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Paper 1

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A Development Program of Curriculum Reform in Mathematics

Preamble

It seems probable that some USAID offices in Africa will agree to support programs of curriculum reform in their host countries. This paper suggests some short and long term objectives and lists chronologically tasks which will become necessary in such developmental programs.

Short and Long Term Objectives

There are three phases in the long term plan for curriculum development. The first phase is the creation of the cadre of local people who recognize the need for change, who have a background knowledge of the subject matter and who are in positions to assume leadership in bringing about the change. These people are normally senior subject matter specialists in the Ministries of Education and the senior subject tutors in the one or two prestigious Teacher Training Institutions (possibly Institutes of Education) which exist in host countries.

The second phase is the developing of a wider base for the spread of change by ensuring that in each training college and in each district there are people capable of introducing suitable courses in the college, organizing and teaching in-service courses for teachers already in the schools and supervising the introduction of the reform programs into the pilot schools. The people who can undertake these tasks are the teacher training college tutors and the Inspectors of schools or District Education Officers.

The third phase is the setting up of innumerable in-service courses throughout the country over a period of seven or eight years, the complete change of textbooks as teachers capable of dealing with the new texts appear in the schools and a general supervision of placing of staff to ensure that there is no break in the mathematical development of the children as they pass through the school. The people to undertake these tasks are the District Education Officer, the Tutors from Training Colleges, the Inspectors of Schools and, of course, the teachers themselves.

Chronological List of Activities

1. Continuation of experimental and evaluation programs initiated under USAID/W contract RES 21 and continued under USAID/W contract 1567.

   This entails:
   (a) Supporting Teacher Training Institutes to prepare teachers for experimental classes in primary and secondary schools.

   (b) Supply of textbooks to these classes.

   (c) Supervision of the work in the classes.

   (d) Evaluation activities.

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The experimental program will continue for at least another four years. Its purpose is to test the suitability of the textbooks prepared under the program. At this date experimental work has been terminated in Standards 1 and 2 and in Form 1.

2. Introduction of modern mathematics courses into the main teacher training colleges

   (a) The ABC graduates who took part in the two year ABC Teacher Institute organized by EDC can be used to staff these courses in the one or two large colleges.

   (b) The Entebbe Basic Concepts texts will be the basis of the courses.

   (c) A well qualified mathematics educator should be available to supervise these courses, to help in their preparation and to act as a visiting lecturer.

   (d) Audio visual aids will be supplied to the colleges.

This will be an ongoing activity.

3. Introduction of modern mathematics courses into pilot schools close to the main teacher training colleges

   (a) The teachers of these classes will be selected experienced teachers who have been used in the experimental program.

   (b) Their work will be supervised by the college staff.

   (c) Modern Mathematics texts will be supplied.

This will be an ongoing activity.

4. Organization of a series of in-service courses for Primary and Secondary Teachers

   (a) Initially these courses will be staffed by participants of the ABC Institute and by local personnel who have attended the African Mathematics Program Workshops which produced the Entebbe Mathematics Series.

   (b) The resident or local mathematical educator and a visiting mathematician will supervise and assist in these courses.

   (c) The Entebbe Series Basic Concepts, Teacher Handbook, Primary and Secondary texts will be supplied for the courses.

This will be an ongoing activity for many years.

5. Organization of a Two-Year program of mathematical education for tutors from all Primary Teacher colleges in the country

(a) This course would be partly residential -- during vacation -- and partly a correspondence course.

(b) It would be staffed by the mathematics educator or ABC and workshop participants.

(c) The early emphasis of the course will be on the additional knowledge of mathematics necessary.

(d) Later emphasis would be on the setting up of good teaching courses within the colleges.

(e) Correspondence courses would be supervised by the staff of the main colleges acting as centres for smaller colleges within their hinterland.

(f) Entebbe Series texts would be supplied to the participants.

This activity need not be repeated immediately.

6. Introduction of modern mathematics into secondary schools

(a) After one or two years of secondary in-service courses it should be possible to introduce modern mathematics into all Form 1 classes in secondary schools.

(b) This introduction of new materials should not take place until there is available a local mathematics supervisor to visit schools to assist the teachers in the work of organizing their new program. The teachers will need occasional evening or weekend seminars to reinforce their efforts on this new work.

(c) The mathematics educator will also assist in such seminars.

(d) Modern mathematics texts will be supplied.

This will be an ongoing activity

7. Introduction of modern mathematics courses into all teacher training colleges after two years

(a) At the end of the Two Year Tutor Course, modern mathematics courses will be introduced into all colleges.

(b) The tutors who have participated in the Two-Year course will staff these courses.

(c) The tutors will be supervised by the mathematics educator and the senior tutors from the main teacher training colleges.

(d) Audio visual aids will be supplied by the tutors.

(e) Entebbe Series Texts will be supplied to the colleges.

After introduction this will be an ongoing activity.

8. Adaptation of Entebbe Texts to suit local needs

(a) Within two years a group should be formed to make recommendations on the production of a local adaptation of the Entebbe Texts.

(b) This group should consist mainly of nationals.

(c) If adaptation is decided upon, the authors of the adaptation should be nationals.

(d) A well qualified mathematician (expatriate or national if available) should approve changes made in the text.

9. Introduction of modern mathematics into the Primary Schools

(a) The modern mathematics courses should not be introduced into a primary school until there is a reasonable certainty that over the years there will be teachers capable to deal with the children who start the course in Primary One. This condition is necessary because mathematics is a structured program and the new approach and content cannot easily be dropped and taken up again if teachers are not available at every level when needed. Moreover, because of the unusual mathematical skills and ability developed by children using the new material, teachers in the upper grades unless trained to cope, could find themselves completely out of their depth dealing with children accustomed to the new math.

(b) Thus, it may be necessary, through careful planned placing of teachers, to introduce the new material gradually by regions - spreading out more and more as teachers become available.

(c) In the plan described, with a committment for continued in-service courses for teachers in the upper grades, it should be possible after three or four years to introduce the new programs into all the schools of a region.

(d) The work in these classes would be supervised by primary inspectors who have participated in the tutors' courses. They would also be assisted by the mathematics staff of the local training colleges.

(e) Textbooks will be supplied -- at an increasing rate as the work expands from region to region.

10. Completion

With a planned program of teacher education and depending on the teacher education resources, introduction of the new material into all classes would be completed within ten to fifteen years.

Paper 2 6

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Plans for Development of Programs of Reform of School Mathematics in African Countries

Local, Regional and Pan-African Aspects

None of the countries which have participated in the African Mathematics Program have the personnel or the materials to enable it to undertake unaided a plan for development as outlined on the attached paper. Only one or two have the financial resources available to see such a plan brought to a successful conclusion. In most countries the implementation of the plan will depend on help given by USAID, or another organization. The help required will be in the form of:

1. Expertise: Mathematical, Pedagogical and Administrative
2. Material: Supply of texts; publication of adaptations
3. Financial: Assistance in covering costs of in-service courses and providing new textbooks

Local

In many ways the plan for development will be very much a local, national effort, requiring intensive help at the local level. Thus, the resident mathematical educator would be appointed for a particular country. The consulting visiting mathematician in the early years of secondary school reform might very well be deeply involved in local activities. Similarly the planning of college courses, and in-service courses, is very much an internal affair as indeed would any financial aid given to cover the costs of such courses, or the provision of textbooks for college courses and schools.

To ensure proper co-ordination of all these efforts separate contracts (or sub-contracts) will be needed for each country.

Regional

It is also clear, however, that there are some activities and needs which will cut across national boundaries, and also that regional relationships are possible that will reinforce national efforts. Clearly, also, if regional or multi-national efforts can be mounted, a saving in costs might be possible. The regional or multi-national reinforcements and relationships could be as follows:

1. Expertise

a) The expatriate appointees should be required to work together regionally to build up and strengthen the cadres of local people capable of assuming leadership in the future. The mathematical educators and consultant University mathematicians

should be required to combine to set up short regional courses for the tutors of the main colleges and for mathematical administrators to ensure that the college programs are effective and that adequate supervision of classroom activities will be possible. Such week-long or weekend seminars could be held two or three times a year.

b) The mathematical educators and consultant University mathematicians from neighboring countries should be available to reinforce local efforts on crucial courses. It will be possible to combine and interchange staff.

c) A regional super-structure will make possible the employment of consultants especially well qualified in particular areas, the alternative being the appointing of "mathematical generalists". Thus, someone especially well experienced in Primary School Mathematics to go to one country, someone else with a special interest in Algebra to another, and one in Geometry to a third. Under a regional approach the expertise of all three could be available to all three countries.

d) The Administration of the program will be more effective and less costly if there is a regional involvement.

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a) Book production will be cheaper if regional agreement can be obtained. This does not negate the possibility of inclusion of detailed reference to local places and customs in the texts. (Much of each textbook is abstract symbolism -- easily reproduced for many countries.)

b) The mathematical supervision of local adaptations can be done regionally and very easily if the adaptations reflect only the need to refer to local places and customs.

c) A more efficient use can be made of video tape and film and other aids if there is a regional co-ordination.

!. Financial

Cost of textbooks will be reduced considerably if publishing was undertaken on a regional basis.

Pan-African

There are advantages to be gained in maintaining some of the Pan-African aspects of the present African Mathematics Program. In the first place, the Pan-African activities will remain until the work of experimentation with the textbooks for the higher classes is completed, and until the conclusion of the work on evaluation.

There are also good reasons for helping to maintain and extend the contacts within African Mathematics. In the long run, these Mathematicians must assume responsibility for the quality of mathematics in Africa. Their contribution to the African Mathematics Program has been very great. They have acted as advisers to the Program, authors of textbooks, motivators of reform and have assisted in running courses inside and outside their own countries. African Mathematics still needs this contribution and the mathematicians themselves still need to communicate with each other if their interest in school mathematics is to be continued.

Paper 3 9

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The Place of Education Development Center in Programs for the Development of Curriculum Reform in School Mathematics in African Countries

All of the countries presently participating in the activities of the African Mathematics Program will require assistance if programs of complete implementation of curriculum reform are to be initiated. Few, if any, of the countries will have a local mathematical educator or a local University mathematician to assist in the early years of the program. Few will be able to provide the textbooks or audio-visual aids needed to strengthen the teaching of the inadequately trained and inexperienced tutors. None will be able to finance the very many in-service courses needed, without adversely affecting educational development in other areas. Extensive assistance will be necessary.

Short Term Objectives

The AID missions which decide to support these programs will initially have to provide assistance for the first two phases of the programs:

(a) the strengthening of the leadership cadre and

(b) the development of teacher education and supervisory capabilities so that

(i) all colleges are preparing teachers for "new" mathematics and are ready to organize regularly in-service courses and

(ii) there is supervisory staff in local areas ready to help teachers introducing the new mathematics.

This assistance can be given in many ways. If direct grants are given, there must be some confidence in the ability of local Ministries, normally already heavily overloaded, to initiate, plan, organize and supervise the steps required by the program. Local autonomy of this sort tends to minimize the possibility of regional or Pan-African reinforcement and sometimes creates frustration in the expatriates appointed to the Ministry to help with the work.

An alternative approach could be to engage contractors to assume responsibility for the programs. In such an arrangement, the contractor, with the agreement and co-operation of the Ministry, would co-ordinate all the efforts needed to bring the program to a successful conclusion. He would engage, supervise and support necessary local and non-local staff, whether they are to operate separately, or through the Ministry or through some

curriculum development centre; he would be responsible for the availability of materials, textual and audio-visual; and he would organize and ensure adequate staffing of teacher training institutes.

Under this approach the African Mathematics Program of Education Development Center would be able to offer some special advantages as a contractor.

Local

(1) It has the most friendly and co-operative relationships with the Ministries of Education of all the participating countries.

(2) It has good relationships with local nationals who are knowledgeable about modern mathematics because it has either given them training in institutes, or they have participated in the Workshops which produced the Entebbe Mathematics Series.

(3) It has over six years of experience of co-operating with local officials in setting up and assisting in staffing in-service courses.

(4) It has close contacts with mathematicians in the United States who, under its auspices, have assisted in in-service courses in African countries.

(5) It is already deeply involved in the experimental program which at this stage cannot easily be handed over to some other group.

(6) It knows well the people in Africa who are likely to be called upon to undertake adaptations and will be able to offer these people the consultant advice of mathematicians who participated in the original workshops.

(7) It has a detailed knowledge of the present development of mathematics curriculum reform in most of the countries.

Regional

(1) Through its ABC Institute program it has had the experience of developing leadership cadres through a mixture of residential and correspondence courses which cause minimum upset to the staffing situations in the countries.

(2) It has already been successful in bringing about co-operation between personnel in two or three countries to reinforce each other's efforts.

(3) It already has an administration geared to operate on a regional level.

Pan-African

(1) It already has an administration ready to act at a Pan-African level when necessary.

(2) It is already controlling the experimental program on a Pan-African base, thus ensuring the availability of texts as needed and at a minimum charge to the program.

(3) It has already given thought to the evaluation aspects of the program and has set up a loose organization on a Pan-African base to handle this evaluation.

(4) It has the contacts with the African mathematics community and is most likely to ensure the continuing interest of the community in curriculum reform of school mathematics.