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9. ABSTRACT

Educators in developing countries are likely to achieve more by applying the principles rather than the things of educational technology. The principles of programmed learning have been shown to be effective in promoting learning in a wide variety of circumstances. The most effective instructional materials can be developed through use of the principles of programmed instruction and mastery learning. Radio, when combined with the use of peer tutors, can be an effective educational tool in developing countries. The concepts of programmed learning and mastery learning can be incorporated in the design of education radio programs. Such programs, accompanied by peer tutors, can accomplish the total educational effort within the resources of many developing countries. This type of educational system is a viable alternative to traditional formal education. Such a system should be tried in several developing countries to explore its full potential.

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THE USE OF PEER TUTORING AND PROGRAMMED RADIO INSTRUCTION - VIABLE ALTERNATIVES IN EDUCATION

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THE USE OF PEER TUTORING AND PROGRAMMED RADIO INSTRUCTION - VIABLE ALTERNATIVES IN EDUCATION

Educators of the world appear to fall largely into two major classes. The time, energy, and imagination of the larger number appear to be totally consumed by the demanding daily activities of teaching by which they are enmeshed. A much smaller group is dedicated to seeking a massive breakthrough in education by means of large scale innovation and technological reform. Admittedly, millions of educators must tend each day to the routine, full-time job of teaching even more millions of youngsters. And certainly educational researchers should be looking for exotic solutions to educational problems, the educational analogue to the electronic transitor or the polio vaccine. Both groups are important to education, but somewhere between these two extremes is an area of far too little activity and attention. That is an area of world education in which there is a desperate need for more designers who search for ways of providing better educational practice with presently available materials and human resources.

Henri Dieuzeide (1971) has called this area "intermediate educational technology." Intermediate technology, originally an economic concept, "... is based on the idea that intermediate levels of technology should correspond to intermediate levels of development (Dieuzeide, 1971)." This is an idea which merits wider currency, for while the concept of intermediate technology is most obviously of value to developing nations, more developed nations may profit from it as well. Education, only one of many national activities, has barely passed the level of intermediate development, even in the most advanced nations of the world. When one compares education in any given nation to almost any other class of institutionalized activity imaginable--medicine, industrial production, transportation, even advertising--it is clear that education is in a comparatively primitive state. As one type of remedy for this situation, the development, study, and exploitation of intermediate technology for education should receive greater attention and emphasis. The products of these efforts should yield for education rapid and widespread return on time and money invested.

With this goal in mind, The Center for Educational Technology (CET), at Florida State University, has fostered interest and research efforts ranging from areas of basic technology to those of great sophistication. The potential of low-cost print media, for example, has been examined concurrently with that of the geo-stationary space satellite. Such explorations have involved CET with nations at different levels of development on several continents, and have led to a number of tentative conclusions, some of which have been drawn by others as well (Coombs, 1973; McAnany, 1973; Schramm, 1973).

The first of these conclusions is that there is a much greater potential for impact on educational reform in developing nations through the use of the principles rather than the things of educational technology, a point emphasized by Dieuzeide and others. Following this same approach, the Commission on Instructional Technology in its report, To Improve Learning (Tickton, 1971), gave two definitions for instructional technology, one relating to the equipment and things of instructional technology, and the other relating to process. The Commission seemed to prefer the latter definition of educational technology as a body of technical knowledge about systematic design and conduct of education based upon scientific research (Gagné, 1974).

The second conclusion is that these principles of instructional technology have been applied in a number of instances where the resulting increased power of programs has been clearly evident. It is also believed that a great deal more generalization of these experiences is feasible in the immediate future in many countries. For example, the application of the principles of programmed learning to the design of packaged instructional materials for middle level children has led to dramatic learning results in the Republic of Korea (Kim, 1970).

Thirdly, it is CET's conclusion that radio is almost universally available to people of the world although its utilization as an instructional tool has been greatly neglected. The contribution that the radio can make to educational and instructional practice is well documented (Chu & Schram, 1967; McAnany, 1973).

The fourth conclusion relates to the exploitation and use of a universally available resource, the non-professional human being as a teacher. Undoubtedly the oldest and most primitive form of educational practice was for one human being to show another how to perform a task of some kind; the concept of "each one teach one" is ancient and honorable. It is CET's contention that this lowest cost, most widely available instructional resource--the peer tutor--can be technologically enhanced. However, there are many unanswered questions with respect to the use of peer tutors, some of which are dealt with at length further in this paper.

The fifth conclusion is that three critical and available resources: (a) the concepts of programmed instruction and mastery learning, (b) radio, and (c) the peer tutor, can be joined together empirically in such a way as to generate a teaching/learning system which will have the following important features. The system will be relatively inexpensive and, in terms of absolute costs, within the reach of most developing nations. Further, such an integrated system can be designed, built and operated by local educators without significant outside technical or financial assistance and would be only mildly disruptive of ongoing practices when introduced into existing schools. Most important, it is estimated that the new system will result in discernibly better learning and lower student attrition rates, as well as operating almost as effectively in nonformal and adult education as in the formal classroom setting.

Programmed Instruction

Several developing countries have used programmed instruction (PI) as a viable application of an intermediate technology. The learning concepts upon which the development of programmed instruction is based are clearly sound and the ambition to use PI as an instrument for educational reform in developing countries is worthwhile. There is no doubt that the advent of PI in the United States in the late fifties has had an enormous effect on public education.

Let us review some of the important features of PI that distinguish it from more conventional forms of instruction. In PI, the instructional objectives are precisely spelled out, for the PI developer knows what behavior his instructional sequences must produce in the learner. The learning objectives and their corresponding instruction are carefully analyzed in terms of the order or sequence of the learning process. To be most effective, the learning should proceed from the simple to the complex; from the concrete to the abstract. In its earliest forms PI usually consisted of a series of steps called "frames" with each frame consisting of three elements: stimulus information to which the learner was exposed; the requirement for an appropriate response based on this stimulus information; and finally, informational feedback to the learner concerning the correctness or adequacy of his response. At its inception, these frames were simply chained from end to end into a sequence of instruction. Since that time, more imagination and variety have been introduced into the PI format. Another characteristic of PI is the process of empirical validation of its instructional effectiveness. During the PI development process the individual programs are tried out on samples of learners from the target population for which the program is designed. Those parts of the programs which do not reach a pre-established criterion level are replaced or revised until they do. Put another way, if the PI does not teach the target students in a satisfactory manner, it is concluded that the inadequacy lies in the program rather than the learners.

PI that was developed by researchers and educators in the late fifties and early sixties varied somewhat in format. Some were designed in modular form to serve as an adjunct to traditional forms of instruction, in contrast to others designed to bear the entire instructional load for parts of or entire courses. Many who participated personally in the development of PI during this period will remember the promise that was envisioned for the improvement of education through its use; however, by 1965 it had become apparent that PI was not the educational panacea that many had hoped for. While there were many PI titles available to schools, and most schools had bought at least some programmed books, the inescapable facts were that virtually no children were spending any significant part of their learning time with these types of materials. It was thought that with the passage of time PI would come into greater use in the schools, but this has not been the case.

The net effect of the PI movement, at least in terms of the use of actual programmed materials, is dismal at best. However, there is a brighter side to the study. By the late sixties it became obvious that the PI activities earlier in the decade were bearing other, quite unexpected fruit. While PI in book-form did not gain wide acceptance, it generated some important by-products in that the concepts that gave rise to PI in the first place are now being applied to other aspects of the learning environment. The concept of defining educational goals in terms of observable behavioral objectives is perhaps the most basic outgrowth of PI. Now familiar to many educators throughout the world, behavioral objectives are having a major and somewhat controversial impact on educational thought and practice. The development of individualized instructional programs, performance contracting, educational accountability, reinforcement/contingency management, and mastery learning all derive from the basic work accomplished in PI. Even more recent by-products are computer-assisted and computer-managed instruction as well as programmed multimedia instruction. All are part of what we now call "educational technology."

Mastery Learning

It is probable that the basic principles of learning essential to programmed instruction are applicable to the development of almost any form of instruction and that the instruction will be demonstrably superior when these applications are made. One of the most interesting examples of the application of PI principles in the development of instructional strategies is the process commonly referred to as "mastery learning," a technique conceptualized by Carroll (1963), Bloom (1968), and Skinner (1968). Incorporating the basic elements of effective instruction, mastery learning can be produced more quickly and inexpensively than PI, yet it incorporates the same principles and seems to yield learning effects that are as good as, if not better than, PI.

In mastery learning, as in PI, the first task for the educational developer is the definition and sequential arrangement of objectives for the course of instruction. This procedure was carried out by Benjamin Bloom for a single college course at the University of Chicago, while in the Republic of Korea Bom Mo Chung and his associates at Seoul National University developed objectives for the seventh through ninth grade courses in science, language, and mathematics. In both of these instances the behavioral objectives were derived from curricula that were already in use, although they could have been as effectively developed for a new curriculum or content. After careful systematic analysis of the subject matter to be taught, these objectives were specified and ordered in a learning hierarchy in the fashion described by Gagné (1970). Such an analysis serves to reveal any gaps appearing in the sequence of objectives, any irrelevant or superfluous objectives, and any objectives not in the appropriate order.

The next step in developing mastery learning is to construct "formative" and "summative" evaluation instruments. These are criterion-referenced tests in that they are designed to measure as accurately as possible the students' attainment of the specific objectives on an absolute scale of reference. The purpose of these tests is not to compare one student's achievement with that of another, but to inform the student and his teacher of which objectives the student has and has not mastered. Primarily designed for the student's own use, formative tests are modular in form and sequentially correlated with the instructional objectives, measuring achievement for particular blocks of objectives. Summative tests, on the other hand, enable the teacher to objectively assess the student's achievement as specified units of learning are completed.

Instructional events are organized around the specific objectives. Unlike PI which employed stimulus and response frames, the instruction in mastery learning can take any available form appropriate for the objective at hand. Typically, some reliance is made on already available instructional resources such as library materials, text and workbooks, or

audiovisual materials. However, there is a significant departure from the conventional practices of instructional materials selection in that the course developer carefully analyzes the available materials, thus directing the learner to the specific portions of the materials germane to a given objective or group of objectives. Although specifically relating instructional resources to the learning objectives they are to teach is time consuming, it is crucial in that the student's "search" time is reduced, eliminating the frustration he experiences in fruitless searches. Bloom (1968) found that his University of Chicago students could achieve a high level of mastery relying solely on available resources including conferences with the professor. He defined mastery as what had been considered in previous courses grade "A" level performance. Working with several thousand Korean middle school youngsters, Chung and Kim (1970) found a much higher degree of learner aptitude variability.

To compensate for the greater student variability and the limited availability of instructional materials in Korea, Chung developed and supplied the Korean children with additional instructional materials of depth and variety. To determine where existing resources were deficient, he analyzed the matching of instructional resources and objectives. Using this information, coupled with his estimates as to where in the instruction remedial or supplementary instruction would be required, he developed additional instructional sequences, in most cases taking the form of modular PI. These programs were used as remedial and enrichment branches supplementary to the central instructional sequences.

Mastery learning in Korea was introduced initially into a limited number of conventional classrooms in the Seoul area, providing the format for the teaching of all of the three courses. The normal group arrangement for teaching was not changed; the difference was that now both students and teachers knew what the learning objectives were and what instructional materials were geared to those objectives. Chung (1970) reports that mastery learning can be used effectively by a teacher new to the program after only two or three hours of orientation. Beyond the classroom, students were given programs of instruction for self-study at home based on the results of the formative test. Through these methods, at least fifty thousand Korean children are now receiving mastery learning instruction in experimental classrooms throughout Korea.

The results of mastery learning have been consistently gratifying (Brock, 1971). Chung, like Bloom, also defines mastery learning as measureable achievement worthy of an "A" grade in conventional teaching. His hypothesis was that all, or nearly all, students could achieve this level of learning given appropriate conditions of learning. Having now tested this hypothesis over the past four years with large numbers of Korean learners, Chung found that the percentage of students achieving mastery by his definition has risen from ten to twelve percent to over seventy-five percent. Bloom drew essentially the same results in his experiment (Bloom, 1968). Overall, the student, teacher, and parent responses to the mastery programs have been uniformly favorable.

A charge often directed at PI (or any other highly systematic form of instruction) is that while it may effectively achieve the specified objectives, it is likely to short-change other educational goals more difficult to objectify, such as problem-solving, creativity, and critical thinking. In a further study of the effects of mastery learning, Chung and Kim (1970) designed an experiment to test these possible effects. Using instruments designed to measure the process objectives of problem solving, creativity, and critical thinking, they compared samples of students who had spent one year in mastery learning classrooms with matched students from conventional schools. They hypothesized no differences between the two groups, but in fact found that the mastery learning group was significantly superior to the control group in these three dimensions.

In terms of development and implementation logistics, mastery learning has much to recommend it to a developing country. In the Korean example, less than two years were required to develop and make ready for use three years of courses in three basic subject areas. Since the development costs were less than $75.00 per instructional hour, the operating budgets of the participant schools were able to support the cost of the new materials, both consumable and non-consumable.

While PI is conceptually appealing, it has the serious limitations of being costly and difficult to develop and use. If used to any great degree it tends to bore learners and often threatens the teacher. Because of wide variability in student learning rate, it is disruptive if used in conventional classrooms. Mastery learning does not appear to have any of these drawbacks, and even better, seems to have a good energizing effect for promoting other innovations and reforms.

Individualized Instruction

When students use teaching/learning units of the kind described in the Korean project, a significantly larger portion of the students' time is spent in self-learning, studying on their own, or forming small groups mutually beneficial to the members. Bernardo Restrepo, of the University of Antioquia, Colombia, hypothesized that students could learn out of school with these types of materials as well as in school (Restrepo, 1973). Through the cooperative efforts of classroom teachers and educational researchers, individualized materials were organized into instructional packages or modules for Restrepo's project. The components in the teaching/learning units were essentially the same as those developed for the Chung mastery learning units. These components were

1. behavioral objectives,
2. selected references,
3. instructional materials (PI, cards, worksheets, readings), and
4. tests and self-evaluation procedures.

The dropout and repeater rate in rural Colombia is very high, with many schools having more than half their students repeat a grade two or three times. In many instances, students never successfully move on to the next grade. Restrepo found that a large part of this dropout rate is due to students having to miss classes for a time and upon their return finding themselves hopelessly behind. Rather than remain in the class trying to catch up with their fellow students, many youngsters drop out until the beginning of the next term. Students in these cases miss classes for a number of good reasons; roads may be impassable in rainy weather; help is needed with the farm work; the student is ill. In 1966, of 242,402 children enrolled for the first grade in the rural area 139,361 were repeaters. In the urban area the repeaters were 92,086 out of 235,273 enrolled in the first grade (Dane, 1969). Consequently, at the start of the new school year for these rural elementary schools there is great variation in the age of students in any class, with some of the enrollees attempting the grade for the fourth or fifth time.

Recognizing these facts, Restrepo hypothesized that an instructional program which individualized the rate of learning, provided the self-instruction, and also could take place out of school should reduce the dropout rate.

In the Colombian project the individualized instruction approach (II) drew upon two conceptual models: (1) the design and development of instructional materials, and (2) the design of the learning environment, that is, the management of individualized and classroom activities which facilitate learner achievement. The design and development of materials took essentially the same approach as that applied earlier in the Korean

experiment, employing adaptations of several II classroom management models (Flanagan, 1968; Shure, 1963; Glaser, 1968; Alschuler, 1968). The main features of this management approach were: (a) operational objectives, (b) diagnostic procedures, (c) learning prescriptions, (d) summative evaluation through objective-referenced tests, (e) periodic student reports, (f) student participation in the establishment of their goals, and (g) student self-evaluation.

The experimental sample for the project consisted of 24 schools chosen randomly from rural schools located within a radius of sixty miles around the Colombian city of Medellin, involving approximately 600 children in the experiment. While Restrepo and his colleagues studied the effects of several independent variables they addressed themselves to two major questions of interest.

1. Will systematically, empirically developed individualized instruction excel conventional classroom instruction when it occurs in the classroom under the daily management of the teacher?

2. Will II excel conventional instruction when II occurs largely outside the classroom and away from the daily guidance of the teacher?

One of the major experimental conditions involved what Restrepo called "flexible schooling," in which the students studied in the individualized mode and only attended school two days a week (compared to five days a week for the control students). Restrepo's measures of instructional effectiveness yielded five dependent variables for his experiment: (a) student achievement, (b) rate of retention in school, (c) student's satisfaction, (d) teacher attitude, and (e) parents' attitudes. The experiment involved three months of instruction in the subject areas of Spanish language, science, and mathematics.

The findings in this study uniformly favored the individualized instruction over conventional instruction. The II students learned significantly more in all three subjects than the control students, and their retention rate was significantly higher. Indeed, there were virtually no dropouts in the experimental groups. Student, teacher, and parent reaction was consistently more favorable to the individualized instruction mode. Of equal importance was the finding that the "flexible schooling" condition led to achievement, rate of retention, and parent, student, and teacher reaction that was as good as for the students who attended school every day.

On the basis of these examples, we may conclude that an educational program which permits irregular attendance and diminishes student reliance on formal classes with a teacher for learning, represents a potential boon to education anywhere, but particularly to developing countries.

Radio

A considerable amount of research has been amassed to demonstrate the effectiveness of instruction via communications media and to draw comparisions between mediated instruction and instruction via interpersonal communications channels (Chu & Schramm, 1967; Schramm, 1973; Jamison, Suppes, & Well, 1974). Since it has been adequately documented that people can learn a wide array of subject matters through communications media, it is not surprising that educational institutions have begun to rely on communications media to provide instruction for students.

The use of media instruction has several advantages attractive to educational leaders in developing nations. Communications media can reach large numbers of persons over great geographical distances, reducing the need to provide a trained teacher for every thirty pupils. Radio transmission, independent of traditional ground communication methods, becomes a viable option for developing countries in that it is unhampered by terrain, especially since portable transistor radios have eliminated the requirement for electricity.

The advanced communications media (television, computers) have commanded a great deal of attention in the recent past. Indeed, many persons have recommended these advanced communications media for realistic utilization for educational purposes in developing countries. However, an examination of the studies of media effectiveness does not indicate any clear-cut instructional advantage for the advanced communications media (Schramm, 1973). But even if these advanced media do seem to be effective in facilitating learning the relatively high costs place them out of range for many of the developing nations. Thus, it seems that in developing nations intermediate media such as radio offer the greatest advantage to educators. Radio meets the criterion of cost-feasibility, can be used in a wide variety of settings and geographic locations, and can be an effective instructional medium according to research data.

Several characteristics of radio make it advantageous for educational purposes in developing countries. The most important for our purpose is its accessibility. Radio presently reaches widespread audiences all over the world, bringing news, entertainment, and education to developing nations by means of inexpensive transistor models. Thus, it would seem a natural choice as a prime communication medium for educators trying to reach a diverse audience in non-formal educational programs, since those programs built around television would likely only reach a small fraction of the people who can potentially be reached by radio.

An advantage for developing countries that radio shares with other communications media is the possibility for rapid change and revamping in outmoded school curricula. Through the use of radio and television, however, it is possible to introduce new content into the schools with a very small time lag and at reduced cost since this would not require widespread retraining of teachers. Due to pressures on educational systems in developing countries, it may be essential for them to rely more heavily on mediated instruction to bring about needed curriculum reforms, since the time and costs of retraining teachers is prohibitive.

Radio has the advantage of flexibility both in format of programs and in the possibilities of choice for listeners. Most formally, it can simulate traditional one-way classroom communications by broadcasting lectures. More informally, interviews with experts or leaders, panel discussion, audience "talk back" programs, commentaries, and radio drama offer a wide array of stimulation to listeners. The effectiveness of radio is further enhanced by live broadcasting, which can allow large numbers of persons to participate in significant events and activities. Not as confining as traditional classroom instruction or other media such as television, radio offers the listener considerable flexibility of access as well as choice of programs. A person can listen to radio alone or in a group, while at rest or at work in the field, or carry on a wide variety of other activities in many settings while listening to radio.

The available evidence from empirical research and evaluations of radio usage indicates that it is equally as effective as other communications media and interpersonal communication channels in producing learning, a fact of particular importance to educators of developing countries, since the more advanced communications media are not currently in the range of possible options for substantial use with widespread audiences. Certainly it seems that radio is in no way an educationally inferior medium or second choice. In a recent review of research and applications of instructional radio, Jamison, Suppes, and Wells (1974) concluded that "...instructional radio (supplemented with appropriate printed material) can be used to teach most subjects as effectively as a live classroom instructor or ITV."

Radio also has the advantage of lower costs both for production and transmission, typically running approximately one-fourth of the costs for television. When these lower production and transmission costs are coupled with the wide potential audience, the unit cost comparison of radio with other options such as television, shows an even greater advantage further emphasized by lower initial investment and start-up costs.

Since there are no great differences in the effectiveness of radio and other communications, and since the costs and availability comparisons greatly favor radio, it would seem that radio is the communications medium for developing countries to consider most seriously.

There are several patterns or strategies of using radio that have emerged during the last three decades. McAnany (1973) describes several strategies that have been used in developing countries. The present paper discusses four strategies for the use of radio: open-broadcasting, in-school radio, radio forums, and non-formal radio schools.

Open-Broadcasting

In open-broadcasting the radio programs are aired in the same manner as commercial broadcasts and can be of a wide variety of formats in order to transmit knowledge and information to listeners. Since no attempt is made to organize the audience into listening groups, to provide a monitor for the listeners or to provide any printed supplements, the programs must be sufficiently interesting to people in developing countries to compete with commercial stations for the listeners' time. Certainly open-broadcasting has had an impact on the developing nations. Rural peasants in remote villages have increased their awareness of events happening outside their village and in other parts of the world by listening to the radio. Frequently open broadcasts are used to alter the attitudes and political allegiance of the listeners. Many open-broadcasting programs seek to inform peasants of better health and agricultural practices, while advertising by radio has created new markets and effectively introduced new products and services.

Open-broadcasting is currently being used in the developing countries of Africa, Asia, and Latin America. McAnany (1973) reports the use of open-broadcasting in Zaire to teach basic health and medical needs in a fifteen-minute weekly broadcast. On a much broader scale, there are a number of open-broadcasting networks aimed at reaching very large audiences with political messages, such as Radio Moscow, Voice of America, B.B.C., and others.

A scarcity of data exists to substantiate the effectiveness of open-broadcasting in developing countries, although audience surveys have indicated that people are listening to open-broadcasts and that they generally prefer music, drama, and the more entertaining forms of radio to the broadcast of lectures or direct information dissemination. Thus, open-broadcasting does seem to be effective in the role of providing information. However, its usefulness in promoting changes in the attitudes and behavior of the listeners is slight unless radio is combined with other local efforts and related to the social structures of the audiences (McAnany, 1973). De Feuer (1971) has suggested several guidelines for improving the quality of broadcasting to rural, agricultural populations, including broadcasting regularly on fixed days to induce the habit of listening, broadcasting at fixed times convenient for the farm listeners, dealing with topical subjects, and where possible, using the same person as speaker each time.

In-School Radio

The use of radio to provide a portion of in-school instruction is common in many developing countries. For example, in Thailand in-school use of radio began in 1958 for grades one through ten and now serves 800,000 students. Kenya has used radio in science teaching in the upper primary grades since 1964, with recent reports indicating that eight percent of Kenya's upper primary children are using the broadcasts. Guarrera (1972) reports that 68% of Italian primary schools and 36% of the secondary schools use radio instruction as a supplement to classroom instruction, the greater usage located in the rural and small urban areas of Italy. The Korean School Broadcasting Section is on the air for 90 minutes each school day reaching a potential five million primary school children with radio programs developed by the most outstanding teachers in the Seoul area. Hulsen (1967) reports that the broadcasts designed for grades one through six emphasize science, music, social studies, the Korean language, and anticommunist education. In 1969 Radioprimeria in Mexico began to provide radio instruction for grades four, five, and six in rural and semi-rural schools that had only the first three grades and by 1972 was serving 2,800 students with approximately 270 hours of broadcasting each year. In-school use of radio is reported for such Asian nations as Burma, Ceylon, China, India, Japan, Malaysia, and Mongolia, and a number of African nations including Cameroon, Ghana, Nigeria, Senegal, Tanzania, and Zaire. In 1960 over 90% of the schools of Australia were receiving instructional radio broadcasts. These broadcasts often consisted of curriculum enrichment programs providing lessons that students might not otherwise receive. Extensive use of school broadcasting has been utilized in Britain to extend the range of subject matter available to students. Thus it appears the most common use of radio for direct instructional purposes is to supplement the school curriculum. In this manner it is possible to provide more students with instruction delivered by teachers who are better prepared and better trained than would normally be available, a point of special importance to the more remote rural and semi-rural areas of developing countries. Although there is a wide variety of radio programming in these projects, it is most common to provide instruction in only a few subjects, often languages (McAnany, 1973). Exceptions to this are the Radioprimeria project of Mexico, and Japanese broadcasting, through which ist is possible to receive a secondary level diploma by correspondence.

There are, unfortunately, few systematic evaluations of the effectiveness of in-school radio projects. Of the several that exist, the studies of Chu and Schramm (1967) and Forsythe (1970) reviewed the existing evidence from evaluations and experimentation with instructional radio and concluded that indeed radio is effective in formal classroom instruction. In a more recent review, Jamison, Suppes, and Wells (1974) report that their evaluations of instructional radio indicate that radio compared favorably with televised instruction and live classroom instructors.

Radio Forums

The desire to improve the effectiveness of radio instruction has led to the use of two basic forms of interpersonal communication as a supplement to radio, the radio forum, and the non-formal radio school. These programs include the use of regular radio broadcasts supplemented with coordinators or monitors who organize listening groups, lead discussions, demonstrate skills being taught, and serve as resource persons.

The basic pattern of the radio forum established over three decades ago in Canada was typically as follows. Regular weekly broadcasts included news, responses to listeners' questions, and the presentation of a topic usually oriented to the conditions and needs of rural persons rather than to traditional academic content. The forums were assembled to listen to the broadcasts together, discuss the programs, and perhaps take group action on the topic being presented. Each forum selected a leader to stimulate discussion and maintain the organization of the group.

India has been the leader in adapting the Canadian model to radio in developing countries. The original pilot project, begun in 1956 and covering 145 villages (Schramm, 1967), was known as the Poona Project, and under careful evaluation was shown to have produced positive results. Conclusions reached by the evaluation team indicated that significant learning was achieved by forum members, that villages with forums were more active in starting community projects than the non-forum villages, and that the forums were beneficial to preliterate as well as literate members of the community. As a result of the success of the Poona project, the forums were continued on a nation-wide basis, although Schramm indicates that while these forums are generally successful none have equalled the initial success of the Poona project. In Togo, radio clubs began to be established in 1964 and numbered over 1,000 in 1966. The Broadcasts were in French and two of the local dialects and covered the five general content areas. Kahnert (1967) reported that despite difficulties due to financing, coordination, and communications with club leaders, these forums were successful in establishing a meaningful dialogue between administrators and workers in the villages. Rural radio forums were developed in Dahomey in 1968 and by 1972 one-third of Dahomey's 1800 villages (McAnany, 1972) had forums analyzing the thirty-minute programs broadcast each week in ten native languages on topics related to health, nutrition, child care, agricultural practices, and national development plans. Each forum of ten to thirty villagers listens as a group and discusses the broadcasts with the village agricultural worker often serving as a technical resource person to answer questions and guide any action or projects that grow out of the forums (McAnany, 1973).

Studies of radio forums have, in general, demonstrated the effectiveness of this pattern of radio usage in developing countries. While it is difficult to isolate the specific factors that produce changes in forum members, several studies have shown that radio forums are effective in increasing knowledge, changing attitudes, and promoting adoption

of new practices and innovations. Sitaram (1969) investigated the effects of radio on the awareness level of the rural Indian population and found a greater cognizance of political, cultural, religious, and family issues in villages. Abell (1965), in a study of eighty villages in Ghana, found that radio forums contributed to the villagers' comprehension of inter-village cooperation, formation of cooperatives, and food nutrition. Similarly, the extension of the radio forum through two-way radio in Senegal is reported by Cassirer (1970) to have achieved the effect of allowing villagers to assume a more active political role in the country. In spite of such successes, McAnany (1973) cautions that for effective rural development programs, radio forums must be coordinated with and supplemented by other development efforts, a key element being the existence of structures to support the individual efforts of village groups.

Non-Formal Radio Schools

The use of non-formal radio schools is a strategy for radio usage that has found widespread acceptance in developing nations, particularly in Latin America. The model for such radio schools is Accion Cultural Popular (ACPO) established in Sutatenza, Colombia, in 1947 by Monsignor Salcedo, a Catholic priest.

Since its inception, when only three radio sets and a homemade transmitter served people in the rural valley of Tenza in the Andes mountains, ACPO has grown to a large organization serving hundreds of thousands of students in forty thousand radio schools throughout Colombia. The focus and orientation of ACPO remains the same in 1974 as in 1947, to teach rural campesinos basic skills and rural education. ACPO does teach many skills found in formal schools such as reading, writing, and arithmetic; however, teaching academic skills is not its main purpose. These traditional academic skills are included in ACPO's programs only to the extent that they contribute to their overall goal. The main purpose is the personal development of the campesinos and the improvement of the quality of their lives.

Currently ACPO broadcasts a wide range of programming throughout Colombia for nineteen hours each day on its five stations. Network programs, which account for the majority of the broadcasts, are developed at the headquarters in Bogota, although individual stations are free to develop programs which are of local interest and are suited to local conditions for the remaining portion of time, roughly one-third of the broadcast day. Included in the network portion of the programming are three radio school courses prepared by ACPO's staff in Bogota.

The first, or basic course, teaches the fundamentals of reading and writing. This course, which lasts about half a year, has a daily thirty-minute lesson broadcast to which students listen as members of a small radio school with an auxiliary person as the leader. This auxiliary is a volunteer who has learned the basic skills of reading

and writing in either a formal school or through ACPO radio schools. The students use a textbook that was specially developed and distributed by ACPO for this course.

The second, or progressive, course is a two-year program which is ACPO's main offering. The content of the progressive course is centered on five basic areas - health, Spanish language, economy and work, arithmetic, and spirituality - presented in six weekly broadcasts of one hour each. Each area makes use of a coordinated textbook specially developed by the ACPO staff. Persons who have completed the basic course or who have learned basic reading and writing skills elsewhere are eligible to progress through this second course. As in the basic course, the students are encouraged to listen in small radio schools with a leader to assist them. The progressive course is often the terminal course for students.

The third, or complementary, course lasts three years and is more oriented towards preparation for a primary school equivalency examination. As a result, this course uusually enrolls fewer persons than either the basic or progressive courses. The radio broadcasts for this course are supplemented with a basic campesino library published by ACPO. Currently there are over twenty titles in this library and it is being expanded to approximately one hundred books, including topics such as nutrition, child care, guitar playing, and first aid.

ACPO's radio network, Radio Sutatenza, operates with five medium wave transmitters located throughout the country and three short wave transmitters situated in Bogota. In addition to the three structured courses, Radio Sutatenza offers other programs that are also educational in nature, such as radio drama, round table discussions, letters from listeners, interviews, and special programs that treat topics of interest to campesinos. The programming on Fridays is devoted to special campaigns related to the classes and intended for motivational as well as educational purposes.

ACPO publishes a weekly newspaper, "El Campesino," designed for the rural peasants of Colombia. The newspaper's four major sections of useful information, editorials, educational material, and recreation or entertainment are closely coordinated with the radio programs by stressing weekly themes in both media. Nearly half of the information section is written by the campesinos themselves drawn from their actual experiences while the remainder consists of regional, national, and world news. ACPO's staff of correspondents pays special attention to gathering news of particular interest to the rural audience. The editorial section includes an editor's note, articles on points of view, as well as stories about important persons or campesino successes. The educational section is primarily written by ACPO's staff of professors in support of the total educational program. Included in this section is information on various governmental programs related to the rural inhabitants of Colombia. The recreation or entertainment section includes a wide variety of articles ranging from how to play chess and how to sew clothes to interesting

facts about geography. The only newspaper out of five hundred in Colombia specifically aimed at the rural population, "El Campesino"'s current circulation is 70,000 and increasing. It is interesting to note recent evidence that indicates each paper is read by approximately ten people, so there are closer to 700,000 readers of "El Campesino." It is not uncommon to find one campesino reading the paper aloud for the non-literates. "El Campesino" also publishes supplements to the basic sixteen page weekly paper supplying more academic content for students in the third course.

A main ingredient of the success of ACPO in educating hundreds of thousands of rural peasants is the training and use of volunteer campesinos working in rural areas to assist ACPO's central staff by working in their own community to start new radio schools and provide assistance to the community.

Each school consists of one leader or auxiliary and three to five students. The auxiliary, a volunteer who has already learned to read and write, often through Radio Sutatenza, coordinates the listening group and assists each student through tutoring and demonstration. As ACPO considers the auxiliary to be an important part of the total educational program, each year several hundred auxiliaries are selected to receive special training at one of ACPO's two training institutes.

These selected students are given scholarships for the basic institute training program which lasts four months. The students' work at the institute is concentrated on gaining more knowledge and expertise in the five fundamental areas (health, Spanish, economy and work, arithmetic, and spirituality). A sizable portion of their day is spent in formal classroom instruction, although they also spend time working on an experimental farm to learn agricultural techniques and animal care. Students also learn more about ACPO and its programs through this training course.

The second training course at the institute enrolls a much smaller number of campesinos, 35 as compared with 180 in the first course. This course lasts five months and places its emphasis on leadership training and community development. Persons trained in this second course have a more active role in ACPO, develop a more in-depth knowledge of the same five fundamental areas as the first course, and are encouraged to assist in establishing more radio schools. Students who are selected for this course have completed the basic course at the institute and have shown promise in their field work following the first institute course.

The third course at the institute enrolls a small number of persons, usually about fifteen, for a period of ten months. This final program is designed to train people who will supervise volunteers in ACPO's field organization, becoming paid field supervisors for ACPO coordinating the various volunteer workers. Participants selected for this program must have completed the other two courses and have done volunteer work for ACPO in different communities. The course content includes more training in leadership, community development, and methods

for using the multimedia equipment of ACPO. During their training at the institute these supervisors all learn teaching techniques and methodology and spend a portion of their training in teaching students in the first course.

These institutes are an important facet of ACPO, a considerable amount of the success of ACPO resulting from the use of volunteers to organize, coordinate, and serve as resource persons. In addition to teaching the necessary skills, the institutes also focus on encouraging positive attitudes and motivation in the student.

Since the beginning of ACPO the use of radio schools has spread to many Latin American countries including Argentina, Bolivia, Brazil, Chile, Costa Rica, Ecuador, Honduras, Panama, and Peru. Several main features are shared by such projects in these and other countries: (a) the audience is primarily rural adults, (b) the radio schools are composed of small listening groups which usually meet in a home with a volunteer leader, (c) the approach is to use multimedia (radio, books, newspapers), (d) coordination is carried out by field organizers or promoters, and (e) the projects are usually affiliated with the Catholic Church.

These non-formal radio schools have shown remarkable results in their capacity to educate usually illiterate rural peasants. The coordinated use of multimedia with the expansive organizational structure of leaders and supervisors focused on the rural adult has enabled these non-formal schools to reach several hundred thousand peasants in Latin America.

It appears that radio can be a powerful instructional tool that can be used in a variety of circumstances in developing countries. There are many examples of successful use of instructional radio. Radio seems to be the communication medium that has found acceptance in developing countries. Its potential for educational uses is great.

Peer Tutoring

The concern in many developing countries over the rising costs of highly labor-intensive education and the lack of trained teachers is forcing educators in these countries to search for lower cost, alternative forms of education which do not require providing a large number of qualified teachers. One solution which dates back to the beginning of time is to use students or learners as teachers, i.e., to use peer tutors. The practice of peer tutoring has an extensive history; over four centuries ago students in Indian, German, and English schools were used to teach other students. Two hundred years later, in 1791, Andrew Bell initiated a peer tutoring program at an orphanage in Madras, India, to compensate for the shortage of teachers. When Joseph Lancaster opened a school for poor children in London in 1793, lacking financial resources to hire teachers, he devised an elaborate peer tutoring system. The use of the Lancaster concept of peer tutoring became widespread due to its economic advantages and the shortage of teachers.

Today, there has been a growing interest, particularly in the last several years, in programs in which students tutor other students. Not only are such programs cost-effective, but research continually demonstrates that both the tutor and tutee learn from such a program. There is a variety of peer tutoring programs currently in use: in some programs older students teach younger students; in others, students from the same age group tutor each other. Sometimes the most academically gifted students serve as tutors, although many programs have used low-achieving students as teachers with considerable success (Cloward, 1967). Thus, peer tutoring programs have been implemented in a wide range of subject areas and levels of subject matter difficulty.

Several researchers have reported that tutorial programs are effective over a wide range of subject matters (Robertson, 1971; Isgar, 1966); although Zach, Horner, and Kaufman (1969) indicate that certain circumstances concerning content must be met if tutoring is to be successful. These conditions include an assessment of what the student knows and does not know, an analysis of the subject matter and the pupil's skills in regard to the subject matter, and viewing the subject matter as a sequence of planned tasks rather than simply a body of knowledge.

As a result of Harrison's (1971) survey of tutoring programs, it was found that tutoring per se did not always result in benefit to the student. In those cases in which tutoring was structured there were consistent benefits; in unstructured programs, however, the results were not as convincing. Hiedermeyer (1970) concluded that the instructional behaviors were different for trained and untrained tutors. Thus, one may conclude that for a tutorial program to be maximally effective the

tutors must be trained and a structured program must be followed, based perhaps on the same learning principles as programmed instruction. In essence, it is an extension of programmed instruction in which the tutorial procedures are carefully prescribed and conform to basic learning principles. Several of the main components of structured peer tutoring are as follows:

1. Pre-established instructional objectives.
2. Specified instructional sequence of objectives.
3. Valid diagnostic tests to assess a student's mastery of pre-established instructional objectives.
4. Instructional materials commensurate with instructional objectives and designed to promote mastery.
5. Validated tutoring techniques that apply to any goals and materials.
6. Management procedures which will facilitate diagnosing students' entry learning level, assigning materials to students, ensuring mastery of material and advancement through the curriculum, and providing alternative instructional prescriptions when mastery is not attained by an individual student.

In the structured peer tutoring model, a student tutor trained in specific skills follows a planned instructional sequence and is not left to his own devices. The tutor is guided in his use of instructional strategies, learning materials, reinforcement of responses, and the individualization of instruction. Thus, he becomes very systematic in assessing a student's capability, assigning learning materials, providing assistance and reinforcement, ensuring mastery, and managing the learning process. Frequent evaluation accompanies the learning process. Results from the use of structured peer tutoring programs generally indicate that both the tutor and the tutee benefit from the programs. In fact, often it is the tutor who benefits the most, confirming the common impression that one learns more subject matter when teaching it than when trying to learn it. In a study comparing structured or programmed tutoring and non-structured tutoring, Harrison (1971) reports that greater learning achievements were produced by students in the structured tutoring groups.

The use of structured peer tutoring appears to be a highly desirable educational strategy for use in developing nations, for the technique is both effective and cost-efficient. Available evidence indicates that peer tutoring can be used to teach a wide variety of subject matters, while at the same time developing positive attitudes in both tutors and tutees. This latter benefit derives from the fact that in peer tutoring the tutor serves as a model for the student who is being tutored, for students will to some extent adopt the attitudes and behavior of their tutors. Because the tutor functions in this important role of model, he is often more responsible in his behavior. Indeed, the entire concept of peer tutoring is one in which both persons jointly grow and benefit. Peer tutoring offers a further social advantage in that it may promote the adoption of innovations in a community. If the peer tutoring program operates in conjunction with other community development efforts, it may be possible to use the tutors as positive change agents.

The use of students as tutors has for the most part taken place in formal school programs. While these experiences have in general been successful, the greater successes are likely to result from the coordinated use of structured peer tutoring programs in non-formal education. Certainly learning experiences which develop knowledge, skills, and attitudes as a result of interaction with one's peers outside of formal schools is not new. Such peer tutoring experiences are not generally systematically planned and organized, but rather become the province of informal education, the process whereby individuals acquire knowledge, skills, and attitudes from daily experiences and the educational influences in their daily environment (Coombs, 1973). While informal education has its effectiveness, greater benefits are more likely to result from the careful planning and organization of peer tutoring programs aimed at teaching specific objectives to a specific audience. This planned, organized educational activity outside of the hierarchically structured schools is called non-formal education and refers to that activity outside the formal school system which is intended to serve an identifiable target population and is focused on specific learning objectives (Coombs, 1973).

In many of the nations of the world the linear expansion of the formal school programs is neither desirable nor possible. This is particularly true in rural areas where an increased emphasis must be placed on developing effective non-formal educational systems. The use of structured peer tutoring programs offers as a solution an instructional technique that has the potential for being both effective and cost-efficient for most developing countries at this time or in the very near future. Certainly the use of peer tutoring programs in formal education has been quite successful. From all indications, structured peer tutoring can be very effective in non-formal educational programs.

A System of Intermediate Educational Technology

So far we have focused on three concepts in intermediate educational technology that offer potential for educators in developing nations--mastery learning, radio, and peer tutoring. Each of these has been successfully applied for educational purposes in developing nations as these intermediate technologies are within the reach of most such countries. The resources that are required by these programs, both human and financial, are not extravagant and are currently available in many countries of the third world.

At a time when these countries are faced with the fact that the gaps are widening between themselves and the more developed nations, and even internally between large segments of their own society, the use of intermediate educational technologies seems highly desirable. Since present educational systems often provide instruction to only a small elite segment of the population, it is doubtful that present patterns of formal education can adequately serve the educational needs of developing countries even if they were expanded. As an alternative, we propose that educators and planners in developing countries explore the possibility of implementing a system based on the intermediate educational technologies of radio, mastery learning, and peer tutoring.

As stated earlier, the concept of intermediate technology emerged from the field of economics and is based on the idea that intermediate levels of technology should correspond to intermediate levels of development (Dieuzeide, 1971). In the urban areas of developing countries it has been possible to bring in sophisticated technology from advanced nations. Predictably, however, the impact of this transplanted, sophisticated technology has been relatively slight in the rural areas. The net result is often an increase in the gap that exists within the country between the few major cities and the large rural population. The use of intermediate technology is one potential solution for reducing these gaps, for intermediate rather than advanced technologies could foster overall development, speed up the progress or rate of development, and ensure the most efficient use of both human and material resources within these developing countries.

In the field of education, intermediate technology would include schemes or methodologies for education that are relatively inexpensive and widely available, within the reach of the human, financial and physical resources of all nations. This would not likely include in the near future the use of television, satellites, or computers, since these are neither cheap nor widely available to third world nations. Intermediate technology would include instead such media as radio, and such techniques as programmed instruction, mastery learning, and peer tutoring. Such technologies can be applied and further developed by educators with

their current resources, thus eliminating heavy initial investments or dependency on foreign personnel. Also, the introduction of intermediate educational technologies is not as likely as advanced media to cause abrupt changes, but rather would create a smooth evolution.

The purpose of intermediate educational technology, then, is to accelerate the development of educational systems in developing countries. The aim of achieving the maximum effectiveness of education while maintaining a high degree of efficient use of resources is not a second rate solution to educational problems. Indeed, we believe it is a first rate solution uniquely suited to many developing countries.

The development of a system based on intermediate educational technology should result in many benefits which can apply to both formal and non-formal education. As Brembeck (1973) suggests, there may be differences in formal and non-formal education that allow each to be better suited than the other for particular purposes. Thus a strategic use of intermediate educational technology within the formal and non-formal educational systems can help each system achieve its goals. It is likely that maximum benefit would be obtained when the formal and non-formal instructional systems were carefully coordinated and articulated to produce an educational synergism.

In order to effectively implement intermediate educational technology systems, it is necessary to examine the developmental objectives and educational goals of any specific country, thereby establishing the overall purpose of the educational system. This is a critical element in the planning of an educational system.

What goals might an intermediate educational technology system pursue? Certainly it is not possible to specify the goals or objectives that are unique to each developing country, but there do seem to be several basic, essential goals generally agreed upon by educators in developing countries. Coombs (1973) lists six elements in a minimum package of learning requirements as follows:

1. Positive attitudes toward cooperation with and help to family and mankind, toward work and community and national development, and toward the development of ethical values.
2. Functional literacy and numeracy to enable a person to read newspapers and magazines, write letters, and perform common computations.
3. A scientific outlook and understanding of nature as related to health, nutrition, sanitation, agricultural practices, etc.
4. Functional knowledge and skills for raising a family and operating a household, such as child care, family health, managing family finances, construction and maintenance of dwellings, etc.
5. Functional knowledge and skills for earning a living including general as well as specific job skills.

6. Functional knowledge and skills for civic participation including an understanding of national and local history and ideology, governmental structure, social service programs, cooperatives, etc.

Each individual society could expand this basic list and specify goals in each category as one of the main tasks of analyzing the environment or society. Educational planners should examine the educational goals and unmet needs of their society as well as the resources available and the constraints which may be involved. Only then, based on this analysis, would it be possible to clearly specify the objectives to be pursued by the proposed educational system based on intermediate technology. This procedure first examines such broad societal goals as reduction of unemployment, development of educational goals (in this case, to provide training in certain job skills), and the breakdown of these educational goals into specific learning objectives to be included in the educational programs. While there is often agreement between countries on societal goals, the specific learning objectives that contribute to these goals may differ considerably.

Intermediate educational technologies can serve a wide range of educational goals. They can be used in conjunction with regular formal school classrooms to improve the quality of instruction and compensate for the lack of qualified teachers. Radio, for example, has been effective in providing higher quality instruction in many schools, often securing the most knowledgable and talented teachers to develop programs to supplement the classroom instruction. Programmed texts and workbooks have been effective in teaching knowledge and skills and can be used by relatively untrained teachers. It is also possible to increase the number of qualified teachers through technologically based training.

One use of intermediate technology may be to extend educational programs into areas in which there are not enough schools, or no schools at all. The potential for reaching new audiences outside the realm of the formal school is great, as a large segment of the school-age population in developing countries is not currently attending school. In Latin America and Asia only half the children of primary and secondary school-age are attending school. One-fourth of the children in Africa are enrolled in schools. The combined use of programmed radio and volunteer tutors offers a feasible alternative to formal schools for this out-of-school segment.

Intermediate technologies can be effectively used to teach literacy and fundamental education as do many of the radio schools in Latin America that are based on the ACPO model. The Radiovision program in Niger has used radio coupled with slide projection to teach literacy. Intermediate educational technology can be very effective when used in a coordinated fashion in non-formal educational programs to teach in these two areas.

Another educational goal for which the intermediate technologies are appropriate relates to job training. It is possible to teach many job skills in formal or non-formal programs through use of peer tutoring

and adequate low-cost printed material. When the content of the materials has been carefully prepared using programmed instruction principles, learners of varying ability levels can achieve mastery, assisted by peers or supervisors. Such instruction can take place as part of an on-the-job training program, in special institutes, or on an individual basis. The potential benefits are those of increasing the labor pool of skilled manpower, reducing the costs for training each person, reducing the failure rate, shortening the length of training, and implementing new or revised training programs with minimum time delays.

Developing nations could use intermediate educational technologies to help achieve educational goals for adults, particularly in the rural areas. Efforts at adult education and community development have been furthered by the use of radio forums, an effective tool for disseminating information on such subjects as better agricultural and health practices. Often, the use of radio combined with organizational support has allowed large segments of society to participate more directly in the development process. Informative programs can also be broadcast to increase the listener's awareness of events in other communities, states, and the nation as a whole. Educational programs using radio and peer tutors can facilitate the undertaking of community projects, such as establishing a better water system.

In many of these areas coordination of the educational technology efforts can achieve a better utilization of scarce resources. For example, a radio station might broadcast adult education courses and literacy courses early in the day when adults are freer to listen, broadcast programs for in-school usage in the morning during school hours, perhaps use the same programs to extend the school to the out-of-school audience, broadcast general job training programs in the afternoon, and broadcast community development programs in the evening. Certainly these broadcasts would have to be supplemented by printed materials and teachers/tutors to be maximally effective. The intermediate technologies are easily adapted to such plans, as they seem well suited for a wide array of educational goals and objectives including the learning of information and skills and the development of attitudes.

Planning and Resources

There are numerous tasks associated with the design, development, and implementation of an educational system which utilizes radio, mastery learning, and peer tutoring. If the educational system is to be optimally effective and efficient in the use of these resources, it is desirable to use a systems approach to its overall development. The following sections present a model for the development of an educational system using this approach.

The educational systems development model contains five major phases: analysis, design, development, implementation, and evaluation. Figure 1 shows these five phases.

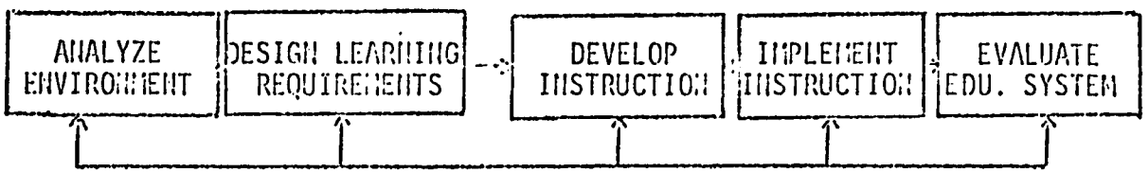

Figure 1.--Major phases of the educational systems development model.

The major phase is the analysis of the society or community that the educational system is to serve in order to determine what goals would be pursued. Such an analysis can identify the existence of unmet needs such as the necessity for better child care practices, or for increased literacy. Once these needs have been identified and information about the setting or environment has been gathered, it becomes possible to translate these general goals into learning objectives.

In the second phase the overall design for the educational program is completed. The goals that have been identified are examined from a learning standpoint to determine the learning requirements. That is, what must a person know or be able to do in order to achieve the educational goals?

When the goals have been carefully spelled out, it is possible to develop the actual instructional programs and materials. All the instruction is carefully designed to enable persons from the intended audience to achieve the learning objectives.

The training of the instructional staff and implementation of the instruction itself comprise the fourth phase of the model, which includes the training of persons who will serve as peer tutors. Once the educational program has been developed and the staff trained, the actual implementation can take place.

The final phase of the model is the constant evaluation and revision of the educational program. The purpose of this phase is to continually monitor the programs and provide feedback to serve as a basis for revising different aspects of the educational system.

There are several tasks associated with the five major phases of the model. These tasks refer to the specific activities that should be performed in order to develop effective educational systems. Figure 2 presents the expansion of the basic five-step model to include the major tasks that comprise the educational systems development model.

The first step in the model is to analyze the context of the educational system. Specifically, this analysis examines the environment, describes the actual and desired conditions pertaining to that environment, identifies unmet needs and unused opportunities, and diagnoses problems that are preventing objectives from being achieved. There are several techniques for accomplishing such analyses. These include field studies, diagnostic surveys, case studies, visitation by a team of experts, analysis of data collected by various agencies, communications with leaders in the environment, to mention a few. The result of this analysis is a carefully developed description of the environment.

In the second step of the model educational goals are derived from the information obtained in the first step. These goals are based on the analysis of the environment to ensure that the educational system will pursue goals that are both realistic and relevant. The further development of instruction will be guided by the specific goals that are selected. Obviously these goals will vary from community to community depending on the internal differences in each community. The intent of a system utilizing intermediate technologies is to offer instruction that is relevant and to do so in a manner that is feasible in the specific context. Thus, the analysis of the context and the identification of educational goals based on this analysis is an important initial phase.

Following the completion of the first phase, it is possible to develop the instructional design. Each educational goal is analyzed to determine what a person must do in order to achieve this goal. The educational goals can be broken down into five different classes or domains of learning: information or knowledge, intellectual or mental skills, motor skills, attitudes, and cognitive strategies. Information refers to names, labels, facts, propositions, and organized bodies of knowledge. Obviously, a large number of important educational goals are posited in the domain of information. The domain of intellectual skills includes tasks such as problem solving, the application of principles or rules, the use of concepts, and the ability to form discriminations. The person learning tasks in the intellectual skill domain must actually learn how to apply the learning. Motor skills involve the use of the muscles of the body as in the case of planting seeds or making clothes. Attitudes are best described as certain pre-dispositions that influence the choices a person makes. For example, if a person has a favorable

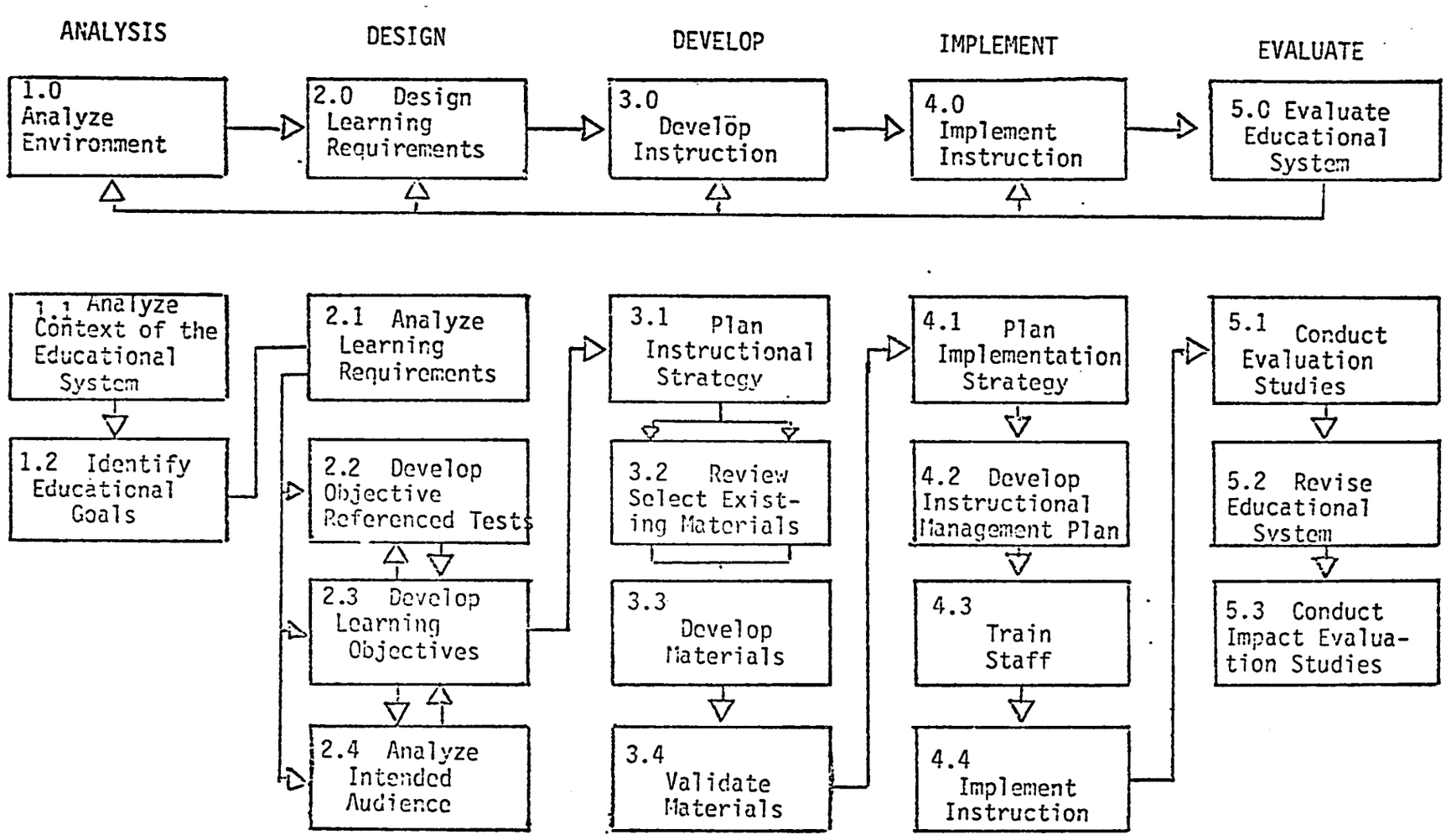

Figure 2.--Educational Systems Development Model

attitude toward agricultural innovation, he will choose to try out different agricultural practices. The domain of cognitive strategies refers to acquiring self-management skills such as learning how to learn. The cognitive strategies influence what a person attends to during learning, how he tries to organize new material to be learned, and how he remembers.

Some educational goals fall solely in one domain, as in learning facts about the history of one's country or the names of governmental agencies and officials. Other goals such as improved crop pest control may involve several domains: information about various insecticides, intellectual skills of calculating how much insecticide to use and discriminating plant diseases to identify the proper insecticide, motor skills of applying the insecticide, and the attitude of choosing to use insecticides. In other words, if the educational goal is to learn about insecticides, this goal can be divided into the necessary information, intellectual skills, motor skills, and attitudes that must be learned before the goal can be achieved. Thus, the educational goals are analyzed to determine the specific learning requirements.

Once the learning requirements have been analyzed, then specific learning objectives can be written. These objectives should refer to what the learner will be able to do following the instruction. The objectives are based on the learning requirements and the analysis of the intended audience. This involves a survey of the intended audience to determine their existing knowledge and skills in order to develop objectives that are appropriate for them. Following this step, test exercises are developed to assess whether a person has mastered each objective. Since these tests are designed to measure the attainment of objectives, they are called objective-referenced tests to distinguish them from traditional types of achievement and ability tests that were not designed to assess mastery of specific objectives. The objectives are used to guide the development of the instructional programs and to inform the learners of the expected outcomes, while the tests are used to assess mastery and evaluate the effectiveness of the instruction. This design phase is the basic blueprint from which the instruction is developed.

The first step in the development of the instruction is to plan the instructional strategy, which is based on the type of learning to be achieved, the intended audience, and the resources available. It includes decisions about how to teach the objectives to the intended audience as effectively as possible. In this planning stage, determinations are made about how to coordinate the use of radio and printed materials, how to effectively use peer tutoring, and when and where the instruction should occur. Different strategies will likely be used to teach objectives in different domains, since the conditions for learning differ. Once the instructional strategies are developed, a review of existing instructional materials can be made to determine if any can be used. Then, using the learning objectives and instructional strategies as a guide, new materials are developed for use. These materials

may be radio scripts, newspaper articles, textbooks, etc. The strategy indicates the type of material that will be used to teach different objectives as well as specifying the role for the peer tutor and any demonstrations he should perform during instruction. The materials development step includes both the development and production of the instructional materials. The complete set of instruction (objectives, test items, learning materials, including radio scripts, peer tutoring guide, etc.) is validated by trying it out with a small sample from the intended audience. If the instructional package is not effective, that is, if the audience did not attain mastery of the objectives, the instruction is revised and modified. In this manner it is possible to develop instructional packages that are effective.

The first step in the implementation phase is to plan the implementation strategy. The purpose of this step is to devise a set of procedures for planning the systematic introduction of the educational system into a community and involves activities usually referred to as promotion. Decisions are made concerning ways to involve people, to stimulate participation of the intended audience, to identify and train peer tutors, and generally, to gain the acceptance of the teachers, parents, and learners of these new approaches to instruction.

Another aspect of the implementation phase involves the development of an instructional management plan to ensure that mastery learning takes place. The instructional management plan must provide for efficient use of the learning packages (objectives, tests, instructional resources) to enable the majority of the participants to benefit from it. This must include the planning of logistical details and establishment of various procedures for the distribution of institutional packages. Another step is the training of the instructional staff. This includes the training of the peer-tutors in whatever particular instructional procedures are to be used. When the peer-tutors have been trained and the instruction developed, it is possible to actually begin to implement the total set of instruction. At any one point it is likely that the organization or agency responsible for the education system will be planning for implementing instruction in one community, training peer-tutors in another, and operating completely in a third.

The fifth phase of the model includes three steps that all follow the implementation of instruction. The first step is to continually evaluate the effectiveness of the instruction to determine if the people are actually learning from it. This evaluation activity will be continuous and will provide data for the next step which is the revision of the educational system based on the evaluation results. In this revision instructional strategies can be modified if they are not effective, for example, radio programs that have not produced desired results are changed, or revisions may be called for in the training or roles of peer-tutors. Basically, the belief is that if the audience hasn't learned, the educational system must be revised. This is one of the major concepts of mastery learning. The final step in the model is the continuous

assessment of the impact of the total educational program on the society to examine both planned and unanticipated outcomes for the purposes of obtaining a clear picture of the overall effect and identify further needs and problems. This last step is similar to the initial step of the model in that it examines the context of the educational system. The impact evaluation reports on the effectiveness of the educational system in meeting the needs identified in that first step of the model.

This model for the development of educational systems identifies the major tasks or activities that must be accomplished in planning and operating effective and efficient educational systems. In order to develop such a system utilizing intermediate educational technologies certain resources will be required. Clearly, it is not possible to provide a detailed description of the necessary resources that would be applicable to all developing countries. However, general categories of resources can be identified and will be discussed below.

A major category for resources is personnel. Figure 3 shows an organizational structure that could be used for such a program as presented in this paper.

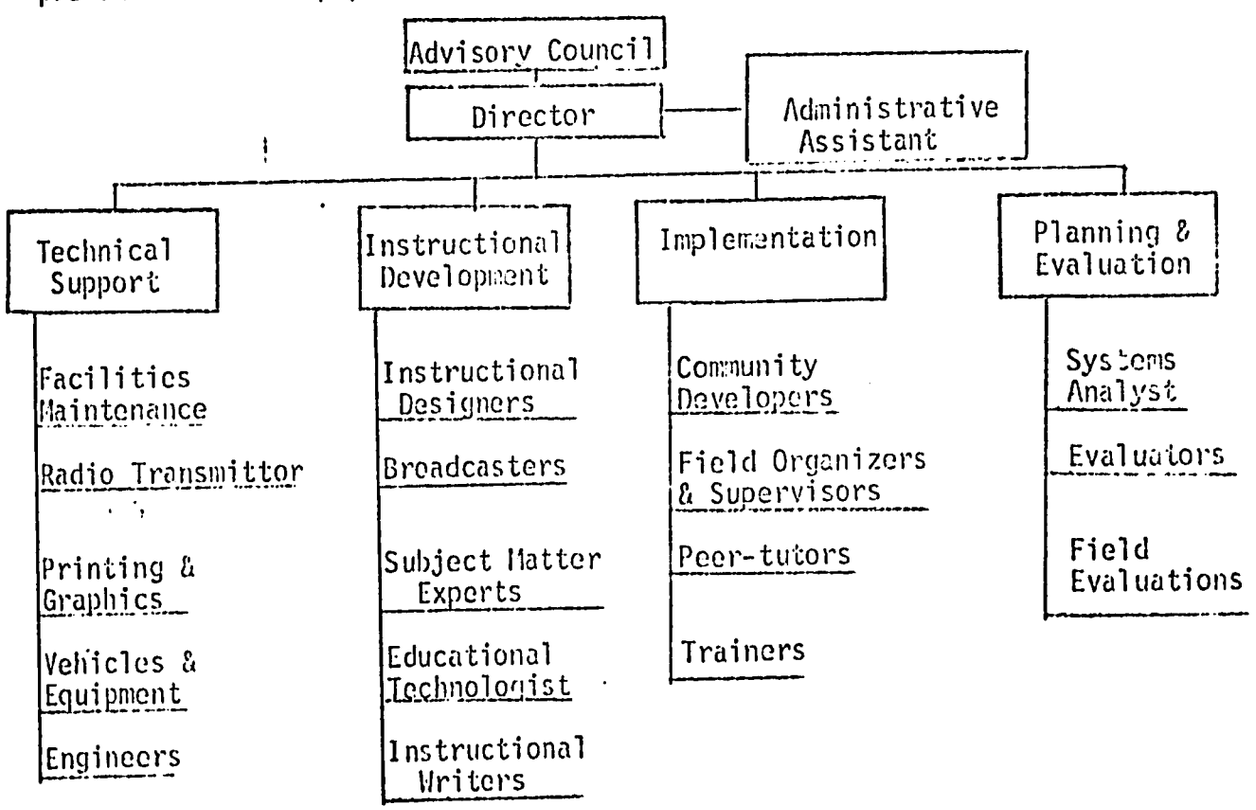

Figure 3.-- A Functional Organization for Instructional Systems Development

As the chart indicates, there are four major functional areas: Technical Support, Instructional Development, Implementation, and Planning and Evaluation. Each area chief would report to a project director who would have day-to-day management responsibility and would report to a policy advisory committee or a board of directors composed of a small group of persons representing varied interests and agencies. The project director and bureau heads would have to be very capable, versatile persons with proven ability.

The Technical Support Bureau would have responsibility for maintenance of all facilities, vehicles, and equipment, production of all printed and recorded material, and operation of radio transmitters. The number of persons needed to perform each function would vary according to the size of the operation.

The Instructional Development Bureau would have responsibility for all instructional aspects of the program. Thiis would include those activities in the design phase and development phase of the previously discussed model. This bureau would include persons capable of developing the instructional design and should be under the supervision of an educational technologist who would coordinate all activities within the bureau.

The Implementation Bureau would be responsible for the installation activities of local organization, peer-tutor training and supervision, and monitoring of day-to-day operations. Obviously these activities are associated with the implementation phase of the model.

The Planning and Evaluation Bureau would have responsibility for the Analysis Phase of the model. This Bureau should contain several systems analysts, evaluators, and field researchers. As in the case of the other bureaus, the number of people required is a function of size of operation.

In addition to these professional staff persons, clerical and administrative support would be required, including secretaries, accountants, and administrative assistants.

The size of the project is the determinant of the facilities that are required. In smaller projects it is not necessary to purchase large amounts of office space, radio transmitters, and printing facilities. It would be more economical instead to purchase time on available radio stations and contract for needed printing.

Costs

Unfortunately there is a lack of good data on the costs for implementing intermediate educational technology projects. Jamison and Klees (1973) in their analysis of the costs for instructional radio and television for developing countries report student-hour costs of $.0041,

$.014, and $.058 for three instructional radio projects in Indonesia, Thailand, and Mexico. The figures on Thailand and Mexico are actual calculated costs; the cost for Indonesia is an estimate. The student-hour costs are sensitive to the numbers involved, for obviously, if larger numbers of persons listen to a broadcast, the per listener costs for development of the lesson are reduced. By spreading fixed costs over a large audience the per listener costs are kept down.

For any given situation, whether it is a system of community schools, a network of nonformal learning centers, or a nation's entire educational program, a cost-feasibility analysis should be made before the project is undertaken. Such analyses can be carried out rather easily and will permit prediction of cost efficiency for new programs as compared to old programs. The systematic approach to instructional development can be undertaken on a massive scale (as in the Republic of Korea, Morgan & Chadwick, 1971) or on a much more modest scale, for the scope of the project is not nearly as critical as adhering to the basic developmental steps that have been described here.

Summary

Several major points about educational technology have been made in this paper. The greatest benefit to educators in developing countries is likely to result from the application of the principles rather than the things of educational technology. The principles of programmed learning have been shown to be effective in promoting learning in a wide variety of circumstances. The concept of mastery learning is based on the premise that the large majority of learners can master the instruction when the instruction is carefully designed and developed. There are many cases in which mastery learning has been used and has led to increased learning by students. There is a considerable amount of data that indicates that the use of the principles of programmed instruction and mastery learning results in the development of more effective instructional materials.

Radio seems to be the most desirable alternative for delivering instruction to people in developing countries. Radio is currently used througnout the developing world for informational and educational purposes. When combined with the use of peer tutors, radio can be an effective educational tool. The use of tutors can serve to strengthen and reinforce the content of educational programs delivered by radio.

It is the general thesis of this paper that the concepts of programmed learning and mastery learning can be incorporated into the design and development of educational radio programs, and that when the delivery of such programs is accompanied by peer-tutors the total educational effort can be successfully accomplished within the resources available in many developing countries. An educational system consisting of these elements represents a viable alternative to traditional formal education. Current evidence from research and experience supports the thesis. In order to explore the full potential of such a system, we urge several developing countries to begin the development and implementation of a system of educational radio incorporating the principles described in this paper. Such efforts should have a good probability of being successful and would also contribute to our knowledge about intermediate educational technology.

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