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## Contributions and Costs of Educational Technology

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In economically developed nations, the rapid fluctuations in the need for new technical and vocational skills create the need for major and continuing changes in what and how much should be taught and learned; and these changes (occurring in ever increasingly shorter periods of time for ever increasingly larger groups of people) demand the invention of more and more effective systems of transmitting knowledge, understanding, and skills.

The so-called developing countries are not only faced with the fact that the gaps between them and more developed countries are widening, but they are also faced with the fact that the widening internal gaps between large segments of their own society have become significant problems. Their present systems of education offers instruction to only small segments of the population, and these segments generally represent only their youth; this educational effort, however great, has a built-in time-lag of 10-20 years before its results can even be felt on the national development processes. Thus, the countries have further widened the gaps between the adult majority of their citizens and the youth on whom they have concentrated their educational efforts. In the meantime, modern nations have moved even further ahead.

This continuing problem of development gaps between nations and between groups within a nation is one which demands that new looks be taken at the role of education in national development; and, one which makes it imperative that new processes must be defined in education if this sector is to serve as a viable tool for development.

Ethiopia is in the midst of designing and implementing those "new processes" particularly applicable to the solution of her problems. The Ethiopian Education Sector Review envisions the development and operation of a structured Non-Formal Education (NFE) Program relative to the needs that exist in each of the more than 100 Awrajas in Ethiopia. These NFE Awraja programs, locally administered, have been conceived of as being both paralleled to and interrelated with the proposed Minimum Formation of Education (MFE) and Basic Formation Education (BFE) Programs. There will be, as indicated in the Education Sector Review, areas of program complementarity even though the fundamental objectives of the different programs will continue to be directed toward satisfying diverse and specific needs.

The Center for Educational Technology at Florida State University is concerned about, and has been involved in, planning educational strategies, developing new educational methodologies and techniques, and in attempting to experiment with the rearrangement of both human and capital resources in order to provide more effective and relevant systems of instruction toward the solution of problems inherent in the development process. We believe that educational technology and its appropriate application has potential in this area. Educational technology, at the Center for Educational Technology, is not thought of as the application

of hardware in the educational process, but as the application of knowledge, research, and invention to the cost-effective solution of educational problems.

The existant efforts of applying technological innovations to the process of education have been few and far between. These efforts have largely been expended on the more exotic inventions (computers, TV-satellites, etc.) -- technologies whose availability, costs, and relevance to Ethiopian development are too impractical and too costly to seriously consider on a large scale at the present time. There are technologies that exist, however, which have application to education and are available within the cost framework of Ethiopian resources. These are often referred to as "intermediate educational technologies," and are herein defined as the innovative adaptation and management of already proven tools and processes that are within reach of the human and organizational resources of Ethiopia.

Of the intermediate technologies available within the context of this approach, those key technological concepts that seem to us to be within the reach of all and to have potential for immediate "systems" development and application to non-formal education in Ethiopia are (1) instructional radio, (2) peer tutoring, and (3) programmed instruction. These technologies are not new to Ethiopia nor are they new to non-formal education programs. Their uses, however, have been varied and unsystematic; and serious research has usually been conducted by the proponents of a specific technology and pointed toward the collection of data that would support the research thesis, rather than a systematized effort to employ them in concert toward the solution of real educational problems or to achieve a massive developmental breakthrough.

The major question posed in this presentation is whether concerted Ethiopian efforts should or could be mounted (utilizing present knowledge and creating new) to design and validate a "system" of instructional radio for a structured non-formal education program, incorporating the basic principles of Programmed Instruction and Peer Tutoring, and serving essential social and developmental needs for the great masses of its youth and adults who in the foreseeable future will have limited access to more formal educational opportunities.

Radio is the only advanced communication technique that has found its place in developing countries. The radio is presently used mainly as a means for providing entertainment, transmitting public information, and for alerting people to both natural and political dangers. It is clear from the review of the literature, however, that radio can be and has been used effectively to teach a variety of subjects under a variety of circumstances. Radio has been successfully used not only to teach knowledge and information, but also to increase various skills of the listeners. As an information delivery system, it has proved to be cheap, easy to use, and flexible. While in its fifth decade of use in both formal and non-formal educational settings, radio instruction has nowhere yet been used as a "central system."

Programmed radio has not, to our knowledge, been tested. Programmed radio must be accompanied by instructional materials to be used in conjunction with broadcasts. These materials could be textbooks, workbooks, diagrams, notetaking guides, or physical displays that are used to facilitate learning. Radio broadcasts must be prepared according to the general empirical approach used in programmed instruction. This approach includes the use of behavioral objectives, overt/covert responses where

necessary, and tryout and revision of materials until they reach prior-specific goals. Also, people support, such as peer tutors and monitors, must be used at the point of listening.

Peer Tutoring is perhaps the oldest instructional method known to mankind. The word "peer," in the context of this discussion, is not limited to age or school grade classifications, but more appropriately to "quality groupings" -- those individuals having similar needs for the same information, knowledge, skills, etc., and, "tutoring" is used to connote the passage of knowledge and skills and information from one person to one or more others.

There are numerous examples of peer tutoring involving the use of teachers, priests, or village leaders to monitor radio broadcasts, lead discussions, ask questions to reinforce the points made in the broadcasts, and to perform a variety of other instructional activities. Using more advanced students to train new students or following the "each one teach one" model have been effective in teaching a wide variety of subject matter. Military applications are widespread and civilian applications are even more so.

Research has revealed that certain knowledge and skills can be learned even as they are being taught, and that one of the real keys to the individualization of instruction lies in the person to person relationship between teacher and learner and/or learner and learner. There has been enough experimental work done in this area to speculate with some confidence that a system of "programmed" and/or "structured" tutoring can be devised that will bring a workable system of radio instruction into almost any social or physical setting.

Programmed Instruction. The concepts central to programmed instruction are clearly sound; and the ambition to use programmed instruction as an instrument for educational reform in developing countries is worthy of serious consideration.

While programmed instruction in printed form simply has not "caught on" around the world, there have been important by-products that have. The concepts of learning that gave rise to programmed instruction in the first place--and which were refined, sharpened and added to during its formative period--have been applied to other aspects of the learning environment. "Mastery learning" is one such concept that has been successfully adapted for use in the developing world.

Mastery learning includes the elements of good instruction. It has the advantage of being capable of production much more quickly and inexpensively than programmed instruction--yet it incorporates essentially the same principles, and seems to yield effects that are at least as good, if not better. It seems clear that the return on development investment for mastery learning is far superior to the same level of investment in programmed instruction. Even though the same principles and development techniques are employed by both mastery learning and programmed instruction, mastery learning builds upon what already exists, while programmed instruction is often perceived as a threatening replacement to what exists.

With appropriate research into such new and innovative applications of the principles of programmed instruction, and peer tutoring, and the use of the findings of such research in programmed radio in non-formal education, Ethiopia is in an excellent position to make significant

shortcuts in search for both educational improvement and the widespread distribution of educational opportunity.

In considering the question of maximizing instruction in a structured non-formal education program, it is important to also examine the various types of learning that can result from any instruction. One useful classification of these different kinds of learning has divided the outcomes of learning into five domains: motor skills, intellectual skills, verbal information, attitudes, and cognitive strategies. Recent research seems to indicate that different conditions influence learning in these five different domains. That is to say that the necessary instructional conditions for teaching knowledge or verbal information are different from the conditions for teaching intellectual skills. This brings us to an area of questions, the answers to which are of significant importance in "improving" the proposed system, but are not necessarily prerequisite to a decision to install such a system where none exists at all. Some of these questions are as follows:

- What combination of instructional dimensions can best teach different types of learning tasks (subject areas and domains of learning) to students of varying aptitudes?
- Is there a difference in outcomes in people support if the person has a passive role (monitoring, distributing materials) or an active role (stimulating, discussion, questioning)?
- Is there a difference in outcomes if the radio broadcasts are presented to individuals or groups?
- Can radio be equally effective in non-formal as well as formal settings? Are there difference conditions that provide effectiveness in a formal and non-formal setting?

-- What age groups respond best to what kinds of radio programs?

Can radio be used as effectively with younger and older listeners by manipulating programming content?

-- What differences in program design, if any, are necessary to accommodate both rural and urban populations?

There are, however, a series of questions the answers to which should be determined (by experiment or by careful estimate) prior to any sizeable Ethiopian commitment of resources to such a program. Some of the answers can be determined by agreement between responsible leaders, some by field studies, some by examining the experience of others, and some only by research and experimentation. A few of these pertinent questions are:

1. What are the specific social and developmental needs that can and should be met through an NFE program?
2. What are the organizational and operational requirements for the establishment and operation of an NFE program? What are the staff, facilities, and materials requirements?
3. What services and support must be furnished nationally and which are appropriate for local Awraja development?
4. What human and fiscal resources exist (or can be developed) within the Awraja to carry out an NFE program?
5. What are the component elements of learning that are common to the MFE, BFE, and NFE? How and to what extent can they be interchanged?
6. What are the existing resources that could be rearranged or reallocated to support the program?

7. What new expertise, facilities, and/or support services would need to be created or procured?
8. What kind of management system would need to be established?
9. How would the program be evaluated both in terms of cost and productiveness?
10. How does the "system," as an interim step, lend itself to transition in terms of future development?

In summary, this presentation proposes that responsible Ethiopian officials seriously consider developing a "model" for the pilot testing of a NFE program delivered through a "system of programmed radio instruction." This system would require central control in order to originate and broadcast carefully designed programs. It would require a reservoir of research, design, and production talent at the point of origin. The system would also require ever increasing management and operational competency at the Awraja level - including the physical arrangements, the peer-tutors, the day-to-day evaluation of instructional outcomes, and the relevance of program to local problems. Furthermore, the relationships between the central control and the Awraja management would have to encompass a two-way system of communication, distribution, and exchange. As the content of the program of instruction was designed in terms of objectives, it could also be designed in terms of delivery systems and evaluation of outcomes. The types of material needed, the characteristics of the audience, the teacher-tutor roles, the research into new modes and models - all of these, and many other elements need careful consideration. This is only to reiterate that a coordinated national effort should be undertaken in the

· systematic assembling of present knowledge about the successful application of particular intermediate technologies and a carefully planned exploration of their potential for widespread application in Ethiopia.

It is proposed that this effort be undertaken within the context that a "learning revolution" for an immediate and massive non-formal educational breakthrough is just as important (and just as possible) as the "Green Revolution" is and has been in the area of food production in South-East Asia.