ICMI BULLETIN

NUMBER 3

April 1974

CONTENTS

1. Report by the President

It is a pleasure to report on three important new developments in the sphere of mathematical education that are likely to arouse general international interest. ICMI Bulletin No. 2 issued in November 1973 referred to negotiations in progress with UNESCO and CEDO for a symposium in Nairobi, Kenya: a project of great importance to ICMI as the first in a series of Regional Symposia concerned with aspects of mathematical education. Full agreement between UNESCO, ICMI and CEDO for a major Symposium on Interactions Between Linguistics and Mathematical Education to be held from 1 to 11 September 1974 in Nairobi, Kenya has now been reached on the basis of the document reproduced below as section 2. I should like to express my warm appreciation for the outstandingly cooperative and constructive efforts of the officials of UNESCO and CEDO in making possible a meeting which had been so strongly advocated at the Second International Congress of Mathematical Education at Exeter.

An important item of news, that may be of general interest to those concerned with the accumulation and propagation of knowledge in education, is the setting up of a central, supraregional Institute for Didactics of Mathematics in the Federal Republic of Germany at the University of Bielefeld. ICMI believes that the details of this development, reproduced below as section 3, will be carefully studied by workers in the field in many countries.

Plans for a possible ICMI Symposium on the Teaching of Geometry, referred to in earlier ICMI Bulletins, have in the last few months been taken much further. It has now been decided, with the enthusiastic agreement of all those interested, that the meeting will take place at the new Institute for the Didactics of Mathematics in Bielefeld from 16 to 20 September 1974. Details are set out in section 4.

In the meantime, large numbers of representatives of many countries have already made their plans to attend the Education Section of the International Congress of Mathematicians in Vancouver, Canada from 21 to 29 August 1974 and take part there in the special ICMI Symposium 'Evaluation of Modern Mathematics Curricula'. I look forward keenly to meeting again very many ICMI members and numerous other persons concerned with mathematical education in Vancouver at what will clearly be a most constructive discussion of this important topic.

Excellent news is being received also from the Japan Society for Mathematical Education, joint sponsors with ICMI of the Regional Symposium to be held in Tokyo from 5 to 9 November 1974, concerning the very strong regional interest in, and enthusiasm for, this meeting. The Executive Committee of ICMI intends to continue its policy of active participation in the organisation of major meetings on mathematical education all over the world in years to come.

James Lighthill

2. UNESCO/ICMI/CEDO Symposium at Nairobi in September 1974

Summary

UNESCO, in co-operation with the International Commission on Mathematical Instruction (ICMI) and with the Centre for Educational Development Overseas (CEDO), proposes to sponsor a Symposium on the interactions between linguistics and mathematical education. It is expected that the Symposium will be held in Nairobi from 1st to 11th September 1974, and that it will involve the participation of 15-20 nationals of anglophone African countries together with 5-10 international specialists.

Origins

The Second International Congress on Mathematical Education was convened by ICMI at Exeter, United Kingdom, in September 1972. Among the recommendations it then made were two which eventually gave birth to the proposed symposium; that in the years between full meetings of ICMI there should be regional conferences or symposia on specific themes; and that "fundamental research should be undertaken on the relation between the learning of the basic mathematical structures and the language through which they are learnt". Subsequently, it was decided to try to give effect to these two recommendations by seeking funds to make possible the holding of a regional symposium in Africa in 1974 on the interactions between linguistics and mathematical education.

Accordingly, ICMI's President, Sir James Lighthill, approached UNESCO to explore UNESCO's interest in jointly sponsoring such a symposium. Soon afterwards a similar proposal was made to CEDO. The upshot was a commitment by all three bodies to contribute to the cost of the Symposium.

On UNESCO's behalf the Programme Specialist within the Division of Pre-University Science and Technology Education has been entrusted with making the detailed arrangements in consultation with a small planning committee representative of the three sponsoring bodies.

The Nature of the Problem

The very complex problem area which is indicated by the title "Interactions between Linguistics and Mathematical Education", includes difficult - and unsolved - problems such as the role of language in concept formation, the role of language in thinking and reasoning, the significance of language for the attainment of clarity and precision, and the influence of language on the individual learners conception and even perception of mathematical ideas.

The learning of mathematics begins with discrete and countable objects, with the recognition of shape and size, and with the notion of matching. Repeated experiences with real things lead to the emergence of pattern, and abstract ideas, such as number and shape, are discovered, and practical problems become soluble when their mathematical essence can be perceived, worked on and re-translated into meaningful reality.

The acquisition of mathematical ability is a subtle process, but dialogue between the learner and the teacher is imperative, and this depends upon effective communication. Hence, clarity and precision of language is a sine qua non of a sound education in mathematics.

Difficulties in the learning of mathematics thus depends on the language of learning, because different languages "support" precision and exactitude in different ways. For example, Sinhala, the medium of education in Sri Lanka, has only one word for a four-sided figure. In such

ircumstances the properties of a rectangle or of a parallelogram can nly be explained by the invention of new words or by circumlocution. ut limitations of vocabulary are minor impediments compared to the ifficulties that may arise when the structure of the language used as edium for teaching and learning is not well suited for the description f mathematical ideas and structures or for deductive reasoning. The pecial features of the native language in this respect may cause very reat problems for the learner of mathematics.

Some "limitations" of Yoruba were interestingly described by Professor aiwo of the University of Lagos in a paper presented to the Conference on athematics in Schools organized by the Commonwealth Secretariat in 1968. detailed, and fascinating, description of the problems of teaching athematics to the Kpelle of Liberia has been set out in a book entitled The New Mathematics and an Old Culture" by John Gay and Michael Cole. uch studies, however, are rarely undertaken, and the dearth of knowledge f the impediments to learning mathematics which arise from the medium of earning being wanting, is very great indeed.

It should, however, also be emphasised that vernacular languages may include linguistic features of benefit for the acquisition of certain athematical concepts. Such features should clearly be exploited in the rganization of mathematics teaching whenever it is possible.

That yawning pitfalls of linguistic uncertainty stand in the path of nderstanding is the universal experience of all who strive to improve he teaching of mathematics, whether in the developing or in the more eveloped coutries of the world. And while difficulties are encountered t all levels, primary, secondary and tertiary, at no level are they more cute than at primary. This is because it is now a mostly accepted octrine that the young child should, as far as circumstances allow, egin his schooling in the medium of his mother tongue, even if other considerations require his subsequent education to be given in a second r third language. Consequently, unless special measures are taken, concept formation in mathematics can be delayed, to the extent that the ocal language has limitations in the vocabulary and structure needed for nderstanding.

In Africa, as is well known, local languages are so numerous that the language of learning after the third or fourth primary class has to become a world language, English in anglophone countries and French in franco-phone countries. Before then, the young child may have been lucky enough to learn in his mother tongue, and when it is not he will begin to learn in a local language which is not the one he uses at home. In such circumstances the difficulties for the child are presumably compounded. In either case, however, it should be investigated in which ways the special features of his native tongue or of the local language will interact on his subsequent ability to acquire mathematical concepts when the second or third language of learning takes over.

While many contrastive studies have been made in the field of linguistics, the overwhelming majority are of a general nature. Such studies as are necessary to bring to light the linguistic implications for a relevant mathematical education are almost non-existent.

The Objectives of the Proposed Symposium

The planning committee agreed that the objectives of the Symposium should be four in number:

(1) To contribute to the systematization within the field of those difficulties in mathematical education which pertain to linguistics, and further to analyze these difficulties and their mutual relationships. This would involve:

1.1 identifying the role of linguistic components in the teaching and learning of mathematics at various levels and in various topics;

1.2 identifying the extent to which difficulties experienced by learners derive from the particular features of indigenous languages or dialects;

1.3 identifying the difficulties which confront the learner when the language of teaching (and communication) is changed from the mother tongue or from a local or regional language to an international language;

1.4 identifying in which ways the difficulties for the learner of mathematics are influenced by the degree of mastering, on the part of the teacher, of the languages involved in the total context of the teaching process.

(2) To identify pedagogical approaches that may help the African learner of mathematics to overcome those of his difficulties which arise from his own linguistic background, and to indicate how such approaches might be put into practice.

(3) To identify problems calling for further studies and research and to indicate how and by whom such activities might be put in hand.

(4) To provide a report which would be of service to mathematics educators in all, but particularly in African countries, and which might be useful as a background material for further studies of the theme, e.g. in connection with the next International Congress on Mathematical Education.

Scope and participants

The theme of the Symposium is clearly of world-wide concern, because difficulties inherent to language and communication are recognised in all countries, including those in which all mathematics education takes place "in" one language. But such difficulties are of much higher order in countries where two or even more than two, languages are used as media for teaching and learning. Although, therefore, the symposium will be of particular relevance for developing countries, it should be emphasized that this symposium, which was envisaged originally by ICMI as a regional meeting for mathematics educators in Africa, and which will be the first of its kind, should be followed up by meetings in other regions, and by other activities afterwards.

For reasons of economy, and also because the complexity of the theme calls for a modest start, the planning committee agreed that certain further restrictions should be made.

First it was agreed that the problems to be studied at this Symposium should specifically relate to mathematics education in "anglophone" African countries. This restriction concentrates the field of investigation, and it implies also that English will be the working language of the Symposium.

Another restriction arises from the fact that, although the work of

the symposium will have implications for mathematics education at all levels, the immediate interest will be in education at pre-university level, and that its main emphasis will be on mathematics in general education. Thus, the work of the Symposium will concentrate on mathematics at the primary and at the intermediate levels.

Next, as to the character of the meeting, it was agreed that although difficulties in teaching and learning are encountered by mathematics teachers at all levels, it was not yet opportune to bring together a large number of teachers for a general discussion of the theme with specialists from the field of linguistics. The difficulties are easily seen, but not the means to counteract them, and hence such a meeting might not bring worthwhile results. Accordingly, the first step should be to ensure a more detailed discussion, at which only 15-20 selected National mathematics educators, chosen for their special interest, knowledge and experience in the theme (and each invited in his personal capacity), might analyse the problems in cooperation with 5-10 specialists, mostly linguists - and preferably linguists with special knowledge of mathematics and science.

Time and place

The symposium is planned to be held from September 1 to 11 in Nairobi, within the framework of the UNESCO Field Science Office for the African Region. Participants will arrive Sunday, September 1, and leave Wednesday, September 11. The Symposium will thus occupy nine working days.

Working methods

It is expected that the work of the symposium will begin in plenary sessions, and that working groups and writing teams will emerge in response to the needs of the meeting and of the theme as these needs appear.

Working documents

It is hoped that the findings of the Symposium will be built upon practical pedagogical experience of the handicaps to learning mathematics which arise from difficulties which relate to language and communication, and of how these can be mitigated. To this end, it is intended to commission five preparatory studies. But, in addition, it is particularly hoped that the participants themselves will bring to the Symposium practical material which will illustrate how problems of communication of mathematical ideas can be solved or circumvented.

The studies to be commissioned will, it is hoped, provide participants before they assemble with background information on the contributions which linguistics generally, and which those of socio-linguistics and of psycho-linguistics particularly, can make to education in mathematics. Other studies will aim to summarize experience of linguistic problems encountered by contemporary curriculum development projects in mathematics, and provide a succinct exposé of a contemporary approach to the teaching of mathematics indicating some of the main areas of interaction between linguistic and mathematical education.

In addition to the above, it is intended to prepare an annotated bibliography and to establish a small library of reference for the use of participants during the symposium.

Further information about the Symposium

The findings of the symposium will eventually be made public in the form of a report which UNESCO will make available.

Further information regarding the Symposium may be obtained by contacting the Programme Specialist in Mathematics, Division of Pre-University Science and Technology Education, UNESCO, Place de Fontenoy 7, 75700 Paris, France.

3. Institute for the Didactics of Mathematics newly founded at the University of Bielefeld

In 1969 the Volkswagenwerk (VW) Foundation had invited tenders for various projects with a view to furthering the didactics of mathematics and natural sciences, the main project being the establishment of a central, supraregional Institute for Didactics of Mathematics (IDM). Several universities had applied for the IDM. In January 1972 the VW Foundation decided in favour of the application sent in by the University of Bielefeld.

After the advisory board for the establishment of the IDM together with the University of Bielefeld and the VW Foundation had finished the preparatory work the first posts could be filled at the IDM in 1973. With Professor Dr Michael Otte as managing director the Institute started work on October 1st, 1973, being temporarily located in rented rooms at Jöllenbeck near Bielefeld. Meanwhile, Professor Dr Heinrich Bauersfeld, Frankfurt, and Professor Dr Hans-Georg Steiner, Bayreuth, after having accepted their 2 appointments, have also joined the IDM. Presently the IDM is staffed with 4 scientific and 9 non-scientific collaborators besides the 3 university professors. For the time being a staff consisting of 20-25 professors and scientific collaborators, including also posts for guests from Germany and abroad, is considered as a possible final capacity.

The tasks of the Institute for the Didactics of Mathematics include the promotion of mathematical didactics by means of research, development and advisory activities, comprising in particular:

a) Assistance with curricular development in the field of mathematics learning, by theoretical and experimental work

b) Elaboration of a theoretical framework for research in the domain of mathematical didactics, in close interdisciplinary connection with the advances of mathematics and other sciences of reference

c) Promotion of young scientists working in the field

d) Building up of an international library for mathematical didactics, encouragement of contacts at home and abroad, distribution of information and promotion of public relations.

Its main fields of study under consideration for the nearest future will still have to be defined more closely by the IDM. A team has begun to review and evaluate the contributions on educational psychology published by Bruner, Piaget and others, with reference to their importance for mathematical didactics. The results are to be reported in one of the first numbers of a series of publications planned by the IDM. In May 1974, together with staff members of the IREM, Paris, a workshop addressed to problems of the renovation of mathematics teaching at senior high school and college level and a development and situation analysis related to the problem whether teaching of set theory at the elementary shcool is useful or not.

Moreover, an international special conference on problems of geometry teaching, which is to be organised together with the International Commission on Mathematical Instruction (ICMI) as well as a symposium on basic problems of cognitive learning are planned for 1974. Furthermore, the IDM will assist in arranging the programme for the 3rd International Conference on Mathematical Education that is to take place in the Federal Republic of Germany (Karlsruhe) in 1976 and which 2000 participants from all over the world are expected to attend.

The city of Bielefeld provides most convenient conditions for a cooperation of the IDM with local institutions. In addition to the university departments of mathematics and of pedagogy, philosophy, psychology with which the IDM keeps up close institutional contacts in the field of research and teaching, mention might be made of the Zentrum für interdisziplinäre Forschung, the Institut für mathematische Wirtschaftsforschung, the Laborschule and the Oberstufenkolleg of the University of Bielefeld, the Pädagogische Hochschule and the schools in the Bielefeld area.

The address of the Institute is:

Institut für Didaktik der Mathematik,
Universität Bielefeld,
D-4801 Jollenbeck (FRG)
Heidsieker Heide 94.

Tel: 05206/ 2505 - 6

4. ICMI Symposium at Bielefeld in September 1974

The ICMI Symposium on the Teaching of Geometry (which was at one time expected to be held in Copenhagen) has now been finally arranged. It will take place at the Institute for Didactics of Mathematics in the University of Bielefeld, Federal Republic of Germany, from 16 to 20 September, 1974.

The meeting is planned to commence at 3pm on Monday, 16 September with a report on the present situation, followed by a discussion in groups and a plenary discussion. The mornings of 17, 18 and 19 September will be reserved for three papers each, followed by group work, reports and plenary discussions in the afternoons. The Symposium is to be concluded on the Friday morning with short statements and a general discussion about future work.

All those interested in this ICMI Symposium on the Teaching of Geometry should contact:

Professor Dr H. G. Steiner,
Institut für Didaktik der Mathematik,
Universität Bielefeld,
D-4801 Jöllenbeck,
Heidsieker Heide 94.