampling Committee report to IMC		October 1979
National Centers contact schools and replace refusals		
Southern Hemisphere	October 1979	December 1979
Northern Hemisphere	June 1980	July 1980
Data collection		
Southern Hemisphere	February 1980	January 1981
Northern Hemisphere	September 1980	July 1981

	Start	Complete
Data Collection Modes		
Consultations with National Centers on potential methods of data collection	January 1977	July 1978
Report to IMC by Dr. J. Schwille	July 1978	August 1978
IMC suggestions to National Centers and return of National Center comment	September 1978	December 1978
Methods of data collection settled		December 1978
Printing of answer forms (if necessary) and dispatch to countries	January 1979	March 1979
Pretest		August 1979
Posttest		June 1980
Completion of manuals		
Pretest		October 1979
Posttest		October 1979
Data Processing and Analyses		
Preliminary Planning		
Outline of instruments with approximate number of items	December 1978	February 1979
Outline of codebooks (dummy)	July 1978	February 1979
Preliminary consideration of file building	July 1978	February 1979
Detailed Planning		
Settle coding of final instruments	February 1979	October 1979
Standardize punching and coding forms for Dry Run	February 1979	March 1979
Settle analyses required by IMC	October 1978	February 1979
Settle file building and weighting procedures	February 1979	July 1979
Update of codebooks	February 1979	July 1979
International trial of countries' capacity to produce files and undertake standard analyses (run as part of the Dry Run)	February 1979	July 1979
Write programs for basic item analyses, univariates, correlations, school reports, and for special multivariate analyses	February 1979	March 1980
Analyses for IMC and countries requiring assistance	April 1980	December 1981
Construction of data bank	December 1981	December 1982

APPENDIX B

Mathematics Study Council Members
(Countries and Individuals as of September 30, 1978)

IEA COUNTRIES

Country	Mathematics Study Council Member	Institutional Affiliation	National Technical Officer
Australia	John Keeves	Australian Council for Educational Research	M. Rosier
Belgium (French)	G. De Landsheere	University of Liège	G. Henry
Belgium (Flemish)	A. De Block	Seminairie en Laboratorium Didactiek	C. Brusselmans-Dehairs
Canada* (Ontario)	H. Russell	Ontario Institute for Studies in Education, Toronto	———
Chile	M. Pizarro	Universidad de Chile	C. Rodriguez
France	D. Robin	Institute National de la Pédagogique Recherche	D. Robin
FRG (Rhine-Westphalia)	H. Fend	Landes Institut fur Curriculem Entwicklung Lehrer Fortbildung und Weiterbildung, Düsseldorf	———
Hungary	Z. Bathory	Research Institute affiliated with Ministry of Education Orszagos Pedagogiai, Jutezet (OP1)	J. Kadar-Fulop
Ireland	J. Rice	School of Education, Trinity College	E. Oldham
Israel	A. Lewy	Tel Aviv University	A. Lewy
Ivory Coast†	K. Kouadio	Service d'Evaluation, Abidjan	———
Italy	A. Visalberghi	University of Rome	M. Laeng
Japan	H. Kida	National Institute for Educational Research	S. Shimada
Korea*	Yung Dug Lee	Korean Educational Development Institute, Seoul	Lee Gwang-Bok
Netherlands	E. Warries	Twente University of Technology	T. Eggen
New Zealand	R. Phillipps	Research and Statistics Division, Department of Education, Wellington	R. Garden
Nigeria	E. Yoloye	International Center for Educational Evaluation	W. Falayjo

Country	Mathematics Study Council Member	Institutional Affiliation	National Technical Officer
Scotland	G. Pollock	Scottish Council for Research in Education	G. Thorpe
Spain*	Isodora Alfonso Hinojal	INCIE, Madrid	Gloria Pérez Serrano
Sweden	T. Husén	University of Stockholm Institute for International Educational Research	R. Liljefors
USA	R. Wolf	Teachers College, Columbia University	E. Kifer

*Countries officially admitted to the Mathematics Study pending ratification of full membership

INTERESTED COUNTRIES UNCERTAIN AS TO PARTICIPATION

Country	Contact Person	Institution
England	F. Yates B. Choppin	National Foundation for Educational Research
Finland	K. Leimu	Institute for Educational Research, Jyvaskyla
Luxembourg	G. Schaber	Institut Pédagogique, Walferdange
Thailand	S. Boonruangratana	Institute for the Promotion of Science and Technology, Bangkok

APPENDIX C

Members of International Mathematics Committee
and National Mathematics Committees
(as of August 31, 1978)

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INTERNATIONAL MATHEMATICS COMMITTEE

Dr. Sven Hilding H. M. Inspector of Mathematics	Swedish Board of Education Stockholm, Sweden
Dr. Edward Kifer Associate Professor of Educational Psychology	Department of Educational Psychology College of Education University of Kentucky Lexington, Kentucky 40506 USA
Mr. Gerard J. Pollock Depute Director	Scottish Council for Research in Education 16 Moray Place Edinburgh, Scotland
Dr. Kenneth J. Travers (Chairman) Professor of Mathematics Education	Secondary Education Department College of Education University of Illinois Urbana, Illinois 61801 USA
Dr. James Wilson Professor and Head	Department of Mathematics Education College of Education University of Georgia Athens, Georgia 30601 USA

(One appointment to International Mathematics Committee pending.)

Dr. A. I. Weinzweig (Consultant) Associate Professor of Mathematics	Mathematics Department University of Illinois at Chicago Circle Chicago, Illinois 60607 USA
Mr. Roy W. Phillipps International Coordinator Chairman, IEA International Mathematics Study Council	Private Bag Department of Education Wellington, New Zealand

DIRECTORY OF NATIONAL MATHEMATICS COMMITTEE MEMBERS

Australia
Mr. R Cowban, mathematics curriculum and research specialist
Mr. Roy James, secondary school mathematics teacher
Dr. John Keeves, IEA Council Member and Director of ACER
Mr. Bill Newton, mathematics curriculum and research specialist
Dr. Malcolm Rosier, IEA NTO and Project Officer
Dr. Glen Rowley, educational measurement specialist

Belgium (Flemish)
Mr. Bollens, Inspecteur Middelbaar Onderwijs (Katholiek Onderwijs)
Mrs. C. Brusselmans-Dehairs, Technical Officer, Assistant in the Laboratory of Didactics
Mr. Cuvelier, Inspecteur Middelbaar Onderwijs (Rijksonderwijs)
Mr. Laumen, Inspecteur Middelbaar Onderwijs (Rijksonderwijs)
Mr. Mariman, Afgevaardigde van het Pedagogish Centrum voor het Katholiek Onderwijs
Mrs. Martens, Inspecteur Middelbaar Onderwijs (Katholiek Onderwijs)
Dr. L. Martens, Assistant in the Laboratory of Didactics
Mr. Pottillius, Bestuursdirecteur, Ministerie van Opvoeding (Secretary)
Mr. Soens, Inspecteur Middelbaar Onderwijs (Rijksonderwijs)
Mr. Tavernier, Inspecteur Middelbaar Onderwijs (Rijksonderwijs)
Mr. Vandevelde, Inspecteur-generaal van het Hoger Onderwijs
Mr. Vanhulle, Inspecteur Middelbaar Onderwijs (Katholiek Onderwijs)
Mr. Van Roey, Inspecteur Middelbaar Onderwijs (Katholiek Onderwijs)

Canada
(Although a National Mathematics Committee has not yet been officially established, the following persons have been active in pilot testing and other developmental activities.)
David Bale, University of Regina, Saskatchewan
John Del Grande, North York Board of Education, Willowdale, Ontario
Lars Jansson, University of Manitoba
Thomas Kieren, University of Alberta
Ronald Ragsdale, Ontario Institute for Studies in Education
David Robitaille, University of British Columbia
Howard Russell, Ontario Institute for Studies in Education

Chile
Prof. Maria Lara, Professor of Teaching Methods, Department of Primary Education, University of Chile
Prof. Luis Levet, Coordinator of Studies, Department of Mathematics, Faculty of Physics and Mathematics, University of Chile
Prof. Angelica Luque, Professor of Teaching Methods in Mathematics, Department of Secondary Education, Faculty of Education, University of Chile
Prof. Arlette Mendoza, Professor at the Department of Primary Education (Mathematics Section), Faculty of Education, University of Chile

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Hong Kong

Mr H F Chan, Subject Officer (Mathematics), The Hong Kong Examinations Authority
Dr K T Leung, Senior Lecturer in Mathematics, The University of Hong Kong
Mr. K. C. Ng, Education Officer/Inspector (Mathematics), Government Education Department
Mr F Parkin, Principal Inspector of Mathematics, Government Education Department

Research Students associated with the pilot stage of the project:
Mr. William Cheng, Mr. Law Hing Chung, Mr. Ip Chiu Kwan, Miss Gladys Li, Mr. Ng Tai Pong, Mr. Stephen Yeung

Hungary

A. Joo, J. Kadar-Fulop, J. Kunstar, B. Novak, F. Pogacs, J. Szendrei, I. Szirtes, J. Urban

Ireland

Mr C O Caoimh, Inspector, Department of Education
Mr. S Cronin, Teacher of Mathematics, Blackrock College, Dublin
Sr. D Gallagher, Teacher of Mathematics, Convent of the Holy Child Jesus, Killney, Dublin
Mr. J. J. Kelly, Teacher of Mathematics, Vocational School, Co. Wicklow
Mr. S. McGuinness, Teacher of Mathematics, Willow Park School, Blackrock, Dublin; Senior Research Office, Public Examinations Evaluation Project
Miss E E Oldham, National Technical Officer; Lecturer in Education, Trinity College, Dublin
Fr. B. P. Steen, C.M., Lecturer in Mathematics, St. Patrick's College of Education, Dublin

Israel

Dr Ariah Lewy, Evaluation Expert, Tel Aviv University
Dr. Markus, Chief Inspector for Mathematics, Ministry of Education
Dr Perele Nesker, Haifa University
Dr Pinchas Tamir, Hebrew University, Science Teaching Center
Dr. Shlomo Weiner, Hebrew University, Science Teaching Center

Japan

Mr. Yuji Hamanaka, Teacher, Tokyo Metropolitan Akikawa Upper Secondary School
Mr. Yoshihiko Hashimoto, Researcher, Mathematics Education Section I, Science Education Research Center
Mr. Tadashi Iijima, Teacher, Upper Secondary School, attached to University of Education
Prof. Yoshio Inoue, Professor, Bunkyo University (Maths Education)
Mr. Shigeo Kojima, Head, Science Education Section, Science Education Research Center
Prof. Satoshi Koto, Professor, Tsukuba University (Maths Education)
Mr Matsuo Kozutsumi, Teacher Consultant, Tokyo Metropolitan Board of Education
Prof. Tatsure Miwa, Professor, Osuka University of Education (Maths Education)
Mr. Hideo Ohashi, Director, Science Education Research Center
Mr. Kazusuke Sawada, Inspector, Bureau of Elementary and Secondary Education, Ministry of Education
Mr. Yoshi Sawada, Head, Mathematics Education Section II, Science Education Research Center
Prof Wetsuya Seki, Professor, Department of Mathematics, St. Paul University (Mathematics)
Dr Shigeru Shimada, NIER
Dr. Takakazu Sugiyama, Researcher, Institute for Statistical Mathematics
Prof. Yoshio Takeuchi, Professor, Yamagata University (Mathematics)

Mr Yiji Torii, Teacher Montomachi Lower Secondary School established by Shihuya-ward
Mr Yukio Yoshikawa, Teacher, Lower and Upper Secondary School attached to Tokyo University
Mr Satoru Yoshimura, Keio Lower Secondary School
Mr Shinichi Yotsuya, Teacher Consultant, Kanagawa Prefectural Board of Education

Netherlands (consulting group)
Dr. H J Duparc, T. Eggen, A J Th Maassen, T Plomp, Dr. S. Sandbergen, G. Schoemaker, W Solberg, J Timmer, Dr F van der Blij (Chairman)

New Zealand
Dr Meggan Clark, Mathematics Department, Victoria University
Mr H Claughton, Mathematics Inspector (Primary), Department of Education
Mr R Garden, IEA Coordinating Unit
Mr A Hutson, New Zealand Education Institute
Mr I Livingstone (Chairman), Senior Research Officer, New Zealand Council for Educational Research
Professor W Malcolm, Mathematics Department, Victoria University, New Zealand
Mr M Murtagh, Post Primary Teachers Association
Mr A E. Naftel, Curriculum Development Division, Department of Education
Mr R Phillipps, IEA Coordinating Unit
Professor D Sawyer, Mathematics Department, University of Otago
Mr O Smith, Mathematical Inspector (Secondary), Department of Education

Scotland
Mr Alex Black, Adviser in Mathematics, Lothian Region
Mr J Gillam, Head of Statistics Department, Exam Board
Professor J M Howie, Professor of Mathematics, St. Andrews University
Mr J Nisbet, H.M.I., St Andrew House, Glasgow
Mr G J Pollock, Depute Director, S.C.R.E.
Mr Graham Thorpe, Research Officer, S.C.R.E.
Dr David Walker, Ex-Director, S.C.R.E.
Mr L Winters, Assistant Head Teacher, St. Margaret's School, Glasgow

Sweden
Peter Claesson, Consultant in Mathematics Teaching at the Ministry of Education
Bengt Dahlbom, Director of the Section for Research and Development of Education, National Board of Education, Ministry of Education
Tord Ganelius, Professor in Mathematics, University of Göteborg
Leif Hellstrom, Research Officer in Education, Teachers College, Malmö
Sven Hilding, H M Inspector of Mathematics (earlier Professor in Mathematics Education, Teachers College, Stockholm; earlier Assistant Professor in Mathematics, University of Stockholm)
Robert Liljefors, Research Officer at the Institute for International Education, University of Stockholm
Jan Unenge, Professor of Math Education, Teachers College, Jonkoping

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United States

Joe Crosswhite, Ohio State University
Floyd Downs, Hillsdale High School, San Mateo, California
James Fey, University of Maryland
Edward Kifer, University of Kentucky
Jane Swafford, University of Northern Michigan
Kenneth Travers, University of Illinois
A. I. Weinzweig, University of Illinois at Chicago Circle
James Wilson, University of Georgia
Richard Wolf, Teachers College, Columbia University

APPENDIX D
Consultants

Curriculum Analysis Group

James Hirstein	Department of Secondary Education University of Illinois
Ulf Lundgren	Stockholm Institute of Education
Horacio Porta	Department of Mathematics University of Illinois
Alan Purves	Curriculum Laboratory University of Illinois
Hans Steiner	Institute for Mathematical Didactics Bielefeld University, FRG
Ian Westbury	Curriculum Laboratory University of Illinois

Classroom Processes

Leigh Burstein	College of Education University of California, Los Angeles
Graham Nuthall	Education Department University of Canterbury Christchurch, New Zealand
John Schwille	Institute for Research on Teaching Michigan State University, East Lansing
Leslie Steffe	Mathematics Education Department University of Georgia, Athens
Alba Thompson	Mathematics Education Department University of Georgia, Athens
Tom Cooney	Mathematics Education Department University of Georgia, Athens

Methodology

Leigh Burstein	University of California, Los Angeles
Jeff Bulcock	Memorial University, Newfoundland
Robert Linn	University of Illinois
Richard Noonan	University of Stockholm
T. Neville Postlethwaite	University of Hamburg, FRG
Seymour Sudman	University of Illinois

New Zealand International Coordinating Unit

Averil Coe, Technical/Clerical Assistant
Trevor Edmond, Seconded Ex-Principal
Robert Garden, Education Officer (Mathematics and Research)
Patricia Hall, Research Office
Roy W. Phillipps, International Coordinator
Roslyn Slemint, Research Officer

International Sampling Committee

John Keeves	Australian Council for Educational Research Melbourne, Australia
Ian Livingstone	New Zealand Council for Educational Research Wellington, New Zealand
Malcolm Rosier	Melbourne, Australia
Ken Ross	Melbourne, Australia

Item Reviews and Pilot Testing

Jerry Becker
Nicholas Branca
Thomas Carpenter
Terrence G. Coburn
Clyde Corcoran
Ed Davis
John Dossey
Ross Finney
Fred Fleenor
Bill Geeslin
Ann Graeber
Judith Guthrie
Jack Hope
Lars Jansson
Thomas Kieren
Donald Kreider
Peter Lappan
James Lockwood
Rogers Newman
John Ogle
Anthony Peressini
David Robitaille
Don Sherbert
James Sherrill
Larry Sowder
Dorothy Strong
Zalman Usiskin
Bruce Vogeli
Diane Wearne
Paul Weichsel
Grayson Wheatley
Don C. Woollen
Wilson Zaring

Office of the Chairman, International Mathematics Committee (University of Illinois, Urbana, Illinois, USA)

Kenneth J. Travers Professor of Mathematics Education	Chairman
Peter G. Braunfeld Professor of Mathematics and Secondary Education	Staff Associate
James J. Hirstein Assistant Professor of Mathematics Education	Staff Assistant
James E. Hecht Graduate Student, Mathematics Education	Research Assistant
Horace Smith Graduate Student, Mathematics Education	Research Assistant
Peter Staples Graduate Student, Mathematics Education	Research Assistant

APPENDIX E

Report of the Planning Seminar for Latin American Participation in the Second IEA International Mathematics Study

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REPORT OF THE PLANNING SEMINAR FOR LATIN AMERICAN PARTICIPATION IN THE SECOND IEA INTERNATIONAL MATHEMATICS STUDY

Caracas, Venezuela
May 8-11, 1978

The meeting consisted of an informative session and a session devoted to the planning of future activities. In the informative session, the following took place:

1. A presentation by Kenneth Travers addressed the reasons for the meeting and the results expected as a consequence of the meeting. Also, a presentation by Roy Phillipps described the previous work of the International Association for the Evaluation of Educational Achievement and the International Mathematics Committee. The actual status of the Second Study, in progress in a number of countries for the past two years, was discussed.
2. A detailed presentation by Cristina Rodriguez described past experiences in Chile regarding the IEA Six Subject Survey, and discussed further the ongoing activities related to the Second Mathematics Study. This presentation was especially important in that it helped the participants familiarize themselves with the dynamics of the study and the difficulties encountered; it was particularly interesting because the study involved a country with characteristics very similar to other Latin American nations.
3. The presentation by Bruce Vogeli discussed reasons for the concern with mathematics achievement and discussed the factors to keep in mind when preparing students for the future.
4. James Wilson discussed the factors involved in developing tables of specifications (grids), tests of achievement, and attitude scales.

With regard to the planning of future activities, the following conclusions were reached:

1. To accept Enrique Góngora's (Costa Rica) recommendation to centralize the production and distribution of informative material for the different activities of the Second Study in Costa Rica. Costa Rica will publish a bimonthly informative bulletin, which will be disseminated to other participating nations.
2. To designate, for each of the nine Latin American countries participating in the study, a National Coordinator who would be responsible for initiating the necessary procedures in his/her country. The persons designated for each of the Latin American countries are as follows:

Argentina	Luis Santaló
Brazil	Klebe Cruz Márquez
Colombia	Guido Elías Valdés
Costa Rica*	Guillermo Vargas
Chile	Cristina Rodriguez
Mexico	Emilio Luis
Puerto Rico	Francisco Garriga
Dominican Republic	Eduardo Luna
Venezuela	Saulo Rada

3. In each country, a committee will be called upon to develop a table of specifications (grid), in keeping with the guidelines set out in a working document, that will be forwarded by Roy Phillipps to each National Coordinator.
4. The tables of specifications are to be sent to the IMC before September 30, 1978. The IMC will compile and revise the materials and will return them to the National Coordinators, together with sample questions for each content and process area, by December 31, 1978. At this point, each country will develop a series of questions in preparation for test development.
5. Each country will define the Population A with which they will be working during the first stage of the Study. This population should consist of students who have completed primary schooling and are approximately thirteen years of age. If the ages designated are not the same for all participating countries, a method will be devised whereby the information collected can be made comparable.
6. The National Coordinators will hold a meeting during February of 1979 to begin development of pilot tests. Previous questions developed by the International Association for the Evaluation of Educational Achievement will be used for this purpose, as will those questions developed in Latin America. The goal of the meeting will be the development of a pilot test, which will be a model for the development of national tests. The national versions of the test should be ready by April 30, 1979.

The Inter-American Committee of Mathematics Education expressed their satisfaction with the inclusion of the Latin American countries in the Second Study. They expressed their appreciation of the information provided by the IMC, as well as their satisfaction in having been able to collaborate with the other participants in such an important international study.

Finally, all participants expressed their appreciation to FONINVES and CENAMEC, and also for their hospitality during their stay in Venezuela.

PARTICIPANTS IN THE PLANNING SEMINAR FOR THE SECOND INTERNATIONAL MATHEMATICS STUDY

Caracas, Venezuela
May 1978

Name	Position	Address
Colina, Pedro José	Jefe del Departamento de Matemáticas y Física del Instituto Universitario Pedagógico de Caracas	Av. Paez El Paraíso Caracas, Venezuela Tel.: 442.57.21
D'Ambrosio, Ubiratan	Profesor de Matemática y Director del Instituto de Matemática, Estadística e Ciencia de Computação Universidade Estadual de Campinas, Brasil	IMECC-UNICAMP Caixa Postal 1170 13100 Campinas, S.P. Brasil Tel.: (0192) 2-40.85
Garriga, Francisco	Catedrático de Matemáticas	Apartado 22152, Universidad de Puerto Rico Rio Piedras, P.R. 00931 Tel.: 761-98.09
Góngora, Enrique	Vicerrector Académico Universidad Estadal a Distancia (UNED)	Apartado Nº 2 Plaza González Viquez San José, Costa Rica Tel.: 23.42.18 (Universidad)
González, Jésus S.	Profesor de Matemáticas Facultad de Ciencias de la Universidad Central de Venezuela	Departamento de Matemáticas Facultad de Ciencias Universidad Central de Venezuela Caracas, Venezuela Tel.: 35.69.29
Hernández, Elsa	Supervisor Nacional del Ministerio de Educación Profesor de Matemática	Edificio Nazareth, Jesuitas a Tienda Honda. Piso 4, Ofi. 41 Caracas 107, Venezuela Tel.: 82.93.29 (ofic.) 284.61.48 (hab.)
Luis, Emilio	Investigador Titular, Instituto de Matemáticas, Universidad Nacional Autónoma de Mexico	Instituto de Matemáticas Ciudad Universitaria, México 20, D.F. Tel.: 5-48-20-07 5-63-45-03
Luna, Eduardo	Director, Departamento de Matemática Universidad Católica Madre & Maestra (UCMM)	Departamento de Matemática UCMM Santiago, República Dominicana Tel.: 582-01.49 (hab.) 582-51.05, ext. 284 (UCMM)

Name	Position	Address
Marques, Kleber Cruz	Profesor do Departamento de Matemática e do Departamento de Metodologia Pegagocia de Universidade Federal da Paraiba, Brasil	Av. Cabo Branco, 2204, Apt. 406 58.000 Joao Pessoa, Paraiba, Brasil
Rada, Saulo	Sub-Director del CENAMEC	El Marques Apartado 75055 Caracas, Venezuela Tel.: 42.01.52 (hab.) 35.47.57 (ofic.)
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Rodríguez, Cristina	Profesor Coordinator Servicio de Desarrollo Docente, Universidad de Chile, Santiago de Chile	Ofic. Rancagua 0544, Santiago Hab. Policarpo Toro 1446 Santiago, Chile Tel.: 49.76.87 (ofic.) 28.18.36 (hab.)
Salazar, Guillermo Vargas	Catedrático Escuela de Matemáticas de Universidad Nacional y Educación Universidad de Costa Rica	Apartado 6617 San José, Costa Rica Tel.: 25-63.88 24-56.80
Santaló, L. A.	Profesor de Educación Matemática	Departamento de Matemática Ciudad Universitaria Nuñez, Buenos Aires, Argentina Tel.: 27-86.80
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Yackovlev, Vladimir	Secretario Ejecutivo de FONINVES	Av. Fco. de Miranda, Torre Europa, Piso 3. Chacao. Apartado 52.042, Caracas 105 Caracas, Venezuela Tel.: 32.46.46 32.89.51

GUESTS OF THE PLANNING SEMINAR FOR THE SECOND INTERNATIONAL MATHEMATICS STUDY

Name	Position	Address
Kifer, Edward	Associate Professor of Education	University of Kentucky Lexington, Kentucky 40506 Tel.: (606) 258-4653
Phillipps, Roy	International Coordinator, IEA	Department of Education Private Bag, Wellington, New Zealand Tel.: 73.54.99 (office) 76.64.45 (home)
Pollock, Gerard	Depute Director, Scottish Council for Research in Education	Scottish Council for Research in Education 16 Moray Place Edinburgh EH3 6DR Scotland, U.K. Tel.: 031-226.7256
Travers, Kenneth	Professor of Mathematics	130 Education Building University of Illinois Urbana, Illinois 61801 Tel.: (217) 333-8600
Valeiras, Andrés	Jefe Unidad de Ciencias Básicas Departamento de Asuntos Científicos, O.E.A.	Washington, D.C. 20006 Tel.: (202) 381-8737
Vogeli, Bruce R.	Professor and Chairman, Department of Mathematics, Statistics and Computing	Columbia University New York, New York 10027 Tel.: (212) 678-3740
Weinzweig, A. I.	Associate Professor of Mathematics, Director, Master Science in Teaching Program	Department of Mathematics University of Illinois Box 4348 Chicago, Illinois 60680 Tel.: (312) 677-3930 (home) (312) 996-8612 (office) (312) 996-3041 (office)
Wilson, James W	Professor and Head, Department of Mathematics Education, University of Georgia Editor, Journal for Research in Mathematics Education	105 Aderhold Hall Athens, Georgia 30602 Tel.: (404) 542-4194