VOCATIONAL PLANNING FOR DEVELOPING COUNTRIES: CURRICULAR AND EDUCATIONAL TECHNOLOGY ALTERNATIVES

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INTRODUCTORY NOTE

In its effort to support vocational and management training, AID's Office of Rural and Institutional Development (Bureau for Science and Technology) and Creative Associates, Inc., undertook a three-phased study to:

- identify AID mission and regional bureau anticipated needs for information on and assistance with current and future programming in the areas of vocational and occupational training;
- prepare three background papers on pertinent issues related to future program development in occupational, vocational, and small and medium enterprise training needs; and
- propose a set of action alternatives and recommendations for future programming efforts in these areas.

"Vocational Planning for Developing Countries: Curricular and Educational Technology Alternatives" is the first of three background papers prepared under the study. The paper, written with AID-field staff as the intended audience, has been prepared for Creative Associates by Dr. Dennis Herschbach of the Department of Industrial, Technological and Occupational Education, University of Maryland, College Park.

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EXECUTIVE SUMMARY

This paper addresses vocational training alternatives in the formal, nonformal and informal educational sectors in Less Developed Countries (LDCs). The first part focuses on program planning alternatives; the second part examines the use of educational technology alternatives for program implementation.

The first part of the paper is divided into four sections: 1) the formal training sector, 2) nonformal vocational education, 3) informal vocational and technical training, and 4) making curriculum and instructional planning decisions. In the first section a discussion of the limitations associated with formal vocational training, is followed by an examination of the strengths, limitations and optimal use of: job and occupational specific training, the cluster concept, the core program, integrated training, the training lattice and prevocational training. It is suggested that formal vocational education plays a restricted but essential role in the training of manpower in LDCs. Program effectiveness can be enhanced by limiting training to fields best served through formal programs, linking formal and private sector training and basing planning decisions on an assessment of local training needs.

The second section on nonformal training discusses how individuals can be upgraded in employment through formal classwork, on-the-job training (OJT), and apprenticeships. Ways of linking formal and nonformal training through accelerated training, cooperative work experience, supplemental OJT, and training centers follow. It is suggested that the effective linking of the formal and nonformal educational sectors can be mutually complementary and has the potential to markedly improve all training in LDCs. The last portion of this section focuses on alternatives to formal programs. Particular attention is paid to rural areas with small and geographically dispersed populations since it is not always possible to offer programs of the scope and quality found in more urban areas. Distance learning, prevocational youth training and mobile units are examples of training schemes discussed. Finally, it is suggested that nonformal vocational training generally is more responsive to the training needs of private business and industry: the immediate skill needs of individual employers can be addressed, there is a greater range of training alternatives and usually there is greater flexibility in program design and implementation.

The third section on informal vocational training identifies common characteristics of the informal economic sector, providing the basis for examining training problems within this sector. The training needs of entrepreneurs as well as establishment, independent, and casual workers are discussed. The training requirements of the craft, workshop and commercial and service sub-sectors are also examined. It is suggested that the interface between formal, nonformal, and informal training is important, although establishing effective educational policy is difficult because of the unstructured and improvised character of informal training. Further mention is given to

the real and practical training problems, faced by individuals in the informal sector, including high opportunity cost and the lack of even rudimentary educational skills. Four training approaches associated with the informal educational sector are examined.

Finally, curriculum and instructional planning is briefly discussed. It is suggested that, due to a limited ability to substitute one training alternative for another, multiple training alternatives are probably required to address the complex and changing training needs in most countries. The use of manpower and employment data, planning based on social demand and contextual factors are also discussed. The allocation of total educational resources, relating decision-making to vocational institutions and programs within each educational sector, and program level decision-making are examined. It is suggested that the most important planning challenge may be to shift the focus of curriculum decision-making in LDCs to the local level.

A number of research and development implications can be drawn from the discussion presented in Part I. These include:

- In regard to formal vocational training, substantial attention needs to be directed to improving program quality, reducing cost, facilitating the transition from training to work, and linking training more closely to private sector employment needs.

- A considerable range of training alternatives are available through which to develop a skilled work force. Attention needs to be directed to identifying the relative benefits to be derived from and optimal applications of different training alternatives. Multiple training alternatives are probably required to address the training needs in any one country.

- Accelerated training and training centers appear to be nonformal training alternatives which merit additional consideration. The extension service model appears to be potentially effective for training in the informal economic sector.

- Training effectiveness is probably related to the degree that local decision-makers have sufficient data to make good choices. Greater attention probably needs to be directed to local-level planning considerations.

Part II of the paper presents an overview of the application of educational technology alternatives to program implementation. A survey of educational technology resources is presented, followed by a discussion on how to decide which educational technology to use in a vocational training setting.

It is suggested that it is necessary to consider: 1) costs, 2) the improvement of instruction, 3) providing instruction not obtained through other means, and 4) extending educational opportunities. Conditions essential for the effective use of educational technologies are also identified, followed by an examination of the evaluation and selection of educational technology, with emphasis on cost analysis and making practical judgments. Guidelines are presented for assessing the quality of instructional materials, since the ultimate worth of the educational technology is best judged by its instructional use. A final section examines the identification and use of instructional resources. It is suggested that the most potent characteristic of educational technology is its capacity to be applied to an extraordinary range of program and educational settings in LDCs. It is this flexibility that makes educational technology so promising as a way to address the complexities of vocational training in LDCs.

Implications for research and development include the following:

- One of the most difficult problems faced in using educational technology is the development of an effective system to collect, manage, disseminate and update resources.

- Additional research and development is needed to facilitate the use of educational technology with local employers in the context of nonformal and informal vocational training.

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PART I
SELECTING CURRICULAR ALTERNATIVES FOR VOCATIONAL TRAINING IN LDCs

For the past two decades, considerable investment in vocational and occupational training has been made in less developed countries (LDCs), often through the assistance of donor agencies. Much has been achieved, yet persistent educational problems continue to exist as do questions concerning the effectiveness of vocational training in addressing educational and manpower concerns in LDCs. Which, for example, of the various vocational training alternatives should be implemented? What kinds of results can be expected, and to what extent can training needs be addressed? Obviously, the answers are as complex as the social and economic environments in which programs are nurtured.

But the need to explore ways of providing vocational opportunity remains. A large segment of the population in LDCs is in low-productive work, lives at the edge of poverty, and has little chance to improve their skills through training. Stagnant economies, deep dissatisfaction with the quality of education, and unfilled expectations have led to the serious questioning of past educational policy. Unemployment, especially "educated unemployment," and underemployment are perceived to be problems, while at the same time the cost and budgets of education have grown both in absolute and relative terms. Tilak (1982: 108) observes, for example, that "there are few areas of public policy where governments have moved so rapidly or so vigorously as in the case of education." This investment, however, has generally not produced the results expected. Moreover, there is little likelihood that public expenditures for education in LDCs will continue to increase at past rates (Blaug, 1979; Tilak, 1982). Any strategy to address vocational training needs in LDCs will no doubt involve considerable redeployment of existing resources. How should resources, new and existing, be used?

It is the purpose of this part of the paper to assist the program planner in making decisions about the use of vocational education resources. The paper addresses the formal, nonformal and informal educational sectors, and then discusses curriculum and instructional planning. Because there are no simple answers, the approach taken is to examine different program alternatives. Specific vocational curriculum models are identified and examined, and the strengths, weaknesses as well as optimal use of these alternatives are discussed. Problems encountered in implementing programs in LDCs are also reviewed.

More specifically, this paper is designed to help the program planner focus on the following questions:

- What is the range of available vocational curriculum options in each of the educational sectors? What type of training is addressed by each?

- Who gains access to training, and what are the ports of entry? Which groups are served best?

- What is the interface between formal, nonformal and informal training, and how does each relate to specific employer needs? Which options best address the skill needs of small and rural employers?

- What are the inherent training constraints of each option, and what practical limits are faced? What are the essential resource needs, financial, human, and otherwise? What is needed to establish program quality?

Vocational training is a diverse enterprise. Within each educational sector there are many ways that training can be provided. The program planner is mainly concerned with determining the most effective way that training can be delivered through the most efficient use of resources. Making planning decisions, however, is a complex undertaking. Choices must be made about general social and economic goals, the allocation of resources, different training options and client populations to be served. These choices are largely based on value judgments, and they can not be determined solely through the use of empirical data. Decisions, nevertheless, need a valid basis, and they need to be made with some consistency. Planning decisions can be considerably improved when they are based on an understanding of the different training alternatives that are available and the optimal use of these alternatives. The following three sections provide discussions of different training alternatives within the formal, nonformal and informal educational sectors.

The Formal Training Sector

Investment in vocational training has tended to be concentrated in the formal educational sector. This is hardly surprising, because in most LDCs the provision of vocational training has been part of a governmental response to public expectations for greater social opportunity. Many governments have taken the view that public funds can be best used through public agencies. Formal institutional structures exist through which to administer programs, greater control can be exerted over finance, and the establishment of programs reflects favorably on those in control. Increasingly, though, investment in formal sector vocational training has been questioned. Blaug (1974: 22) puts it bluntly: "Unfortunately, vocational training in formal institutions makes little sense on either educational or on economic grounds." Major criticism includes the high cost of vocational training, lack of responsiveness to labor market needs, and the poor placement record of those leaving the program.

Vocational training is expensive. Facilities, machinery and equipment, limited class size--all tend to make vocational education more costly than general secondary education. In addition, Psacharopoulos (1973), Blaug (1974) and others have shown that the rate of return on primary educational investment surpasses that on secondary, including, of course, secondary level vocational education. One conclusion reached is that investment should be shifted to primary schools. Another is that perhaps greater investment should be made in private sector, nonformal education.

"Recent research," Colclough (1982: 169) concludes, "has produced a considerable amount of evidence to suggest that primary schooling makes a significant contribution to economic and social development." In addition to the inherent values of primary education, basic literacy and numeracy skills are necessary to successfully complete vocational training in many occupations. Even among those who have no organized vocational training, individuals with primary education tend to fare better in the labor market than those without it. Simply put, primary education helps to make people more productive. However, to say that primary schooling is beneficial does not automatically mean that investment in later vocational education should be reduced. Typically, vocational enrollment currently accounts for approximately 10 percent of secondary level enrollment in LDCs. There is no easy way to judge whether this is lower or higher than it should be.

In regard to greater investment in nonformal vocational training and less in formal, on purely economic grounds there is no basis for this conclusion. Nonformal programs typically cost more than formal (Zymelman, 1976; Corvalan, 1977; Ahmed, 1975; Castro, 1979). Formal education enjoys the advantage of economy of scale: large numbers of students can progress through a common course of study, using common machinery and equipment. Faced with the need to provide a variety of programs to small groups of participants, nonformal education does not have this advantage. Corvalan (1977: 6) concludes that it is "reasonable to expect higher costs per hour of teaching in the nonformal than in the standardized formal systems." Of course, not all programs are comparable. On-the-job training schemes, for example, may have low costs, but the scope and transferability of training usually are restricted.

In part, because formal vocational education tends to address large numbers of students in common programs, it is less responsive to labor market needs than is desired. Instruction is given in occupational areas that are relatively stable and that have the potential for employing large numbers of future program graduates. Typically, these are the more traditional skill areas, such as automotive, office occupations, health services, building construction, metal working and the like, or technical subjects that undergird technician and engineering occupations, such as electronics and drafting.

This focus on a few select occupational areas, coupled with the fact that there is a considerable investment in fixed facilities, equipment, and staff, markedly reduces the flexibility required to initiate program changes in response to the specific training needs of the private sector. Consequently, facilities, equipment and machinery are used over relatively long periods of time, partly to realize the full benefit of costly investments. This tendency is coupled with a general view of program development as a one-time investment, particularly when it is supported by donor agencies which work within a relatively short time period. Thus, it is not surprising that formal training programs consistently lag behind private sector needs.

Lack of responsiveness to employer needs is further compounded by staff obsolescence. Even if it is possible to recruit a reasonably qualified staff, obsolescence sets in very rapidly unless individuals have the opportunity to acquire updating on a regular basis (Evans, 1971). Upgrading, through work

experience or in-service training, may be required in as little as three to five years. However, there may be little incentive to acquire upgrading if it is not accompanied by any additional benefits to the staff.

In addition to staff upgrading, it is also necessary to upgrade instructional content continually through the regular and systematic identification of current job practice. This requirement is usually ignored, however, in program planning and administration. Consequently, instruction increasingly fails to respond to the immediate and changing skill needs of business and industry. Obsolescence, nevertheless, can be corrected, and it is not necessarily a structural characteristic of formal training.

It is probably unreasonable, then, to expect formal sector vocational training programs to effectively meet the needs of employers unless considerable investment is made. This investment would require that numerous program options are provided, recurrent expenditures are generous, new equipment and machinery are phased in on a regular basis, quality staff are recruited and periodically upgraded, and close working relationships are maintained with business and industry. Without meeting these conditions, the capacity of formal sector vocational training to respond directly to immediate skill needs of employers is limited. By meeting these conditions, the cost of formal training is substantially increased.

Another issue facing the formal vocational training sector is a poor placement record. Vocational students are not immune to "educated unemployment." While data are sketchy, it does appear that the unemployment rate of vocational school graduates may be as high, or higher, than the rate of other secondary school graduates (Stoikov, 1975: 104). Simmons (1979: 1107), for example, estimates that in Pakistan 40 percent of vocational school graduates are likely to be still unemployed two to four years after graduation. Students from vocational schools may have a difficult time finding jobs, some may be unemployed a considerable time before finding jobs, and some may find jobs in completely different fields from those in which they were initially trained. Considerable numbers of students apparently also view formal vocational enrollment as a way to eventually work their way into the university, abandoning the field in which they received often costly training. Castro (1979: 623), for example, found in Rio de Janiero that between one-fourth and one-half of technical high school graduates entered college, rather than remain in the field for which they were trained.

It is to be expected that vocational students experience the vicissitudes of the labor market; also, there is no reason to think that vocational students should lack the social aspirations that others hold. A more fundamental problem, however, is the inability of the formal sector to adjust training to meet labor market needs.

It is difficult to make reasonable projections of specific skill requirements beyond more than two or three years. What this means is that needs may have changed in the time between initial enrollment and program completion. Furthermore, even short-term projections often lack any semblance of validity. For example, in Barbados, Oxtoby (1977: 232-233) found that roughly 38 percent

of polytechnic graduates were not working, even though official manpower projections generally indicated a large number of job openings. "The follow-up study," Oxtoby (1977: 234) observes, "casts considerable doubt on the credibility of the manpower projections and underlines the need for improved sources of data about relationships between education, employment and economic growth." This statement is probably true in general (Simmons, 1979).

The economies in many LDCs have not grown fast enough to absorb the output of formal vocational training programs. The short-term result has been, on the one hand, overinvestment in formal training, and on the other, oversupply of graduates (Simmons, 1979; Colclough, 1977). This situation has been exacerbated by a general inability to base program planning and development on meaningful projections of manpower needs.

Even if manpower forecasts were accurate, formal programs simply lack the flexibility to change with changing needs. As previously suggested, investment in facilities, equipment, machinery and staff cannot be easily discarded and replaced. In addition, cost-effectiveness is best realized by large enrollments in a limited number of courses. Furthermore, there is often considerable "lag-time" between course development, teacher training and recruitment, and student enrollment and graduation.

These are not reasons, however, for eliminating formal vocational education. Rather, they are factors that limit the role that formal programs can play in preparing the young for work. To recognize these limits is the first step in formulating development strategies that are effective. The following are major points:

- Formal sector programs should probably be limited to fields of study requiring related formal study. Some training is simply better addressed through formal instruction based on organized knowledge. Conversely, some instruction is better handled in nonformal settings.

- Rather than spread limited resources among a large number of programs, none of which are sufficiently funded, it may be better to concentrate resources on the development of a restricted number of higher quality programs, which in turn produce better trained graduates.

- In countries which have better developed labor markets, it is probably prudent to restrict the number of formal vocational training opportunities, rather than oversaturate the labor force with new entrants. This will help to avoid the imbalance between the outflow of graduates and employment demands.

- One should not expect formal vocational training to result in high levels of direct job placement. Formal vocational training should be recognized for what it does, namely, provide instruction in an occupational field, thus

establishing the foundation to enter into a number of related jobs in that field through minimum additional, and specific, training. Substantial flexibility is achieved, in itself, an asset in uncertain economic times when labor force needs cannot be anticipated with any accuracy.

- Support services should be established to assist students in making the transition from school to work. Many of the difficulties that the young initially experience in the labor market are due to their inability to "manipulate" it; in other words, to find a job. Formal programs should probably not be established without these related services. Furthermore, placement services provide some of the best indications of current employment demand.

- Links probably should be established with private sector training. Formal training is only the first step in occupational preparation, not the terminal point. In most cases, it is to be expected that additional training will be required of graduates, even if only informally. It is useful to think in terms of a continuum of training opportunities, spanning the formal and nonformal sectors.

One of the most perplexing problems associated with formal vocational training programs is maintaining quality. Many difficulties that the young experience in the labor market may, in fact, be directly attributed to poor quality programs. Therefore, careful attention needs to be given to establishing and maintaining quality programs. This includes management systems, supply and inventory systems, program evaluation procedures, curriculum development mechanisms, in addition to the use of advisory committees, student placement services, and the like. It is the failure to deal with the whole range of complex components in order to get a program to work well that may, in fact, be the biggest failure of formal programs.

To be sure, the purpose of vocational education in the formal sector is to prepare individuals for gainful employment. There are a variety of curriculum designs, each with its relative merits and limitations, varying in cost and the type of training provided that can help accomplish this purpose. The educational planner must fully consider the range of curriculum options, selecting those which are appropriate to the program aims under consideration. Following is a brief review of different curriculum options.

Job Specific Training

When the term "vocational education" is used, many individuals think of job specific training. Instruction is focused on a clearly defined set of skills which prepare the student for direct placement in a specific job. The apparent direct relationship between training and job placement is the attractive feature of job specific training.

Job specific training, however, tends to be narrow in scope, but depth of coverage is provided, enabling the student to seek immediate employment following the completion of training. Training may be given in only one job category, so that only limited training resources are needed. In general, occupational mobility is reduced through job specific training because job options are markedly reduced. It is for this reason that mature students who have made definite career choices are the most likely candidates for job specific training, and training should be targeted on jobs which provide definite long-term employment opportunities.

Much of the criticism directed toward formal vocational training stems from the fact that training is less specific than what it is expected to be. As previously suggested, however, formal vocational programs are limited in the amount of job specific training that can be expected. Job specific training probably should be restricted to 1) fields that are capable of absorbing relatively large numbers of new entrants over an extended period of time, and 2) areas of critical skill shortage, particularly those that require formal instruction.

Occupational Specific Training

Formal vocational programs tend to offer occupational specific training rather than job specific training. That is, training in a representative sample of skills relating to one occupational field or related fields is given. Programs tend to evolve in this direction because of the constraints associated with job specific training: inability to upgrade machinery and equipment; failure to maintain a close working relationship with industry; the need to address a large, general student population; uncertainty about student placement; and the like.

Occupational specific training provides a basic technical and theoretical background, but few individuals are prepared to enter directly into productive work without additional training, often of short duration and on the job. Criticism that trainees are not prepared to go immediately and directly into employment is largely misplaced when it is realized that the intent is to provide broad training, and skills are not always taught to high performance levels. Broad coverage is traded for depth of instruction. Obsolescence in staff and equipment, while certainly not desirable, can be more readily tolerated in occupational specific training because specific and current training can be obtained at the place of work. Greater economy can be realized because large numbers of participants can use limited and common machinery and equipment. Also, it is easier to identify and focus training on a core of representative skills common to a range of specific jobs within an occupational field rather than focus on the individual skill requirements of a specific place of employment. Finally, labor force mobility is enhanced because the individual is prepared to pursue employment in a range of related jobs.

To be most effective, however, it is essential that occupational specific training be complemented with specific and focused training just prior to or at the time of employment. Few formal programs provide for this, directly

reducing the potential effectiveness of occupational specific training. More specific, short-term training can be obtained in a number of ways, either in the formal sector or by links directly to private industry. The combination of occupational specific training coupled with short-term job specific training capitalizes on the strengths of both schemes.

The Cluster Concept

Programs based on the cluster concept prepare individuals to enter a family of occupations rather than a specific job (Maley, 1975). Representative skills from a number of related occupations are taught, so that the trainee is prepared in a broad range of entry skills, but does not acquire depth in any one job. Five criteria are used to determine which occupational areas should be the focus of instruction: 1) favorable long-term employment outlook, 2) opportunity for entry upon program completion, 3) opportunity for advancement through further schooling, such as apprenticeship or on-the-job training, 4) commonality of the skills and knowledge of individual jobs with the other jobs in the cluster, and 5) the capability of being implemented in a formal school program. Basic task analysis procedures are used to identify instructional content and to group jobs into clusters which share common requirements. Typical clusters, for example, might include the following:

- Electro-Mechanical Installation and Repair

  1. Business machine serviceman
  2. Home appliance serviceman
  3. Radio and television serviceman
  4. Air conditioning and refrigeration serviceman

- Metal Forming and Fabrication

  1. Welder
  2. Machinist
  3. Sheet metal worker
  4. Assembler

One outcome of programs based on the cluster concept is that participants have a broad, basic background which can form the basis of further training. In addition, the trainee has increased mobility within an occupational area, facilitated by the transferable skills developed. A major drawback, however, is that instructors must be trained in a number of related jobs.

Core Program

The core program is based on the idea that there are skills common to a number of related technologies (Schill and Arnold, 1965). These skills can be grouped, forming a basic instructional core. Subsequent skills, common to fewer technologies, are also identified, forming a less general core, and so on. The result is that a curriculum can be organized around skills which have the greatest common application, those that have the next evident application, and eventually, those that are most relevant to only one occupational field or job.

Standard task analysis procedures are initially used to identify the skills in each technological area. The skills are sorted on the basis that they are 1) closely related to the technology, 2) somewhat related, or 3) totally unrelated. Common skills are identified across the different technologies.

A major advantage of the core program is economy. Common skills can be taught in large instructional groups using the same equipment and machinery. At the same time, trainees eventually specialize in one area, but this specialized training includes only a limited number of skills not common to other technologies. Specialized skills also can be acquired through on-the-job training or through other combinations of training. However, specialized training is required prior to, or at the time of employment.

Besides the economy of instruction achieved, the core program results in greater occupational flexibility. First, the trainee can delay a specific occupational choice until after core skills are learned; choices can then be narrowed to one or two technologies, and, then to one. But the trainee also has the potential to shift to other technologies with only limited training required. In sum, entry level training is provided, but the foundation is also established to address a number of employment opportunities and build additional competencies. The flexibility of planning is increased, and the negative effects of inaccurate labor market forecasts reduced.

Integrated Training

A less common, but potentially effective curriculum option is the integrated program: technical training is directly coordinated and integrated with supporting academic and theoretical instruction. Science, mathematics and language instruction, for example, occur concurrently with instruction in technical skills, with all instruction linked through coordinated planning and course sequencing. All instructional content is identified through an analysis of job activity in the field. Theoretical and academic instruction make use of practical examples, and technical instruction fully integrates theory.

The integrated model is particularly useful in high technology fields where scientific, mathematical and communication skills form the foundation for developing job skills. Instruction is directly focused on the technology, while at the same time the separation between academic and technical instruction is minimized. It is thus possible to develop in-depth, high quality instruction relevant to many of the emerging technologies. The integrated training model, however, needs to be followed by additional training, and should be viewed as most appropriate for developing the base for specialized training. In many schools in LDCs, this type of program might profitably replace secondary curricula which are nearly devoid of emphasis on science, mathematics and technology.

A Training Lattice

There are many specialties within an occupational area. The training lattice attempts to build a sequence of skills from the most simple and

elementary jobs to the more complex. This sequence can extend both horizontally and vertically. Starting with the more simple job, the participant can progress through the training lattice, electing to choose different options, advancing as far as achievement and time permit. Multiple placement options are thus provided for, while at the same time individual choice and interest are accommodated.

The first step in the development of a training lattice is to identify the representative jobs within the occupational field under consideration. The jobs are then sequenced according to their difficulty and training requirements. The attempt is to structure a sequence so that the mastery of one job builds the foundation for learning the next. Individual tasks for each job are then identified and objectives developed. A systematic and comprehensive evaluation system is developed with performance measures tied directly to objectives. It is necessary to determine if one job level is mastered before the student progresses on to the next level.

A training lattice provides the individual trainee the option to not only specialize within a given field, but to leave the training program for employment at different points. Reasonable economy is achieved because common equipment and machinery are used for more than one specialty. Instruction, however, usually extends over a two or three year period, so this type of organizational structure is most appropriate for large, comprehensive programs with high student enrollment. Thoroughly trained teachers are also required because there may be the need to instruct in more than one specialty. Finally, some occupational areas lend themselves less readily to developing a training lattice. They can not be easily organized into a sequence of skills, building from one level to the next.

Prevocational Training

There is considerable recent interest in prevocational training. There is hardly a ministry of education in a LDC that has not considered efforts to "vocationalize" formal education. While emphasis is still directed to the teaching of literacy and numeracy skills, the attempt is to introduce usable skills for rural and urban populations. Motivation stems from the belief that those who complete elementary and secondary school are not prepared to enter employment. In addition, there is a strong conviction that what is taught in education should be more related to work and community life. The content of formal education is seen as inappropriate to the development needs of the country (World Bank, 1980: 44-45; Blaug, 1979; Colclough, 1977).

Prevocational programs take many forms: work-oriented units in the primary or middle school; special courses, such as woodworking, leathercraft and home economics; or the introduction of a practical thrust to all subjects taught. In some cases, a specific occupational preparation stream is offered, in others work experience is provided. Such schemes are designed to develop a positive attitude toward work, impart useful skills for employment, and provide the focus for successful career development. These developments, however, should probably be viewed with caution.

In many cases, costs associated with prevocational programs are as high as those for vocational programs because of the required equipment, supplies and material. Teacher salaries are often higher because the teachers have more formal education. Considerable resources may thus be diverted from the support of other vocational programs and from the educational system in general. At the same time, all of the difficulties experienced in staffing and maintaining conventional vocational programs are also experienced with prevocational training, and even more so because prevocational programs usually function within the context of a general educational setting. The program may not be clearly understood, teachers unqualified, facilities inadequate, and administrators inexperienced in managing prevocational programs. One result is programs that lack quality and substance and the rapid deterioration of costly equipment and machinery.

Secondly, the results are mixed. It cannot be assumed that students will be able to enter into an occupation based on prevocational training alone. Instruction may consist of as little as 5 percent of class time, and usually not more than 10 to 15 percent. The best that can be achieved is basic familiarity with tools, machines and simple processes. The results expected from prevocational training programs are probably greater than most programs can produce (World Bank, 1980: 44-45).

Blaug (1979: 380-381) suggests that the basic value of prevocational training is to turn out "a trainable person, rather than a person whose acquired skills make him immediately employable." Prevocational education is thought of as complementing the academic education, and enriching these subjects with the practical, while at the same time exposing students to skills and attitudes essential to meaningful occupational development. That such a reorientation of education can be achieved through prevocational education, however, is still in doubt.

Nonformal Vocational Training

The development of a more critical attitude toward formal vocational training, plus the realization that there are many ways that training needs can be addressed, has led to increasing interest in nonformal education. Coombs (1976: 293) argues that "there is little doubt that the wide and strong momentum that nonformal education has generated in recent years will continue to build and not turn out to be another passing fad." Moreover, he adds, nonformal education "will provide a major stimulus for change in formal education as well. It will restore education's flagging reputation as a good investment in development." Even if these optimistic predictions are only partly realized, nonformal education will have probably proven its value (Kahler and Droegkamp, 1982).

Nonformal education is defined as "any organized educational activity outside the established formal system--whether operating separately or as an important feature for some broader activity--that is intended to serve identifiable learning clientele and learning objectives" (Coombs, Prosser and Ahmed, 1975: 29). Nonformal education differs very little from formal as an economic activity, Ahmed (1975: 11) observes. That is, resources are consumed

and yields are produced, and both are amenable to measurement, study and comparison. It is probably a mistake, however, to consider one form of education as a substitute for the other; each provides alternatives that are effective in achieving particular outcomes with certain groups of individuals. Ahmed (1975: 11-12), moreover, identifies three general characteristics that distinguish formal and nonformal programs:

- There is a greater range of nonformal training activities, consequently the management of nonformal education activities is usually dispersed. Budget, source of revenue, financial control, administration--all may be spread among different agencies or ministries.

- Many nonformal education activities tend to be a part of larger general activities, such as literacy or rural health programs. Administratively, it is difficult to separate training from other activities.

- There is usually greater flexiblity in nonformal education, including duration of courses, clientele served, and instructional personnel. "As a result, there is a great flexibility and diversity in the way that the different types of resources are used--quite unlike the standardization of formal education."

Nonformal programs tend to have low capital cost compared with formal training programs, but operational costs tend to be higher, often consisting mainly of staff costs. The tendency may be, in fact, to put resources into staff, but the result may be low educational efficiency, particularly if instructional materials and aids are neglected. Coombs and Ahmed (1974: 183) observe that "the more a nonformal program resembles its counterpart in formal education, the higher its capital costs."

Cost can be held low by using existing facilities, sharing arrangements, or locating low rent accommodations. Part-time staff can be used, as well as volunteers. Formal programs are a potential source of assistance. It is also important to add that considerable nonformal training is often unaccounted for because it occurs within business and industry, outside the scope of government activity.

Limited government involvement, in fact, may be a strength of informal training. Programs are less encumbered by bureaucratic inertia; direct control can be maintained over staff since individual firms recruit, train and retrain instructors; and, greater accountability can be achieved since training is directly linked to employee effectiveness. Sometimes associated with formal programs is the expectation that the government will employ trainees if they cannot find jobs. This can be avoided, perhaps resulting in higher levels of performance by the trainee.

Blaug (1979: 393) identifies three categories of nonformal education: 1) programs designed to upgrade individuals in employment, 2) programs which

function as a bridge between formal schooling and employment, and 3) programs which are organized as an alternative to formal schooling. Following is a brief review of different program options within each category.

Upgrading Individuals in Employment

Nonformal industrial training is more specific than training in the formal sector. Employees generally have to train only for the skills needed in a particular job in their establishment. Since most new employees already have some skills, the total training period may be relatively short. In addition, retraining and upgrading may be necessary, but since this builds from an existing skill base, training is usually of short duration.

There are several reasons why skill specific training should probably occur during employment, and not before (Staley, 1971: 80-87). In the first place, as previously suggested, formal programs are generally structured to accommodate relatively large groups of trainees, and unless all of the trainees are to be employed by one firm, job specific training will still be required to address the skill needs of specific employers, even though this training may be minimal. Moreover, in-house training is more realistic, using actual work skills and methods, relying on current technology. In addition, there is incentive to learn, since continued employment and advancement relies on learning specific job skills.

While, in general, specific skill training should occur as close as possible to actual employment, as Staley (1971: 81) observes, this condition "does not apply uniformly at every level and in every case." Low level, unskilled jobs require little organized and direct in-firm training. Conversely, higher level subprofessional and professional preparation can probably be best carried out in more advanced, specialized formal institutions providing relatively concentrated and advanced study (Staley, 1971: 81).

In general, small firms, particularly in rural areas, have the greatest training needs. Large employers can afford to "hire away" trained employees from other firms, or else have the necessary financial resources to establish training and retraining programs. Since small firms lack resources they rely heavily on formal sector training programs to supply employees who need only minimal upgrading requirements. A review of alternative approaches to nonformal employment training follows.

> Organized Classwork: Larger enterprises in the private sector, government agencies and public service organizations may find it necessary to provide organized training in-house for initial training and retraining purposes. This occurs when formal skills are required which can be best taught in large groups through trained instructors. This may include processes and procedures used only by the employing company, new technological developments being introduced, or retraining necessitated by the reclassification of workers or the redesign of work.

The major advantage of in-house training is that the firm can control the content and quality of instruction. Accordingly, when large numbers of individuals are involved it is beneficial to provide training in-house because the benefits flow directly back to the employer in the form of a more competent work force. Such training, however, should be linked to advancement and other incentives, otherwise trainees can be lost to other firms because their "market value" has been substantially increased through training. Staley (1971: 115), for example, observes that "the benefits to Firm A from its investment in training may be considerably diluted by loss of trained workers to Firms B, C, and D, which perhaps are competitors and incur no training expense." This leads to the design of training programs which restrict rather than enhance inter-firm mobility of trainees.

In addition to the fact that relatively large groups of individuals must be trained to insure cost effectiveness, other major constraints include difficulty in finding suitable instructors who have a combination of theoretical and practical skills and can also serve as effective instructors. Instruction often lacks scope, deteriorating into "tricks of the trade" rather than comprehensive coverage of the field. In addition, due to lack of resources, small and middle size firms cannot afford to provide substantial, organized in-house instruction.

On-the-Job Training: On-the-job training (OJT) differs from organized classroom instruction in that training is provided to a relatively few individuals at one time, instruction occurs along with job performance, and individual employees learn at their own speed. Basically, OJT is "learning by doing." To teach specialized skills to a small number of persons, OJT is probably one of the best training alternatives.

A major advantage of OJT is that training is in direct control of the employer. Current and specific skills can be taught using the latest industrial techniques and machinery. Attitudes and values, considered valuable by the firm, can be instilled. This, coupled with the opportunity for regular upgrading and advancement, can lead to positive relations with the employee. In addition, training is often limited to the skills performed at the firm, so there is less likelihood that the employee will be "hired away."

OJT is also relatively less costly than other training alternatives. The new employee can be immediately productive, contributing while learning. Instructors are often fellow employees, and they need little formal training in how to instruct. Additional equipment, machinery and training aids are not required.

OJT is also effective for training individuals with poor educational backgrounds and limited ability to read. Instruction is basically "show and tell," with the trainee learning through supervised "trial and error" performance.

There are also distinct disadvantages associated with OJT. For one thing, the novice trainee is "hostage" to the incumbent worker, who may or may not teach the full range of skills required to perform optimally. In many situations where there is intense job competition within firms, lack of employment opportunity in general, or significant wage differentials between work levels, OJT may be a particularly inadequate source of training. These conditions often exist in LDCs.

The normal work output can also be disrupted by trainees. Fellow workers may have to spend too much time with the trainee. Costly materials can be ruined by the untrained, and production equipment may not be operated at full capacity. On some jobs, trainees may injure themselves and fellow workers. The larger the number of trainees at one time, the greater these factors become problems (Zymelman, 1976: 12-14).

In addition, complex job skills or theoretical material is not taught well through OJT. Long practice periods or formal study is required. Also, OJT can be a static approach. If incumbents responsible for training new employees do not have the opportunity to upgrade their work skills regularly, or if the employer does not use recent technological innovations, these skills can become obsolete, leading to built-in obsolescence transferred to new employees. The results can be less than satisfactory.

Ideally, for new employees, OJT should provide: 1) orientation to the purposes and procedures of the firm, and to the relationship of the individual traineee's job to the total work of the firm; 2) instruction in the specific skill requirements of the job; and 3) actual work experience, gradually increasing in complexity and reponsibility (Staley, 1971: 91-92).

Apprenticeship: Strictly speaking, apprenticeship is a form of OJT. In the more traditional sense, apprenticeship is associated with learning craft-based skills in contrast to more modern apprenticeship training based on a planned program which combines 1) an analysis of skills, 2) specialized instruction, and 3) supervised work experience. "Planners," Staley (1971: 89) cautions, "will be well advised to think in the broader, more feasible, and more modern terms of a 'training system' rather in the more confining and traditional terms of an 'apprenticeship system.'" Low-skilled, and semi-skilled production simply does not require extended periods of apprenticeship. High technology skill development, on the other hand,

increasingly requires formal education. Moreover, in production systems undergoing rapid change, shorter initial training is preferable to long apprenticeship training periods that tend to concentrate on a fixed body of traditional skills.

In conditions where the total range of skills is not taught, there is a danger that apprenticeships can become a source of cheap labor and exploitation. The individual is bound to a long period of service, but yet this does not require or provide for the learning of a wide range of skills (Staley, 1971: 89-91). Also, Allen (1982) cautions that apprenticeship can function as a "controlling mechanism," with the number of workers in a field expanded or reduced through new entrants or variable lengths of training. Phillips (1978: 14) indicates that in many LDCs a large proportion of apprentices are illiterate, a serious individual handicap and often a barrier to the development of full productive capability. He suggests that this condition cannot be simply ignored: "Measures are required to provide facilities in pre-employment training centers or similar courses conducted within industry to provide the necessary basic education which should accompany the apprenticeship."

Despite the disadvantages of apprenticeship in a modernizing industrial system, this form of training is widely used, especially in LDCs. Ways to strengthen apprenticeship training (DeForge, 1980) include the following:

- Provide apprenticeship after completion of formal vocational studies. The trainees thus have the opportunity to build on broadly-based skills.
- Adjust periods of apprenticeship to correspond to the learning requirements of the job.
- Ensure that contractual arrangements are made which clearly identify the scope and quality of training offered; monitor training.
- Build in opportunity for formal study, integrating course work with training on the job.
- Use trade associations, unions, and employer associations to plan, regulate, supervise, and verify instruction.

Linking Formal and Nonformal Training

The effective linking of formal and nonformal training has the potential to markedly improve overall training in LDCs. Formal systems cater to a large general public, and probably function best by providing the general vocational

background necessary for more specific skill development in the private sector. Each training sector has its own aims, but these should be viewed as complementary, not necessarily competitive. And each is able to address some training needs more effectively than the other.

The degree to which formal and informal vocational training are mutually complementary depends, in part, on the marketplace. Immature economies are probably less able to absorb formal school graduates directly into nonformal training programs because few in-firm programs exist. More developed economies generally have a greater capacity to link the two educational sectors effectively . The perception of individual employers is also important. Some employers may tend to favor hiring experienced workers over recent graduates, only turning to formally prepared trainees when the supply of experienced workers is exhausted. Some, on the other hand, may favor vocational graduates because they have greater training and advancement potential. Then again, the job level is a consideration, with prior vocational preparation highly beneficial for some levels of training, and little preparation needed or desired for other levels (Staley, 1971; Fuller, 1976; Allen, 1982).

There are curricular models useful for linking the formal and nonformal educational sectors. Following is a brief review:

> Accelerated Training: Accelerated training programs, commonly referred to in the United States as short-term training, have the potential to be highly effective in LDCs. Training is less than one year in duration, requires relatively few additional resources, and it is directly responsive to labor market demands. Initial training, retraining or upgrading can be provided, and different training formats can be used, addressing, for example, the training needs of university graduates, the managerial skill needs of businesses, the skill requirements of new technology, or the marketing requirements of rural community cooperatives. A direct and functional link to business and industry is the key factor in accelerated training. As Paulsen (1981: 4) points out, "The success of the short-term skill training programs is directly related to the degree to which the curriculum focuses on the needs of employers or the degree to which it enables students to meet their licensing or certification requirements."
>
> Accelerated programs should not be thought of as permanent programs. Rather, they are phased in or out as needs change. The existing facilities, equipment and machinery of the industry or the school are used, and teaching staff are hired on a part-time basis, drawing from technical experts in industry or the formal educational sector. It may be necessary to recruit successful technical workers and provide limited training in instructional techniques. Enrollment is often limited to employees or potential employees in a particular firm or group of firms, and the employers participate in course development.

Accelerated training may be particularly useful in dealing with the problem of unemployment and underemployment of secondary and university graduates faced by many LDCs. There may be a substantial "pool" of secondary and university graduates who have good educational backgrounds but who may lack the specialized technical training necessary to secure employment. This is a potential source of highly trained manpower through accelerated, industry-based training. High technology in particular makes use of skills which are more the outcome of secondary and university training rather than traditional vocational training programs. Accelerated training programs can be of short duration and of high quality, building from the already established academic skill base. On the other hand, accelerated training is less appropriate for craft-based training that requires relatively long periods to master manipulative and technical skills.

Accelerated training programs can make use of links between the formal and nonformal, or informal, educational sectors. The formal sector may provide long-term administrative coordination, make available facilities or instructional staff, provide short-term training for potential instructors from industry, or directly channel graduates into industry-based training programs. The nonformal sector identifies training needs, often provides in-house training facilities and equipment, provides technical instruction, and identifies students.

Cooperative Work Experience: Cooperative Work Experience (CWE) programs combine technical skill training in firms with in-school instruction. In some cases, trainees may have completed a one or two year technical course, with placement on the job as a final "topping off" of the formal school program. In other cases, participants enroll directly in cooperative education for a one or two year period. Participants may be placed a half day with an employer and attend school for a half day. Or, they may work for one week and spend one week in school, a pattern known as the "week about" system. Two trainees may share a job, so the employer has what amounts to one full-time employee.

A major advantage in regard to the formal sector is that use is made of the training facilities and equipment of the employer. A single teacher, moreover, can provide theoretical instruction to a large number of trainees. Perhaps one of the greatest benefits to formal programs, however, is that by working closely with employers it is possible to identify training needs and accordingly, regularly update the in-school portion of instruction.

Trainees can benefit from CWE because they are exposed to the machinery, equipment and processes currently used by business and industry, gain practical work experience, and often have the option to remain as permanent employees.

Because trainees can only be placed in available jobs, training responds to real job openings, thus eliminating the training of surplus workers. If training sites are not available, individuals simply cannot participate in the program. Quality training experiences depend upon good training stations, so care should be exercised that participants are not exploited, have the opportunity to learn different job skills, are adequately supervised, and receive fair wages. Close coordination should also be maintained between in-school instruction and training in the firm. The use of cooperative programs, however, is limited in rural areas because of lack of transportation and shortage of available employers.

An alternative type of cooperative training is "sandwich" courses for older workers. These are individuals who are already employed and are released to obtain upgrading, often through short-term courses sponsored by formal training institutions (Phillips, 1978: 14). Sandwich courses are a major way to provide technical upgrading to the already skilled.

Supplemental On-the-Job Training: Yet another way formal and nonformal training are linked is through supplemental instruction provided by the formal sector. Employers provide the technical skill training through work experience, but rely on the formal school to provide additional technical knowledge. This is commonly done after work hours through class instruction to a small group of apprentices. This approach has merit because individual employers are not always current on the newer developments in the field, group instruction is more efficient, and trained technical instructors are made available through the formal sector. Such programs require the development of necessary administrative structures and procedures.

By using existing formal sector facilities, the marginal cost of the additional instruction is low. Ahmed (1975: 61) reports, for example, that in Thailand the evening program using regular school facilities and staff costs less than half of the regular day program. This finding is probably typical.

Training Centers: Training centers provide activities that extend beyond a single employing establishment. These may include correspondence courses, semi-formal courses, apprenticeship programs and conferences, seminars, and in-house demonstrations, in addition to regular courses. Often administered by trade associations, unions, professional organizations, or government bodies, training centers can keep abreast of current labor market demands and apprised of the latest technological innovations (Staley, 1971: 117-118). Centers offer a way to centralize and disseminate information that individual employers simply cannot achieve. In Singapore, for example, the Industrial Training Board (ITB), through the Joint Government-

Industrial Training Scheme, assists firms in retraining and upgrading in order to minimize training wastage and skill shortages (Squire, 1981: 203-204). Through SENA (National Training Service) in Colombia, joint planning is conducted with firms to improve training, drawing from knowledge of advanced technology and training resources (Corvalan, 1979).

The costs of training centers may be substantial, but this is usually shared among a number of firms. Moreover, there is no reason why centers cannot draw from the existing capabilities of formal sector vocational education or individual firms.

Centers are particularly useful in cases where individual firms cannot support their own training programs, and may provide one of the best practical ways of addressing the skill needs of small and medium size employers. Training in centers sponsored by industrial groups tends to provide instruction that is specific and narrow, while training in government sponsored centers is usually more broadly based and general, thus addressing the needs of a variety of employers (Zymelman, 1976: 15-16). Training is often targeted on skills that are in short supply. Centers may also train instructors that will in turn teach at the site of employment.

Trainees may be drawn from formal vocational school graduates, or they may have little previous occupational training. Organizational links with formal vocational programs are probably useful because prior screening and selection can insure that higher quality trainees enroll in center training programs. Training usually combines classroom instruction and practical workshop experience. Work is mastered to acceptable job standards, approaching the speed, skill and accuracy demanded on the job. General academic instruction is generally not given, but remedial instruction may be required so that trainees fully benefit from skill training.

Many centers tend to collect and develop training materials, functioning as a resource center for the specific training needs of individual employers. Direct assistance may be given to training programs conducted within industries.

In summarizing the activities of SENAI (National Industrial Apprenticeship Service) in Brazil, Castro (1979), identifies major characteristics that are probably important for successful training:

- Courses are specific to particular jobs. There is a direct relationship between training and job openings within the industries being served. Instructional content is based on an analysis of the job tasks performed, and course completion depends upon attainment of job standards.

- Close ties are maintained with the employers who hire program graduates. Training is in response to their immediate needs, with built-in feedback mechanisms concerning both the quality of training and the numbers of trainees required.

- Course content is restricted to job skills. A few skills and concepts are taught thoroughly. Rapid and broad coverage is avoided. Remedial instruction is given when needed.

- A placement service is provided. Graduates are placed and followed up for the first year of employment.

Providing Alternatives

Yet another category of nonformal education includes programs that provide alternatives to formal education. Particularly important are programs that focus on rural areas.

Rural areas present difficult training problems. Often isolated with a small and geographically dispersed population, it is not always possible to offer training of the scope and quality found in more urban areas. Rural economies are also restricted, offering limited employment opportunities. Following are a number of approaches to rural based vocational training.

Distance Learning: Through distance learning, instruction is given without the direct assistance of an instructor. Use is made of educational media to deliver prepared instruction to individual students. Educational radio is a common medium, although inexpensive tape cassettes, programmed booklets and correspondence lessons are also methods, among many, that are used.

A major attraction of distance learning in LDCs is that remote rural populations can be served relatively inexpensively. Students do not have to travel long distances to a centrally located school, and instruction can be given in the evenings, weekends, or part-time, thus allowing individuals to work.

Distance learning systems require a coordinating organization. There are a number of ways that this can be done; three examples follow (Smith and Stroud, 1982). First, off-campus instruction can be administered by the formal school, such as a regional vocational center. The distance learning courses are but an extension of the regular courses, packaged in suitable form, with regular credit given for completion. Successful examples are the American Samoa ITV Project, the Nicaraguan Radio Mathematics Project, and the Brazilian Education

Movement. Second, special, nonformal, multimedia programs designed specifically for adults, school leavers, and school dropouts can provide special purpose education. An example is the British Literacy Campaign already modeled in various LDCs. Third, special, independent or semi-independent organizations can be established to develop and regularly conduct instruction in rural areas. These organizations can qualify for accreditation from a public institution, such as in the case of the Institute of Adult Education in Tanzania, or they can be autonomous, offering their own evaluation and certification.

There are a number of constraints associated with distance learning. In the case of vocational instruction, relatively small populations are served, increasing the unit cost of instruction. More troublesome, however, is that it is difficult to provide adequate practical instruction; distance learning is best used for imparting information. This does not eliminate instruction, however, in such areas as small business mangement, technical math, and so on. Organization, production of quality instruction, management, and linking instruction to real training needs are among major problems encountered. Nevertheless, as Jamison (1977: 17-18) suggests, "in those cases where these problems have been overcome, distance learning has achieved marked success."

Prevocational Youth Training: Another category of instruction can be loosely classified as prevocational youth training (Anderson, 1973). Programs range widely in the type of support and instruction provided. In general, prevocational youth training programs are supported by private sector agencies, attempt to provide vocational opportunity for primary school leavers, mainly in rural areas, and direct training to local crafts and trade activity. Perhaps the best known are the Village Polytechnics in Kenya. Designed to meet the multiple occupational needs of rural life, training is directed to such occupations as weaving, carving, beekeeping, well digging, building trades and mechanics. One objective is to promote self-employment, rather than wage employment; modern techniques are taught, but with rural application, using locally available materials.

Generally, these programs are established on a self-help basis, drawing from student labor, available material and local tradesmen for instructional staff. The local dimension is probably both the strength and weakness of prevocational training programs. As Blaug (1979: 294-295), observes, "such programs are characterized by low recurrent costs, by pupil-teacher ratios higher than in the formal training system, by the absence of formal requirements for admission...". There is greater community rapport because of the close links established, training generally relates to local needs, and students,

if unable to find full-time work, tend to apply their skill "on a part-time or casual basis, and the remaining time is then used to farm or trade," reflecting the multiple nature of occupational roles in rural areas (Anderson, 1973: 296).

These programs, however, are highly localized and of limited replicability. Success often depends upon a dedicated director, the recruitment of skilled craftsmen as teachers, or on local donations. Program development is very much ad hoc, often dependent on voluntary assistance. The jobs prepared for are often low-paying, and the employment success of those completing the program is spotty. This is partly due because, as Blaug (1979: 395) observes, "regardless of the focus of the course on self-employment, the students themselves have their eyes on training as a means, however remote, of gaining access to a wage-earning job." Anderson (1973: 298), suggests that "the impact of the polytechnics is more ideological than institutional. They have given a new, positive experimental orientation to employment-oriented youth work but offer no ready-made answers...".

Mobile Units: Mobile training units are another approach to providing instruction to rural areas. On the Indop Plain of West Cameroon, for example, a mobile unit provided prevocational, practical arts instruction to a cluster of primary schools in the surrounding area. There were no local opportunities for practical instruction available, and the state of the transport network made it impractical to travel to other areas. There are 46 Mobile Trade Training Schools (MTTS) operating for out-of-school youth and adults in rural areas of Thailand. Welding, auto mechanics, electric wiring and installation, radio repair and woodwork are offered. Originally planned to rotate between rural villages in three to six month intervals, these units have become more or less semi-permanent centers in some of the larger provincial towns (Zymelman, 1978).

Mobile units can extend practical training to areas normally bypassed because of inaccessability. There are, however, substantial drawbacks. The physical limitations of the unit restricts the scope of instruction provided and the number of students served. Costs are also increased by the operation and maintenance of vehicles, need for an on-site instructional area as well as storage areas. In rural areas, because of poor roads, the wear on vehicles may be excessive, breakdowns common, and accidents to be expected. Mobile units probably can best operate out of a center, to which they can return, receive maintenance, resupply, and plan and develop instruction.

Informal Vocational and Technical Training

For the past decade the term "informal education" has been used to distinguish learning that is acquired on the job or at home from formal and nonfor-

mal education. To be sure, nonformal education takes place outside of the formal system, but it is nevertheless an organized system of training in contrast to informal education, which is unorganized (Coombs, Prosser, and Ahmed, 1973: 10-12; Blaug, 1979: 396). Ahmed (1975: 10) defines informal education as "the life-long process of acquiring incidental attitudes, values, skills, and knowledge from one's environment."

In the less developed and rural sectors of the economy, and particularly in traditional societies, the greatest part of occupational training is acquired through informal means. Blaug (1979: 396), for one, suggests "that the vast majority of the labor force throughout the Third World learn the skills they need for their livelihood not in the systems of formal and nonformal education, but informally..." In Kenya, for example, roughly 226,000 students complete primary school each year, yet formal skills training is available for only about 5,000 students. The majority of those who leave primary school eventually enter the labor market in one capacity or another, but their skills are largely learned through indigenous training opportunities. Similarly, Allen (1982) observes that the informal "apprenticeship" is, for all practical purposes, a universal component of the West African labor market, comprising a vast "training system" through which critical economic and development needs are addressed.

It is not inaccurate to think of informal education as primarily responding to the skill needs of the informal sector of the economy. Informal training feeds the skill needs of this sector, and supplies in part its dynamic character. Informal training is tied to local labor force needs, promoting skill development related to local resources and production; training and advancement are based on production and achievement rather than on certification; production incorporates labor-intensive and simple, adaptive technology; and, entry into the labor force is relatively easy, with a prevalence of small scale, low capital investment operations and self-employed enterprises (World Bank, 1980; Sethuraman, 1981). The urban informal sector may comprise between 20 to 70 percent of the labor force in less developed countries. "It would seem unwise," Papola (1981: 2) cautions, "to disregard such a sizeable segment of these economies in any strategy of development."

Characteristics of the Informal Sector

The single common characteristic of the informal sector is the "smallness" of the work unit, often consisting of only one individual, with, perhaps, a couple of helpers. Sethuraman (1976) suggests that firms consisting of 10 workers constitute the upper limits of informal enterprises. The informal sector, however, is actually made up of a number of subsectors, each of which has different policy planning implications for vocational education. Within this range can be found entrepreneurs, those who own the means of production or commerce, individually or in partnership; enterprise workers; independent workers; and casual workers (Papola, 1981).

Entrepreneurs tend to be the highest educated group in the informal sector, many having substantial formal education, most are able to read and write. In small establishments, the owners are workers, and when others are

employed, they may be family members or relatives. Most buy raw material locally, manage their own finances, and sell locally to different buyers. The major constraints faced are the lack of capital, dependence on what may be limited demand for goods and services, and inaccessable credit. In addition, few informal enterprises are covered by government regulations or benefits.

The lack of managerial and marketing skills, along with low or outmoded technical skills, are perhaps the two greatest educational problems faced. These are followed by the need to locate information on better technology and production processes (Papola, 1981; Sethuraman, 1981). Instruction, however, must be fully adapted to the requirements of the very small businessman, and conveyed through means that can be fully taken advantage of by entrepreneurs who have limited resources and even less discretionary time available. This group does have, in general, a level of education that suggests that they can benefit from formal and nonformal programs of education.

Establishment workers, those employed by entrepreneurs, comprise a substantial group of workers in the informal sector. Basically wage earning employees or relatives, they make up the three or four additional workers on the average that the owner-worker requires to meet market demand. Generally, establishment workers are employed regularly on a full-time basis, have relatively high skill levels, and may have as much as eight years of formal schooling. Papola (1981: 74) finds that the preponderance of establishment workers are in white collar or skilled jobs: vending of goods, repair work, skilled manufacturing, clerks, bookkeepers, office attendants, salesmen and bookbinders, to name some. The majority of establishment workers learn their skills on the job, basically through apprenticeship. This is true even when secondary school is completed, and in the case of vocational and technical school graduates, a high proportion still undergo training on the job. Of those who did not complete primary school, Fowler (1981: 55) found that "95 percent of them underwent apprenticeship... One implication of this trend is the possibility that such extramural training could, if properly organized, prove more than a substitute for incomplete primary education."

The ability to make time for training remains a problem with establishment workers as with most workers in the informal sector. On the other hand, with the exception of introducing new technology and managerial skills, apprenticeship and informal on-the-job training appears to provide substantial skill training, addressing many skill needs. Moreover, for purposes of adapting technology to simple production and accommodating labor intensive activity, indigenous apprenticeship training may be adequate. Technical training probably needs to complement, rather than replace, indigenous work techniques.

Another, and often large, category of workers in the informal sector are independent workers. These are individuals who are basically self-employed. Most work single handedly, only a few hire others, and when they do, often this is a family member. Most own their tools and equipment. While they may work for wages, they are nevertheless "independent." Auto-rickshaw drivers; street vendors and hawkers; bicycle, clock, watch and shoe repairmen; producers of earthenware and leather products; and laundrymen and sweetcake bakers are but a few of the multitude of individuals who perform daily tasks in the

streets and alleys of large urban areas and along the village roads and in the town squares of rural communities. They provide simple, but essential, services, independent but yet restricted by the generally low market value of their product or service. Papola (1981: 54) observes that "independent workers constitute the smallest units in the category of establishments and are the simplest forms of production units in the informal sector."

This group has characteristics which make it difficult to directly provide training services. Independent workers are generally unorganized, a nebulous group difficult to count, keep track of or maintain organized contact. While many work from fixed locations, it may still be difficult to provide educational services through any organized scheme. Workers in the informal sector have few resources or little time that they can give to training, and their hours may be irregular and based on market demands. Most are earning wages about 50 percent less than those obtained in the organized sector of the economy.

Better tools and equipment and more technologically advanced ways of working are desirable, but low-paid, labor-intensive work is a competitive advantage in low-demand markets. The independent worker can compete, in part, because of the low price of his physical labor, which is less costly than machinery or equipment. Finally, independent workers generally have lower educational levels than entrepreneurs or establishment workers in the informal sector or similar workers in the formal sector. Slightly more than half are literate. Restrictions on initial educational attainment further constrain the potential for retraining and upgrading. Papola (1981: 87-88) also found that a sizeable proportion of independent workers originally started out in establishments, but are "rejects (retrenched)." Reasons for this retrenchment are probably key to the design of any training activity.

Casual workers are the most disadvantaged group in the informal sector. While casual workers earn income in the form of wages, their jobs rely heavily on manual labor, little training is often needed, and earnings are usually low. Household workers make up the largest group of casual workers, with gardeners, cleaners and sweepers accounting for another considerable group, and mechanics, construction workers, watchmen, and spinners and weavers constituting other typical casual jobs. Casual workers are the least educated group in the informal sector, with large numbers illiterate and few completing more than two or three years of school. Work skills can usually be learned incidentally on the job. This fact, along with low pay and the fact that casual employment generally leads nowhere, suggests that if training is made available to casual workers, it should be directed to more skilled jobs that provide greater social and private return.

Using a different classification system, the World Bank (1980: 48-49) identifies the following three subsectors: 1) craft, 2) workshop, and 3) commercial and services. In the craft subsector, production units are usually small, with work completed in home workshops by the self-employed individual, including a high proportion of women. Skills are basically learned on the job by an older worker teaching the novice over a relatively long period of time; manipulative skills usually take an extended period of time to learn well.

The greatest educational need of the craft subsector appears to be acquiring marketing and accounting skills. Enterprises that produce quality products are limited by their inability to expand their markets. In rural areas, it may be particularly beneficial to facilitate the establishment of marketing cooperatives.

The workshop subsector produces a variety of products in addition to service and repair activities. A considerable proportion of production may directly feed the modern sector through intermediate products. Papola (1981: 65) observes that "the only segment of the informal sector that can be expected to contribute significantly to the income and employment growth is that of manufacturing units." Rather large proportional amounts of income are generated in the workshop sector, increased output generates considerably more employment than other activities, and growth in this sector is more "autonomous" than in trade and commercial activities. Further, Papola (1981: 124) emphasizes, there is

> Some evidence to show that the major contribution to the urban economy and its growth has been made by units which are small but have technological and market characteristics of the formal sector units. Small manufacturing units are found to be the key segments of the "informal" sector in this context, but in terms of technology, productivity and marketing characteristics they compare reasonably well with the units in the formal sector. In fact, most of them are technologically and marketwise integrated with and grow and prosper on the basis of their relationship with the units in the organized sector.

Sethuraman, however, (1981: 197) observes that "a major part of the employment growth in the informal sector seems to be not in older enterprises hiring more labor, but in the growth of the number of small, i.e., single person enterprises."

In the majority of workshop enterprises, simple and adapted technology is used with heavy reliance on labor-intensive production. While skills are basically learned on the job, it does appear that greater use is being made of institutionalized training programs, formal and nonformal, to provide basic skill training for younger participants (World Bank, 1980: 49; Sethuraman, 1981). On the other hand, this may indicate the saturation of the formal labor market so that the young are seeking employment in the only place that they can find work--the informal sector (Gregory, 1980).

Any training scheme to address the workshop sector should probably be structured around on-the-job activities, should coordinate learning with existing production processes, and at the same time introduce technologies and production processes that have a reasonable chance of being absorbed into the informal work mode. Trainers, the World Bank (1980: 49) suggests, "should be recruited from among the best local workers; and the community should be responsible for organizing and running these training programs."

The commercial and services subsector is usually large in LDCs, and it is often integrated both with other informal sector activity and formal sector enterprise. The largest percent of entrepreneurs and establishment workers are employed in this subsector, and, obviously, jobs tend to be white collar (Gregory, 1980). The World Bank (1980: 99) observes that "for the literate rural dweller, the transition from daily marketing to the permanent status of an urban trader is the first step into the wider field of commerce and services." The overall growth rate of this sector and its ability to absorb labor, however, is limited since "trade and commerce activities have an induced rather than autonomous growth and, therefore, cannot be made to grow faster than warranted by the growth of other sectors," Papola (1981: 65) observes, "and even if they grow fast, their employment potential seems very low." Fewer workers are added for a given increase in output than in other economic activity. As previously suggested, the lack of capital and restricted credit remain major obstacles to the extension of activities. Training needs generally are in marketing, management and investment skills.

The existence of the informal economic sector in LDCs has been recognized for some time. It is also a debated issue. The informal sector is characterized by its "smallness," lack of capital and available credit, and by the fact that it is the "unprotected" sector of the economy (Mazumdar, 1975; Sethuraman, 1976; Weeks, 1975). These characteristics, however, may merely place the informal sector at the lower, and less advantaged end of a continuum of economic activity. This question is important, because it directly relates to the formulation of policy: should the informal sector be treated separately from other economic and educational activity, or should development policy be thought of in the broader context, encompassing all economic activity? Sethuraman (1981: 201), for one, suggests that while the informal sector is considered a subsector of the economy, "it does not follow that the policies and measures proposed to develop this sector can be independent of the economic system in which the informal sector coexists with its formal counterpart." Papola (1981), Allen (1982), Jurado (1981) and McLaughlin (1979) make similar arguments. The two sectors are linked in many ways, and those activities in the informal sector which show the most vitality and promise for growth are the ones which apparently are most closely linked to the formal sector.

Training in the Informal Sector

There are also important links between formal and nonformal education and the informal economic sector. Probably to a greater extent than realized, formal and nonformal education directly impact on the occupational success and mobility of individuals within the informal economic sector. For one thing, evidence suggests that those with basic literacy and numeracy skills fare better in the informal sector than those who lack these basic skills. Moreover, the lack of functional skills often prevents the individual from taking advantage of the training opportunities that are available locally (Phillips, 1978), and may constitute the single most tenacious barrier to occupational progress. Access to additional skill training appears highly important to occupational mobility in the informal sector (Moir, 1981; Sethuraman, 1981; McLaughlin, 1979).

While relatively few individuals may have the opportunity to gain formal or nonformal skill training, the interface with informal employment appears, nevertheless, highly important. As McLaughlin (1979: 37) observes, "technical practice in the informal sector continues to be influenced profoundly by the diffusion of skills and technology from the formal sector." To a large extent, it is from organized programs that skills are learned which, in turn, eventually find their way into the skill repertoire of informal workers.

The establishment of effective educational policy, however, is less certain, particularly regarding the interface of organized training with informal skill needs. Blaug (1979: 397), for example, cautions that "at present, the best thing that could happen to informal education is that it be left alone, not the least because it appears to achieve a wide range of educational objectives more successfully than the formal system." One of the strengths of informal training is its unstructured and improvised character which makes it flexible and adaptable to immediate employer needs. Hunter (1973: 282) suggests that "since informal education is more specifically related to real needs and to locally felt demands, it may well be one of the most flexible and efficient forms of education there is...." "Formalizing" informal education may eliminate the flexibility so highly valued while at the same time redirecting the purpose of training. Anderson (1973) observed in Kenya that intervention tended to influence the development of programs so that they increasingly tended to take on the characteristics of formal education: participants expect to receive certificates, sit formal examinations, and eventually move into formal, wage earning employment.

A more immediate and practical problem, however, is to provide training that is accessible to informal sector workers and that directly addresses their skill needs. Training may be inaccessible simply because of basic educational requirements. As suggested, workers in the informal sector can be characterized by low levels of formal education and limited literacy and numeracy skills. At the same time, even the simplest training makes use of basic mathematical and communication skills. Those that are the least occupationally skilled and lack the most basic education may be excluded de facto from training simply because they cannot meet even the least demanding requirements for successful participation (Phillips, 1978).

Training may also be inaccessible because it cannot be afforded. Even token registration fees, when combined with transportation cost and expenses for instructional supplies can constitute costs that are a real barrier to informal sector workers, consisting of perhaps as much as 50 percent of an individual's monthly income. In addition, the trainee from the informal sector is faced with high indirect (opportunity) costs. Work hours are usually long, often spent in piece work, so that any time lost through training constitutes a real loss in earned income. And it is highly unlikely that the employer will provide time off to pursue training. While the employer in the modern sector is likely to view additional training as a net gain because of a better qualified work force, the small employer will probably be threatened: there is little guarantee that newly acquired skills will not result in demands for higher wages, the loss of the worker to a competitor, or the establishment of an independent business by the former employee (ILO, 1977: 223-224).

Lacking the most rudimentary educational skills and faced with real economic and time constraints, informal sector employees may not enroll in organized training programs. The ILO (1977), for example, found that in Chile, programs tended to have a high concentration of more prosperous workers; poorer candidates simply did not apply. Similarly, courses may tend to offer instruction that is suited to modern sector employment because this is what those who design the program are most familiar with. In rural areas, in particular, the mismatch between organized skill training and indigenous production techniques may be marked. Following are a number of training approaches that are potentially effective for the informal economic sector.

Training Approaches

It is not surprising that indigenous apprenticeship constitutes the major way that the young enter the informal employment sector. Few initial skills and little experience is needed. The potential apprentice merely has to locate a willing master, often a relative; pay the fees usually associated with training; and be willing to undergo an extended period of training with, typically, no pay. Apprenticeship in the informal sector differs from that in the nonformal in that it may be largely craft-based, focused on skills that are labor-intensive or that involve simple and adapted technology, or the range of skills learned may be limited (Allen, 1982; McLaughlin, 1979). Battery charging, shoe repairing, bed construction, weaving and pottery making are a few of the host of jobs the young learn by attaching themselves to the established "master." At the start, Allen (1982: 128) observes, they act "as little more than errand boys or menial labor: going to the market, taking care of the shop, sweeping the floors, and being generally available." In time, the apprentice will pick up skills by observing, be given simple tasks to perform, and eventually be expected to complete complex tasks, returning value to the master in the form of labor. If time permits, some formal instruction will be given, but basically the apprentice learns by observing and doing. The quality of training is only as good as the skills of the master and his willingness to teach the apprentice all that he knows. Apprenticeship is a "relationship of exploitation," Allen (1982: 127) cautions, "in which the component of 'cheap labor'--as opposed to 'excellent training' can come to dominate."

McLaughlin (1979: 222) suggests that informal apprenticeship systems can be directly improved by providing more opportunity for technical upgrading. He observes, for example, that "those artisans who had received specific trade training in an institution were more productive (i.e., had a higher output) and had higher earnings than artisans with only the usual apprenticeship training." One approach is to make technical assistance directly available to the employing establishment. This is an idea based on the agricultural extension model in which assistance is provided to individual farmers at the workplace. In an example reported by McLaughlin (1979: pp. 224-225), a truck was equipped with a complete mobile workshop used as an instructional center. Through a schedule of regular visits, team members assisted small-scale mechanics who had particularly difficult repair problems. Instruction was provided through nonformal methods and focused on the problem at hand. Phillips (1978: 20) suggests that the extension model be applied to technical assistance for family businesses and small enterprises in the informal sector.

Other ways of providing training opportunity to workers in the informal sector include Vocational Improvement Centers (VIC) and "day release" programs. Coombs and Ahmed (1974: 53-55) report on VICs established in six northern Nigerian states to assist small-scale industry and independent artisans and craftsmen. There are no minimum entry requirements and no fees; instruction runs four or five days per week for roughly 400 hours, starting after the working day. At the end of the program, participants are eligible to take the Grade III (lowest) level trade test or to continue on for Grade II and I level training.

The VIC program uses existing facilities, such as primary school classrooms or the shops of local vocational schools. There are no permanent staff excepting for the program coordinator; instructors are hired from local industry or vocational schools. The opportunity cost to individuals is low. The main outcome of the program is that it "may be credited with opening up training and modern sector employment opportunities for rural semi-skilled workers with little or no formal education" (Coombs and Ahmed, 1974: 55).

The day release approach is a combination of regular on-the-job apprenticeship training and classroom instruction. Trainees spend two days a week at a vocational center and the remaining days at work. The program in Kumasi, Ghana (McLaughlin, 1979: 229-233), for example, is organized into three phases. The first phase lasts about three months, at which time the apprentice returns full-time to work. The second phase, about nine months later is also for three months, followed by the third phase of three months of training in the last year of apprenticeship. Formal instruction is roughly divided into 75 percent practical and 25 percent theoretical work, with each instructional phase more intensive than the preceding one. At the completion of training, the participant is eligible to take a trade examination.

Key to the program is collaboration with the local vocational center: staff and facilities are used. Members of the local Artisan's Cooperative Society also fully participate in instructional planning, helping to realize the "goal of delivering specially tailored supplemental training to an occupational group previously ignored by the educational establishment" (McLaughlin, 1979: 231).

Making Curriculum and Instructional Planning Decisions

A considerable range of training alternatives, then, exist within the formal and nonformal educational sectors. Which should be used, and what sector should receive major development attention? In addressing these questions, two general observations should be kept in mind. First, the ability to substitute one training approach for another is limited. For example, on-the-job training effectively imparts on-site skill development, but it is less useful for formal learning. On the other hand, formal instruction is limited for training purposes in the informal sector because of the literacy and numeracy skills required. Rather than attempt to substitute one training approach for another, curriculum decisions need to be made by fully assessing the training problems at hand, and identifying the training option that best addresses a particular problem.

A second observation that should be kept in mind is that multiple training alternatives are probably required to address the complex and changing training needs in any one country. No single approach is sufficient alone. "Countries progress along a variety of manpower growth paths," Blaug (1979: 364) observes, "and the range of alternatives is almost as wide as the range of their living standards." A mistake of the past has probably been to overinvest in formal instruction, while practically ignoring nonformal training. To overemphasize a single sector or training alternative is only to promote the imbalance that needs to be avoided to sustain regular and even development. This is not to say, however, that training should not be targeted to stimulate specific development goals or to address certain groups of individuals.

It is useful to think of curriculum decision-making as consisting of different levels of decisions that need to be made. The first relates to the allocation of the total educational resources:

- What proportion of public expenditures on education should be devoted to vocational training? How much can be privately financed?

- How should public expenditures be divided between the formal and nonformal educational sectors? How should private finance be used?

These are aggregate-level decisions, relying on macro-planning. There is rather general acceptance that planning at this level is essential for the optimal allocation of resources (Psacharopoulos, 1975). The public sector largely controls the supply, and to a lesser extent, the demand side of education, so market forces alone cannot be relied upon for the allocation of resources. On the other hand, the macro-planning of education has not been highly successful (Windham, 1975). The lack of good, overall planning models, the inability to collect and use data, and the administrative insufficiencies encountered, all contribute to less than adequate results.

Method (1979: 13) suggests that a major problem associated with macro-planning is that assessments are conducted "at such a high level of aggregation (national, regional, sectoral) that alternatives for training or skill utilization at the level of the firm, project or local organization cannot be considered directly." Nevertheless, it is often at this level that planning must commence since decisions are made about the general allocation of resources. Common practice "in sectoral planning is to take the choices made at higher levels as givens and make the best decisions one can within the budget allocated from above" (McMeekin, 1975: 31).

Another level of decision-making relates to vocational institutions and programs within each educational sector:

- What types of vocational programs will be supported, and will public or private funds be used? What incentives can be provided to increase private expenditures? What will be the total range of programs offered in each sector?

- What will be the target populations served by each sector and by the individual programs? What is the expected student outflow, and what skill categories and levels will be addressed?

At this level of decision-making, emphasis is shifted from determining the optimal use of resources across the total educational sector to identifying the most effective vocational training alternatives to consider (McMeekin, 1975: 31-32). While macro-planning data and analytical techniques are useful, it is also important to consider the in-country potential to deliver training as well as the range of training alternatives that can be used within the formal and nonformal educational sectors.

Yet a third level of decision-making relates to curriculum design:

- For each program, what skills will be taught, and how will these be identified?

- What will be the best program design? This includes duration of training, skill level taught, instructional format, and so on.

- How will programs within each sector and between sectors relate to each other? How will linkage be established and maintained?

For purposes of making decisions at this level, a needs assessment at the firm, plant or institutional level is highly desirable (United Nations, 1969). Program effectiveness is probably directly related to the degree that local decision-makers have sufficient data to make good choices. Furthermore, planning at this level is a continuous process. Most ministries of education are concerned with the preparation of a planning document, largely conceived of as a one-way process, whereas decision-making at this level requires a process of continuous analysis and action (McMeekin, 1975: 33).

In a real sense, then, there is no single optimal "mix" of curriculum options that is appropriate to all training situations. Curriculum decisions are usually made on a case-by-case basis. Perhaps Bowman (1980: 21) offers the best advice, noting that curriculum decisions should be made "with a cold eye for their costs and some concern about how education is serving the small enterprise sectors of the economy."

Just as there is no one general mix of programs suitable for all training circumstances, there is no one agreed upon curriculum planning technique. Harbison (1976), however suggests an approach based upon a manpower training assessment, indicating both the scope and complexity of curriculum planning.

The first step includes assessing the working environment. This means determining (Harbison, 1976: 551-552):

1. Access to Working Environments

   What is the aggregate employment in the modern, traditional and intermediate sectors of the economy?

   For each sector and major activity, what are the principal "ports of entry" into employment?
   In each sector and major activity, what pre-employment education or skills are required for entry?

2. Learning Process

   In each sector and major activity, how do people learn to perform their tasks?

   What kinds of organized training are provided by the larger employing institutions?

   What kinds of skills cannot be developed practically "on-the-job"--i.e., in what critical areas is there a need for persons with specific kinds of formal or nonformal education?

3. Constraints

   What are the practical limits of work-related skill and knowledge generation in each sector and major activity?

   What measures, if any, would be effective in improving the skill generation capacity of various working environments?

   What are the essential inputs of educated manpower--organizational and technical human resources--required to take appropriate measures to improve working environments?

These questions provide the starting point for assessing the potential of the work environment to generate skills and employment. While the answers may largely constitute judgments, they nevertheless establish the basis for making training decisions.

Next, Harbison (1976: 552-553) suggests assessing the capability of formal education to provide work-oriented learning. This includes determining:

1. Access to Formal Education

   At each level, who gains access to formal schooling, and more important, what groups are denied access and for what reasons?

   What are the differential rates of access between modern, intermediate, and traditional sectors (rural and urban)?

2. Orientation of Formal Education

   What are the major objectives of various levels and types of schooling?

   Is formal education at various levels effectively geared to the requirements for educated manpower in working environments?

3. Constraints

   What are the limits, financial and human, to expansion and improvement of education?

   How rapidly can access be extended to presently excluded groups?

   How can the financial burdens of education best be shared?

Extending Harbison's work to nonformal education, the third step should address these key questions:

1. What groups are served, and how do they gain access?

2. What are the major objectives of the programs, and how are they realized?

3. How do programs relate to the formal education sector? Nonformal and informal? How do programs serve the social and work needs of the working environment?

4. Who plans programs, and who controls them?

5. What do programs cost, who pays and who benefits?

6. What are the limits to expansion and improvement?

Harbison (1976: 553) views the fourth step as the most critical and this includes assessing the "possible alternative combinations of available or potential learning opportunities." What is the optimum mix of programs, lowest cost combination, and highest potential for quality? This obviously includes the consideration of existing programs as well as the consideration of potential innovations. "In any developing country," Harbison (1976: 556) suggests, "the range of the best alternatives is the key to effective human resource development planning."

Manpower and Employment Data

It is obviously important to bring to decision-making as much relevant information as possible. Manpower and employment data in particular are used widely to estimate the existing manpower supply and to determine needs for

replacement and additions to the labor force. Harbison's model as well as other models make use of manpower analysis. This information serves to assist in decision-making, but can rarely serve as the sole basis of making curriculum choices (Young, Clive and Miles, 1972).

Data should be collected from the various economic sectors and subsectors. It is useful to determine shifts in the total rate of employment within industries, along with total employment, participation rates, unemployment and underemployment. Data on the age structure of the labor force allow replacement rates to be figured, but migration rates are more difficult to project.

Manpower and employment data are linked to educational planning by matching the various occupational categories with levels and kinds of educational attainment. There is, however, considerable variation in the educational level of people performing the same work. This, along with the difficulty of determining entry standards, the inaccuracy of data, and the difficulty of collecting data, particularly in rural and subsistence economies, as well as the lack of long-term validity of data, make the use of manpower and employment projections tentative and limited at best.

Despite the shortcomings, the analysis of manpower needs is frequently used in curriculum decision-making. Incomplete and inaccurate data are probably better than no data whatsoever. However, one must not be dogmatic about the results and must be willing to temper findings with good judgment.

Because of these limitations, curriculum decisions in formal vocational training based on manpower analysis often result in selecting a few "safe" occupational areas as the focus of instruction. These are technical fields that are relatively stable in employment opportunity, that may form the foundation for performing a variety of jobs, and that traditionally employ large numbers of workers. The tendency is to avoid offering courses in specific, relatively small and rapidly changing occupations. Faced with the inadequacy of manpower data, such an approach may be the most reasonable one to take. On the other hand, local planning, especially when coupled with placement services and the use of employer committees, probably provides more accurate labor market data in terms of local curriculum decision-making than does national or regional planning.

The lack of good manpower data is less of a problem in the informal sector when planning and decision-making is done by the employing establishment. Potential workers are screened, hired and trained in-house according to need. And, except for the case of specialists requiring extensive formal preparation, there is little need for long-term projections of requirements. Employers hire and train as needs become known. In the case of vocational centers sponsored by industry, common practice is to adjust training to direct employment placement. When demand for new employees is increased or decreased, training input is accordingly adjusted. Since most of these courses are short-term, there is little lag time between need and training output (Castro, 1979: 626).

One of the most important uses of manpower analysis is the identification of specific course content. This is equally important in the formal and nonformal sectors. After an initial decision is made to train in a specific job or occupational area, it is necessary to collect specific information on the tasks that are performed by the incumbent. It is only by careful analysis of actual job performance that content validity can be built into the instructional program. Lack of such an analysis is probably one of the major reasons why formal vocational programs lack work relevance.

Local analysis is also highly important in the case of nonformal programs. As Coombs (1976: 288) observes, "because of their great diversity, nonformal education programs have to be separately planned with an eye to their own particular objectives and clients. The most effective programs have been sensitive to the social, economic, political, and ecological characteristics of the area in which they are to operate." Nonformal planning, in addition, should probably take place "as close as possible to the scene of action. So far as possible, the intended clients themselves should be brought into the process, especially to help define their own needs, interests, and priorities" (Coombs, 1976: 288). Most planning simply does not occur at the local level.

Social Demand

The most widespread approach to educational and curriculum planning is based on social demand. "If the truth were told," Bereday and Lauwerys (1967: 85) contend, "nine-tenths of educational planning around the world is of this type, despite all the lip-service to the more sophisticated varieties of 'education as investment in economic growth.'" Decisions are simply made to make one type of educational investment or another based on the fact that there is a perceived demand for the investment. Social demand is usually translated into the political process, and as Blaug (1979: 365) observes, decisions on how to make public expenditures are "only vaguely connected with any objectives that might be described as economic." Spaulding (1977: 61) contends that "social demand often destroys the best laid plans...since those in power usually wish public support for their leadership...whether a manpower plan or rate-of-return analysis shows that [their plans are sound or not]...."

Planning, however, is not eliminated by basing curriculum decisions on social demand. "Facts" are often massed to support what is basically a political decision. On the other hand, more neutral planners can use whatever data are available to help modify plans and to direct implementation along lines that may be more socially and economically functional. Then again, planning data may be used to formulate political, social and educational goals, and since the social demand approach is so widely used, this may be one of the most potent uses of planning data. Generally, the following types of data are useful in social planning (Chesswas, 1967: 73-84):

Demographic Data. Included are population data by single-year age levels, providing an indication of enrollment trends by age. It is obviously desirable to place more of the new programs in areas which show either growth or stability in potential student enrollees.

Stock and Flow Data. "Stock" data include a count of what exists one day in each school year in contrast to "flow" data that indicate the way students and teachers move into, within and out of the system during the year. Information on the stock of students typically includes cross-classification by grade, sex, age, and branch of study. Counts of ethnic groups are often made. Also useful is a count of the proportion of students completing the course, the numbers repeating and dropping out as well as the proportion proceeding to different types of training at other levels.

Stock and flow data indicate to what extent the capacity of the training system is being used, as well as program completion rates. Cross tabulated with costs, stock and flow data make it possible to calculate program and student costs.

Cost and Finance Data. The costs of education place real limits on the social demand approach to planning. Are plans feasible in light of available resources? Certain demands simply cannot be accommodated without additional resources or the shifting of resources from one program to another. Data on past capital and recurrent expenditures, along with estimates on additional funds, provide the base for initial decision-making.

It is useful if data are available on the total annual cost of education, broken down by grade levels and type of program; this, in turn, will yield recurring and capital costs per student enrolled. Costs may also vary according to geographic location. Information on the sources of funding should include private and public expenditures as well as donor assistance.

Manpower and Employment. Existing and potential skill shortages, manpower projections, as well as other manpower data, while not sufficient to form the basis of planning, are often used to support social demand decisions, lending creditability, if not reality to decisions. Curriculum decisions, moreover, are often tied directly to general economic policy decisions.

Contextual Factors

Often overlooked in decision-making are the contextual factors surrounding program development (Richter, 1978). These may include incentives which influence the decision to select a training program, such as job security and benefits; or they may include more subtle factors, such as the social status of the occupation or local tradition. Training location, the availability of transportation and educational fees all work to attract or discourage enrollment in programs. Taxes on employees, political interference and government regulations may tend to retard training efforts by employers.

Contextual factors are often difficult to directly identify and measure. They often go unnoticed in planning, and they are seldom considered in macroplanning. However, they probably are an indispensible element in microplanning, even though they are generally overlooked. Donor assisted planning in particular may fail to consider contextual factors because of the tendency to rely on centralized planning and because consulting experts are unfamiliar with local conditions. As Rondinelli (1979: 51) observes, "design problems

are caused in part by the failure of planners to include clients or ultimate beneficiaries in the formulation and preparation of projects, [and] by the use of foreign consultants unfamiliar with local conditions to draw specifications...."

Planning requires information, but typically it is difficult to obtain basic information in many countries, and what information there is may be of questionable value. In addition, data collection may be carried out independently from those who use it, and there may be little relationship between what planning data are needed, what are collected, and the form that the data are in (Spaulding, 1977; Chesswas, 1967).

Planning, more often than not, tends to deal with aggregated information, broad goals and the allocation of general categories of resources. Such "macro-planning," however, tends to be divorced from the actual implementation of programs at the local level, ignoring what are important constraints and conditions essential to addressing the concerns of industries, businesses, and traditional enterprises which employ the trained manpower outflow of programs (Spaulding, 1977: 57; World Bank, 1980: 54).

Planning and curriculum decision-making tend to occur on the national level within ministries of education or planning commissions. Often "quantifiers" dominate the planning process, and planning may be separate from implementation, with the two never coming together, except perhaps spuriously. Such national planning, Coombs (1976: 287) observes, has tended to be "concentrated almost exclusively on the formal education system, has dealt largely with national statistical aggregates and projections, and has been mainly concerned with the quantitative expansion of the existing formal education system." There is some evidence to suggest that both manpower data and planning decisions are qualitatively superior at the local level, especially when employers and community leaders are brought into the planning process. The most important planning challenge, in fact, may be to shift the locus of curriculum decision-making to the local level in order to link more closely to indigenous enterprise.

PART II
EDUCATIONAL TECHNOLOGY ALTERNATIVES FOR PROGRAM IMPLEMENTATION

Educational technology has considerable potential for improving the quality of vocational training in less developed countries (LCDs). Up-to-date subject matter in effective training formats is available. In general, however, the potential of educational technology has not been fully realized in LDCs (Armsey and Dahl, 1973; Jamison, 1977). Instructional systems are difficult to manage; expenses may be more than expected, and educational results less positive than anticipated (Schramm, 1977). Some individuals even question the appropriateness of educational technology designed in developed countries for educational settings in LDCs. Christiansen (Armsey and Dahl, 1973: 10), for one, argues that "educational materials, the products of technology, cannot be exported intact to less developed countries. Only the process by which materials are created may be exported by the developed countries."

The usefulness of educational technology no doubt extends considerably beyond the narrow limits that its most severe critics suggest; its practical impact on realizing educational improvement, however, is probably less than its most ardent proponents claim. To be sure, educational technology can contribute to qualitative improvement in vocational training and to the extension of educational opportunity to a wider range of audiences. Nevertheless, the introduction of educational innovation and change in occupational and vocational training settings must be measured carefully, considering the constraints of the environment in which it is to be placed, calculating the long-term investment involved, and assessing potential benefits. The successful introduction of new educational technology also depends upon other social and economic conditions which may impede or promote its effectiveness.

Perhaps the most potent characteristic of educational technology is its capacity to be applied to an extraordinary range of program and educational settings: industry-based accelerated training, formal classroom instruction, extension programs, rural training centers, these and a wide range of other formal and nonformal vocational training alternatives can equally benefit through the use of educational technology to extend and enhance instruction. It is this flexibility that makes educational technology so promising as a way to address the complexities of vocational training in LDCs. Progress, however, lies largely in understanding the full potential of educational technology, as well as the constraints that are faced.

The purpose of this part of the paper, then, is to examine the use of educational technology to support vocational and technical instruction in LDC settings. First, educational technology will be defined. Next, different kinds of technology will be surveyed. Constraints to the use of educational technology will be examined, including a discussion of how to optimize its benefits. Finally, attention will be given to the identification, evaluation, modification, and dissemination of vocational instructional resources in LDCs.

What Is Educational Technology?

Educational technology can be defined in different ways. The most current definitions view educational technology from the perspective of a total educational system. This includes the systematic design and implementation of an instructional system in which technological devices supplement, and in part supplant, the instruction (Knapper, 1980: 14). Educational technology is considered to encompass the instructional design process as well as the devices and media used to deliver instruction. The Association for Educational Communications and Technology (1979: 11) identifies three "domains" of educational technology: educational management functions, educational development functions, and learning resources.

Eraut (Armsey and Dahl, 1973: 2) points out that there are four common conceptions of educational technology: 1) the use of machines and devices in education, 2) a technology of instructional design, 3) curriculum development, and 4) the management of education. In the older, more restricted use of the term, educational technology refers mainly to educational media and machines--the software and hardware of instruction (Ingle, 1974; Knapper, 1982). Used in this sense, educational technology is considered independently of the particular instructional system, whether it is conventional teacher-directed instruction, individualized instruction, or a competency-based instructional system.

The term "instructional technology" is often used interchangeably with "educational technology." The Association for Educational Communications and Technology (1979: 12) considers instructional technology to be a subset of educational technology, encompassing instructional management functions, instructional development functions, and instructional system components. However, as Armsey and Dahl (1973: 4) point out, while the meanings of both terms are broad and varied, "the practical applications are usually narrow." Instructional technology is often linked in meaning to sophisticated, electronic hardware, and when not, more precise terms are used.

Not discounting the broad use of the term, educational technology is used here mainly to refer to the hardware and software of instruction. It is also used interchangeably with "instructional technology." A distinction is also made between the subject matter, or content, of instruction and the technology used to deliver instruction.

Survey of Educational Technology Resources

There is a wide range of instructional resources available for use in vocational training settings; some can be used in the existing form, while others can be adapted or developed in-country. Each has strengths, advantages, and disadvantages for use in LDCs.

A combination of resources is probably preferable to the use of one type of resource: greater instructional flexibility is achieved. Selection, however, should be made as judiciously as possible, fully assessing the potential of resources, and relying on informed choice. The purpose of the following discussion is to assist in resource selection.

In general, print material is the widest used medium. In the United States, for example, print material accounts for about 54 percent of the educational media purchased, filmstrips about 16 percent. Films account for 6 percent, with all other media comprising the remaining 24 percent (Woodbury, 1980: 20). While these figures will vary in LDCs, they, nevertheless, indicate that relative percentages of different resources available in the U.S. for use in LDCs.

Instructional Aids

Simple, conventional instructional aids should not be overlooked in educational planning. These include flip-charts, overhead transparencies, simple reproduction processes, such as ditto, and even chalkboards. Most LDCs lack even the most basic educational resources, and situations probably should be avoided where instructional technology is introduced in learning environments lacking basic materials. In a sense, this is "technological overkill." Basic resources are often essential to fully use the technologies as well as to extend instruction beyond what the technologies will provide (Evans, 1976: 321). Coombs and Ahmed (1974: 174) suggest that a key to nonformal education, particularly in rural areas, lies in the use of "new combinations of media and greater use of creative talents to produce richer and more effective program content." This involves "finding low-cost combinations of technologies," often simple and conventional, but used in new ways.

Print Materials

Print materials, including textbooks, manuals, programmed materials, teacher and student guides, and work sheets are highly flexible and adaptable to a wide range of uses. In addition, they are relatively low cost and relatively easy to develop in-country. Knapper (1980: 30) observes that for those over 21 years of age, the amount of nonformal learning through the use of print materials far exceeds learning through other means.

In regard to vocational and technical instruction, a number of constraints need to be kept in mind.

- The potential audience served is often relatively small when compared with general instruction. The unit cost of locally produced materials may, accordingly, be relatively high.

- Technical knowledge can become quickly obsolete. It may become necessary to revise instructional materials in as little as three to five years.

- In the development of materials, there may be a tendency to overly emphasize technical theory when emphasis should, in fact, be placed on the actual skill requirements of the job. This is mainly due to the fact that written materials are often developed by using other written reference material rather than by conducting an analysis of actual work activity.

- Special attention must be given to the vocabulary of written material since technical terms tend to raise the reading level of these materials.

- A relatively long development time may be anticipated in the development of materials. In the case of books, a three to five year cycle can be anticipated; for other materials, a two to three year cycle. Even simple materials will require a one to two year cycle.

The development and use of written materials can be enhanced by considering the following:

- Use material prepared by the manufacturers of specific machinery and equipment. This can be complemented by student work sheets, study guides and the like, which can be produced locally.

- Translate material that is already available rather than publish completely new materials.

- Complement theoretical material with supplemental materials that stress practical application.

Print material is relatively cost-effective, can be easily used, and is suitable for most training situations. It requires, however, a literate trainee population and time for its development.

Film

Films are a rather expensive audio-visual material, and thus should be selected because they are timely, have lasting value, and provide instruction that probably cannot be obtained in other ways.

It usually is not feasible to adapt films, so the content must be relevant to the teaching situation and the soundtrack needs to be in the language of instruction. Films are effective in teaching complex material and motor-perceptual skills (Woodbury, 1980: 200-202). Armsey and Dahl (1973: 51) observe that "only film has been able to bring into the classroom certain visual effects, imagery, and experience."

Short, single-concept films provide more instructional flexibility than multi-purpose films. The use of film loops is more economical than regular 16mm film. Film loops are very accessible to students, lend themselves to individualized instruction, and are suitable for rural and distance education programs. Considerable instructional material is available for vocational training in the form of film loops

Sound/Filmstrips and Sound/Slides

Sound/filmstrips and sound/slides are among the most popular media. They can be easily used, are relatively low in cost, and incorporate both sight and

sound. An added advantage of film cassettes is that the audio portion can be translated into the language of instruction. While filmstrips cannot be altered, slide presentations can be adapted within limits, and like filmstrips, the tape cassette can be easily re-recorded.

There is a wide variety of vocational-technical instructional material available in film/cassette and slide/cassette. Since this material is relatively inexpensive, it can be excluded from media collections when it becomes outdated, and replaced with current materials. Projectors are relatively low cost and are portable. The economy, instructional flexibility, ease of use, and the ruggedness of the technology make it highly suitable for use in LDCs in formal, nonformal and informal learning.

In regard to vocational training, the following points are worth keeping in mind:

- Slides are particularly useful in "localizing" instruction. That is, relatively inexpensive presentations can be made that feature local industry, indigenous production processes, and the like. In this respect, the potential for nonformal and informal instruction may be considerable.

- Slides and filmstrips are a generally good substitute for expensive equipment or machinery that can not be purchased for instructional purposes. Trainees can at least become familiar with the objects and are introduced to some of the working features.

- One of the more effective uses of slides and filmstrips is for teaching the internal working of machinery and equipment through cut-away views or diagrams. An "internal view" is not available otherwise without disassembling the item.

Audio Tapes

Audio cassettes are inexpensive, as are tape recorders. Recorders are simple to operate, small in size, and relatively durable. Instructional materials are easy to develop for tape. The major drawback, however, is that audio instruction only is rarely sufficient for teaching technical concepts and procedures. On the other hand, audio instruction is "literacy free" and recorders have a playback capability that enables the student to repeat at any point. Perhaps the best use of audio tape recordings is to supplement other instruction, to provide review or to give directions.

Video Cassettes and Video Discs

The initial investment in video tape and disc equipment is high, but operational costs are relatively modest. Maintenance and repair costs, however, tend to be high. An additional problem is the compatibility of video equipment: individual systems are not standardized, so software from different manufacturers may not be compatible. Because of the high cost and skill required to produce video material, and the cost of systems, this medium may

not be realistic in LDC settings. Armsey and Dahl (1973: 27) suggest that "because they combine the electronic complexity of color television with the electromechanical complications of very high quality and high precision audio cassette tape recorders, the video tape cassette recorder players are more complicated than any consumer equipment yet marketed by the electronics industry."

A limiting factor of both video tape and video discs is the lack of instructional materials. Presently they are not available in a sufficient number of occupational areas and of the quality to justify the use and cost of systems. On the other hand, some individual companies provide video tapes to accompany the sale and maintenance of equipment and machinery, but this material is usually specific to a single manufacturer.

Computer-Assisted Instruction

Instructional systems incorporating computer use are undergoing rapid development and add a new dimension to educational technology. Videotex systems allow graphics and text to be displayed on regular television receivers. Microprocessing systems link a computer with a typewriter keyboard, a television receiver, and an audio cassette recorder or disc. These systems have the potential for a wide range of application. Currently, however, these systems are expensive to install, operate and maintain, and they require highly skilled staff. In addition, the technical state of the hardware and software is rapidly changing, suggesting that many current systems may not have an adequate use-life to justify large initial expenditures in LDCs. Also, many of the current instructional programs are of a tutorial or drill type, and the application to vocational and technical instruction may be limited.

Instructional Radio

The major advantage of instructional radio is that it can reach into rural and remote areas, bringing instruction to individuals and groups formerly bypassed. Jamison (1977: 43) suggests that radio combined with textbooks and workbooks can be operational at an annual student cost of $20 to $40 per year (1977 costs). The major limiting factor of radio for technical instruction is that it is mainly suited for theory and has limited application to "hands-on" instruction. Combined with support materials, however, the effectiveness of radio instruction can be increased. In Tanzania, for example, marketing and allied tasks were taught to members of rural cooperative societies by using printed text material and correspondence instruction in conjunction with related radio broadcasts (Coombs and Ahmed, 1974: 158-159). Even though many members were illiterate, through the use of study groups including literate members, useful results were obtained.

Educational Television

Educational television can take a number of forms: cable television, closed circuit, open circuit transmission, microwave transmission and satellite transmission, among others. While this educational technology is adaptable to a wide range of instructional uses, it is expensive. Using 1977

costs, Jamison, Klees and Wells (1978: 241) for example, estimate that the cost of instructional television in LDCs ranges from $.05 to $.15 per student hour. And, they emphasize, "the low end of this range can usually be reached only if close to a million students are using the system in a reasonably compact geographical area." Jamison (1977) suggests that given the high cost of instructional television and the fact that other lower cost technologies are just as effective, the use of educational television should be restricted. On the other hand, one of the best uses of educational television may be providing information to a large general audience about labor market and training opportunities.

The following chart (p. 78) summarizes the characteristics of instructional resources, and indicates the potential use for vocational training purposes.

Deciding Which Educational Technology To Use

Educational technology is one means of solving educational problems. To what extent, however, should technology be incorporated into the instructional system? The particular circumstances of individual countries certainly enter into decision-making. Justifying the use of a particular technology, or mix of technologies, also depends on at least four major factors: 1) cost, 2) improvement of instruction, 3) providing instruction not obtained through other means, and 4) the extension of educational opportunity (Jamison, 1977; Schramm, 1977; Wells, 1976).

Cost

It is obvious that a particular instructional technology should be cost effective, otherwise alternative technologies should be examined. One hoped for outcome of high educational technology has been the potential cost saving. In general, however, reduced educational costs have not followed the use of more advanced instructional systems, such as instructional television, computer-assisted instruction, video discs and the like (Jamison 1977; Jamison, Klees and Wells, 1978; Knapper, 1983b). Print material, in all of its forms, is still the most cost-effective instructional resource. As Neumann (1980: 11) notes,

> The textbook, defined as including all printed material used in education, is the single most potent and cost-effective instrument for raising academic standards....
>
> Consequently, textbook projects, as an influential aid to development, have received increased attention by governments of less developed countries....

The cost of instructional technology includes the initial expenses of purchasing material and hardware and developing the instructional system. In addition, there are considerable costs often incurred in maintaining the instructional system and replacing or updating educational material. These recurrent costs are often overlooked when making planning decisions. Further-

A COMPARISON OF EDUCATION TECHNOLOGY FOR
VOCATIONAL-TECHNICAL INSTRUCTIONAL PURPOSES IN LDCS

	Initial Costs	Recurrent Costs	Availability of Instructional Materials	Effectiveness for Vocational Instruction	Adaptability In-Country	Potential for Rural Use	Potential for Use with Small Employers
Instructional Aids	moderate to low	moderate to low	high	high	high	high	high
Print Materials	high to moderate	moderate to low	high	high	high	high	high
Film	high	high to moderate	moderate to low	high	low	moderate to high	moderate to high
Sound/Filmstrip Sound/Slide	moderate	moderate	high to moderate	high	moderate to low	high	high
Audio Tapes	moderate to low	moderate to low	moderate to low	low	high	moderate	low
Video Cassettes Video Discs	high	high	low	high	low	moderate	moderate
CAI	high	high	low	high to moderate	low	moderate	low
Instructional Radio	high	high	low	low	high	moderate	moderate to low
Instructional Television	high	high	low	high	moderate	moderate	low

more, the costs of staff training, housing material, and the distribution of material have to be considered. Armsey and Dahl (1973: 21) observe that "the one indisputable statement that can be made about costs is that there has been a consistent underestimation of what it takes to produce effective educational programs--not only in money, but in human skills, testing and revision, and time."

Cost is directly related to use. High levels of use over an extended time may make an initially expensive system cost effective. In the case of vocational-technical instructional systems, however, the total student population served is relatively small, at least when compared with general education programs. Furthermore, instructional content often becomes quickly obsolete, perhaps in as little as three to five years. It is simply not possible, then, to always achieve the high level of use over an extended period of time required to justify an investment in high technology high-cost instructional systems (Jamison, 1977). Investment in high technology, high cost instructional systems for vocational-technical education should probably be viewed with caution in LDCs.

Schramm (1977: 110-111) found that costs tend to be grouped into two broad categories: "Big Media," such as ITV, film and VTR; and "Little Media," such as audio tapes, filmstrips and slides. Big media can cost between three to fifteen times as much as little media, depending, of course, on the lifetime use of the technology. In addition to economy of scale, quality directly influences cost. The major planning decision faced, then, is the trade-off between accommodating specific user needs and ensuring wide use. As Schramm (1977: 111) states: "The more programs are made to fit local needs and curricula, the less advantage can be had from economics of scale. The more central programming is used to bring about high-quality production, the less likely the programs are specifically to fit the local areas."

Little media can also vary greatly in cost, but in general their cost ratios are considerably lower when compared to big media. These may vary on the average from one fourth to half as much. Schramm (1977: 125) contends that "the greatest strength of the small audiovisual media is their ability to serve local needs at low cost, rather than providing high-quality materials for general needs over a large area."

Quality instructional materials, often designed for medium-level technology, such as filmstrip/cassette or film loops, are available from some manufacturers as an incentive to purchase machinery and equipment. These materials are relatively low cost and are of high quality. Similarly, there are specialty companies which produce instructional materials in select occupational areas. These materials are often moderate in cost, use medium level or low cost technology, and are of high quality. Because they are produced by a specialty company, both the cost and quality of these materials are probably more suitable to training in LDCs than are materials available from large, general commercial firms catering to a mass market in the formal educational sector.

Perhaps the greatest potential savings through the use of educational technology can be realized at the public secondary and post secondary levels.

Relatively large numbers of students can use the technology, and direct teacher contact hours can be reduced through self-instruction, thus offsetting some costs. In the case of private industry, upgrading through technology is usually less expensive than building completely new programs. Central resource centers, or instructional material sharing arrangements, can reduce the cost to individual firms. Through CINTERFOR (Interamerican Research and Documentation Center on Vocational Training), for example, a wide range of vocational teaching materials are disseminated to member institutions (Cuervo, 1982: 88-89). In the Philippines a privately operated organization, the Social Communications Center (SCC), develops multimedia educational packages for use by government agencies and other similar organizations, with particular emphasis on serving rural clients. Centers such as these provide a way to extend the use of resources, while at the same time, coordinating the services essential for effective identification, production and dissemination.

Improvement of Instruction

Instructional resources have the potential to improve the quality of instruction. High-quality materials can be purchased or developed that are superior in content and design to instruction provided by the local teacher through more traditional instructional practices. This is especially true in cases where teacher preparation programs are poor or there is a lack of qualified teachers. Schramm (1977: 144-145) reports, for example, that Niger educational officials wanted to expand primary education beyond the current 7 percent enrollment of school-age children but faced a serious shortage of trained teachers. With considerable aid from the French Government, a system of instructional television language instruction was installed that made use of trained monitors in place of qualified teachers.

Among the different educational technologies, however, there is generally no significant difference between student performance and the type of technology used (Jamison, 1977; Schramm, 1977; Wells, 1976). Students learn just as effectively, for example, through the use of filmstrip/slides as they do through instructional TV, textbooks, or conventional teaching methods. Wells (1976: 102) observes that "there are apparently no significant differences on a variety of test scores for students receiving conventional instruction and those receiving instruction via technology... This conclusion is based on an overall view of many projects." Students can learn equally well regardless of the instructional delivery used.

It should not be assumed, however, that all instruction is equally effective. As Wells (1976: 102) suggests, "there are individual instances where conventional instruction is superior and other instances where instruction through technology is superior." The important variable is the quality of instructional software and not the particular technology used. While it is true that some hardware devices have greater instructional capability and versatility, such as storage capacity, visual format and audio quality, the hardware has relatively little direct impact on learning. Rather, it is the software that gives the orders to the hardware, provides the instructional interactions, and presents the substance of what is to be learned. In short, it is the quality of the content and the design of the learning experience

included in the software that make one type of instructional delivery more effective than another.

To say that there appear to be no significant differences between the instructional effectiveness of one technology over another does not mean that all technologies are equally suitable. What it does mean is that other selection criteria are important: acceptance by the instructor and student, complexity and cost, availability of a range of quality software, the type of learning experience provided, among others. As discussed in the following, it simply may be necessary to use a particular technology because it is the only way to introduce certain content or to reach a particular audience.

But, perhaps the effectiveness of educational technology should not be judged in isolation. Instructors use technology because it offers a way to change the pace of instruction, to motivate students, and to interject something new. And, some students respond better to a mix of instructional modes. Research generally supports the use of multimodal instruction: greater learning apparently occurs when the student can interact with the instructional content in more than one way (Schramm, 1977). Accordingly, when educational technology is viewed as not only films, computers, printed materials, and television sets, but also as "the methods for organizing and utilizing these media as elements of an integrated teaching/learning system" (Ingle, 1974: 6), then there is a greater chance that instruction will be effective.

Providing Instruction Not Obtained Through Other Means

In the case of vocational-technical instruction, perhaps the greatest potential value of educational technology is that it provides technical content not obtained through existing instruction. Instructors of technical subjects can become rapidly outdated unless they have the regular opportunity to obtain in-service training or on-the-job upgrading. This fact, coupled with poor initial training, often results in instruction programs of poor technical quality. The low instructional quality often associated with formal vocational education can be directy attributed to the fact that unqualified instructors were employed or that instructors may have little incentive or opportunity to obtain upgrading.

Private business and industry is also faced with the need to update and train the work force in new technical skills. This is especially true in the case of small and rural employers who cannot afford to conduct training, who are isolated from training opportunities, or who cannot recruit adequately trained workers. Perhaps the greatest value of educational technology, then, is that it provides technical content that can be used to upgrade current training staff as well as instruct trainees. This is particularly true in occupational areas undergoing rapid technical change. Relatively inexpensive technology can be introduced which provide an effective way to combat technological obsolescence. In Singapore, for example, the Industrial Training Board (ITB), is responsible for locating and developing training materials relating to new technology; this material is in turn made directly available to industry (Zymelman, 1978).

Extending Educational Opportunity

Educational technology has the potential of extending educational opportunity to individuals and groups not served. This may include, for example, distance educational systems; small, rural programs served by a regional resource center; and evening programs run by trade associations or community organizations. The technology is used to substitute for the lack of qualified staff, provide instruction to individuals or small groups, or to supplement traditional forms of training, such as apprenticeship. An additional advantage is that technology can often be introduced more rapidly than teachers can be trained. By offsetting the lack of trained teachers, urban-rural disparities may be reduced.

Educational media has been used to extend schooling at every educational level, including vocational education. Adults and workers wanting upgrading are among those who are increasingly taking advantage of extended schooling opportunities. Print, according to Schramm (1977: 205), is the most used medium, providing self-study texts, programmed instruction, and technical manuals. Both instructional television and radio have been used extensively in LDCs, basically through large, well-financed programs, such as use of radio to teach English in the Philippines and the educational television project in El Salvador. Costs, however, are high (Jamison, Klees and Wells, 1979). A more low-cost trend is the use of combinations of media and learning practice, such as programmed instruction, reading assignments, self-instructional kits, and technical exercises to be completed by the student in, perhaps, conjunction with occasional classes, tutorial centers, and radio or telephone consultation. The major question faced by the educational planner is "how sparse or how rich to make the system.... The availability of resources--human, technical, and economic--therefore is an element in the decision" (Schramm, 1977: 224- 225).

Such programs are usually established where the student population is scattered over a wide geographical area. While the original cost of establishing programs may be relatively high, operational costs can generally be kept low if staff expenses can be kept to a minimum. In addition, "programs that put most of their resources into staff costs," Coombs and Ahmed (1974: 183) observe, "with only negligible amounts going to instructional materials and other learning aids, are likely to have low educational efficiency." Finally, the marginal cost to serve additional students is low compared to conventional programs that involve greater use of full-time instructors.

Conditions Essential for the Effective Use of Technologies

Educational technology has the potential to improve vocational and occupational instruction in LDCs. It cannot be assumed, however, that the use of educational technology alone is sufficient to result in improved instruction, or that educational technology can be easily introduced into an educational setting. "Issues related to educational reform are complex in any setting," Gooler (1979: 8) cautions, "but perhaps even more so in developing nations." Choices among different educational alternatives must be carefully considered, choosing those that have the greatest potential for cost-effective success.

While there is a multitude of factors that must be considered, following is a brief review of key conditions that appear essential for the successful implementation of educational technology.

Instructional Content

Of primary importance is the technical content provided, and not the particular hardware or delivery system of the technology. Superior instructional content can be provided through low-cost technology. Conversely, the value of some of the more sophisticated instructional systems, such as Competency-Based Vocational Education (CBVE), may result more from the superior content developed through the instructional design process followed, than from the particular hardware used. Content, then, must receive primary preference, irrespective of the other features of the technology.

Anker (1973: 471) observes that, unfortunately, training courses too often bear little relationship to the actual "jobs the trainees will have to do once they start work." The training is "far too advanced and ... ill adapted to the simple needs of the trainees and their future job openings." This is a particular problem with rural adult training. Not only is there little time available for inappropriate instruction, but adults know their training needs, which usually are immediate, specific, and limited (Gilpin, 1979). Instructional materials produced in urban centers for distribution and use in rural training tend to be designed for the urban job market, and thus, less suitable for rural use. Similarly, off-the-shelf instructional materials from developed countries may be designed for modern enterprises, and less appropriate for economies in LDCs, rural and urban. This may be also true in the case of informal sector training.

Gooler (1979: 13) raises a similar issue when he suggests that "suppliers of technology tend to have a magnified view of the importance of the technology they advocate. Suppliers would like receiving institutions to adopt a technology in complete detail...." Training needs in LDCs, however, may be limited, as is the capability to support an extensive training system, especially if it is only marginally related to immediate skill needs.

Capability to Use the Technology

Avoid introducing technology that is above the capability of the technicians in the country who are to use it. Some technologies can strain the capability of the instructional system to use them effectively. For example, they may require high levels of recurrent expenditures, large numbers of trained staff or special facilities. Dust-free, moisture-free facilities, for example, may not be available, but may be required for long-term effective use of the technology. Similarly, an extensive collection of films may be rendered useless because it is difficult to get projector replacement bulbs due to government currency controls. Technology should be introduced only after a careful analysis of both immediate and long-term constraints, real and potential.

Gooler (1979: 10) warns that "tendencies are strong, particularly in the commercial sector, to sell products and procedures with little responsibility for determining the readiness of the receiver to appropriately use the products." In the first place, there must be an adequate infrastructure existing that will permit the introduction of the instructional technology. This may include electric power, transportation, postal service, maintenance services, and the like (Schramm, 1977: 204). Only technology that has suppliers in the country, for example, should be introduced. If replacement parts, expendable supplies and repairs cannot be obtained at reasonable costs in-country, then little long-term use can be expected of the technology.

Costly technology may drain resources from other educational programs, causing undesired impotence in the total educational system. Particularly important is the long-term cost of the technology. The amount of technology introduced should not exceed the level of recurrent expenditures that can be allocated on a long-term basis to keep the system functioning. It is essential to build in sufficient recurrent expenditures to adequately maintain an updated collection of software and to keep the technology in top operating condition.

Wells (1976: 158) cautions that "one must also be concerned with the availability of personnel to maintain and operate the equipment." In rural areas in particular, trained staff may not be available, resulting in ineffective use and rapid deterioration of the instructional system (Gilpin, 1979). Educational technology does not eliminate the need for trained personnel. It shifts the training focus: a cadre of trained individuals is needed, which in turn can serve larger numbers of less trained individuals. The introduction of most educational technology also requires the introduction of suitable staff training programs. This is true in the case of low level technology, and more so for medium and high level technology (Gooler, 1979).

Incremental Change

It is probably advisable to phase in the use of technology rather than introduce a total system at one time. It is useful to try out several alternatives, carefully monitoring cost, use, durability and effectiveness. Then make the decision to implement a more extensive system. In this way, not only can more objective decisions be made, but a cadre of experienced personnel will be on hand that can assist in implementing an extended system, whether in one institution or on a large scale.

Avoid purchasing large amounts of software, such as films and audio tapes, at one time. Rather, think in terms of phasing in materials on a regular schedule, and phasing out materials. Technical materials become outdated very rapidly. In addition, a media collection can become rapidly overloaded with outdated and little used material which, nevertheless, requires considerable resources to maintain.

Use educational technology only where other forms of training are not available. A considerable amount of educational technology in vocational and technical education is produced for mass-market, formal educational programs.

This material is often very general, and provides little that cannot be obtained through conventional instruction, apprenticeship training, and the like. If simpler, less costly training methods can be used, then more technology intensive systems should probably be avoided.

Training can also be selective; that is, focused on a restricted number of skills. Upgrading needs to cover only those skills that individual workers lack. Any given work force already has a considerable skill base, and training should build from this base. Failure to inventory the skills of the current work force can lead to poor planning decisions and overinvestment in training technology not required.

The organization of instruction into modules appears to be effective because it allows students to focus on their individual skill needs (ILO, 1977). In addition, as Gilpin (1979: 19-25) observes, adults in particular are limited in the amount of time that they can spend on instruction, and they tend to drop in and out of learning activities because of seasonal work, shifting workloads, and job changing. Instruction should be organized so that it is "short, close to the home or place of work, and timed to fit in with adult work." Modular organization facilitates this.

Link to Users

Schramm (1977: 235, 263) stresses the need to "localize" programs. No one technology can be applied to every teaching situation; therefore, it is important to "carefully consider local needs, situations, and resources, and then interpret such guidelines as exist." If needs of local users are not fully considered, the technology is simply not used (Evans, 1976).

There is probably a tendency to cater to the perceived skill needs of the formal and modern sectors, which in turn results in the neglect of the skill requirements of the less developed and informal sector. "This is explained by the fact that the main clients of the training institutions are modern sector enterprises" (ILO, 1977: 221). In addition, the specific training needs of rural economies tend to be overlooked, particularly when there is a central organization, usually based in an urban center, directing the development and use of training technology. Urban skill needs may be addressed, but these are not the same as rural needs. While central planning and development is certainly essential, it is probably vital to link instructional decision-making directly to the populations being served.

Facilitate Use

The ultimate measure of the success of educational technology is the use made of it by individual instructors. One advantage of "little media" over "big media," Schramm (1977) contends, is that teachers feel that they have greater control: they can schedule it when needed, and start, stop and review as required by the immediate instructional situation. Again, the instructional technology must not require additional planning or preparation, otherwise instructors will not use it. The technology must be in a form that will allow the "average" teacher to use it, perhaps, at the maximum, with only

15-20 minutes preparation time, or even "off-the-shelf." The technology must be either designed for easy instructional use, or else sufficient support must be provided to facilitate the use of the technology.

The collection, distribution and maintenance of educational technology must be centralized in some way, either through regional centers or in individual training institutions. However, operating procedures, which tend to inhibit the full use of resources by instructors may be set up by these centers. Procedures which lead to the effective operation of centers may not in turn lead to effective teacher use. In fact, the more sophisticated and costly the technology, the more likely that the technology will be "protected" by barriers that inadvertently inhibit use. Rather than follow cumbersome and time consuming procedures, instructors will simply not use the technology. Procedures for the operation of centers must foremost consider the access and use of resources by instructors (Evans, 1976).

Similarly, if instructors have direct responsibility for costly technology, they may elect not to use the technology rather than incur the risk of breakage or theft, either of which may jeopardize their careers. And, if instructors are willing to use it, they may not be willing to allow student access. Procedures must be established which safeguard the technology, but at the same time, instructors must feel that they are not unduly burdened with responsibility. This is extremely important in many LDCs: the cost of a single piece of media equipment may equal the yearly salary of an instructor.

The Evaluation and Selection of Educational Technology

The evaluation and selection of educational technology can be examined at two levels: 1) Decisions need to be made whether to use one "technological mix" over another, or to what extent educational technology should supplement or supplant more conventional instruction; and 2) decisions also need to be made regarding how appropriate the media is for particular instructional purposes. This is a decision relating to the quality of the instructional materials.

Deciding Which Technology To Use

Evaluation can be used to make initial decisions regarding the implementation of an instructional technology system, to determine if adaptations should be made to an existing system, or to determine the instructional effectiveness of an existing system. In actual fact, little initial evaluation is probably made; most evaluation occurs after an instructional system has been implemented (Schramm, 1977). Furthermore, there is a conspicuous lack of evaluativedata relating to the use of educational technology with specific vocational curricular options in the formal, nonformal and informal educational sectors.

Evaluation is made on the basis of cost effectiveness and educational efficiency. In the case of making an initial evaluation prior to implementing instructional technology, data regarding educational efficiency are usually not available unless a pilot study is conducted. Evaluation, then, mainly falls back on cost analysis.

Cost Analysis

Cost analysis is one basis for making decisions. In the case of educational technology, cost analysis probably assumes greater importance because there appears to be so little comparative learning advantage of one instructional alternative over another. The analysis of cost is an extensive topic, but there are several basic ways of figuring cost that can be covered here (Jamison, Suppes and Wells, 1974; Jamison, Klees and Wells, 1976; Wells, 1976; Jamison, 1977).

Capital cost is the cost incurred for the initial purchase of a piece of equipment, machinery, or other item that has use beyond the time of purchase. Recurrent costs are incurred for goods and services used at the time of purchase, such as maintenance, instructional time, materials and supplies. If the lifetime of a material or supply is more than one year, it is usually treated as a capital cost. In general, the recurrent costs of educational technologies are relatively high, and they should not be overlooked in original decision-making.

Fixed costs may include capital and recurrent costs; variable costs may also include both, but, in general, capital expenditures are associated with fixed costs. Variable costs are due to expenditures that vary with the amount of use, e.g., with the number of students served. Fixed costs do not change with the level of use, so an instructional technology system can be expensive in terms of unit costs if it is underutilized. This leads to a high average cost; that is, the total cost of the system divided by the number of students served, number of hours, or number of student hours. (Wells, 1976: 110-112; Jamison, 1977: 19-28).

Marginal cost is the additional cost to the total cost of serving each additional student. This is an important consideration. One of the advantages of some instructional technologies is that they have relatively modest marginal costs, providing the capability to extend instruction at a low cost beyond the number of students served by one teacher.

Capital costs can be annualized by establishing lifetime use estimates; a fraction, 1/n, is charged each year. This yields a depreciation cost. In annualizing capital expenditures, it is also important to figure the social discount rate. This is an estimate of the cost to society of the resources used, figured as an interest charge on the capital cost. Jamison (1977: 46) explains that "there is a cost (interest charge) involved in having capital tied up in a project, and this cost is measured, to some extent, by the potential rate-of-return to capital elsewhere in the economy." However, determining a single value for the social discount rate is complex, particularly when computing the net costs and benefits over different points in time (Jamison, 1977: 46; Wells, 1976: 120-121). Capital equipment and buildings depreciate, the reinvestment of returns must be considered and social value judgments have to be taken into account. Common practice is to apply several social discount rates in decision-making. Opportunity cost is the value of the next best alternative that is turned down in order to choose one alternative. This cost is often not considered if the technology is supplied through

a donor grant. However, opportunity cost may be one of the most important to consider.

As Wells (1976: 120-212) observes, the most common method of analyzing project costs on a yearly basis is to estimate recurrent costs. The depreciation cost of the capital investment is added to the recurrent expenditure estimate. This is then combined with the yearly social discount rate of the value of the capital. Comparisons between different educational technologies obviously involve capital, recurrent, variable, average, opportunity and marginal costs.

Knapper (1980: 123, 137) suggests that it is initially difficult to estimate the extent instructional technology will be used, therefore leading to unrealistic cost estimates. Also, there is a tendency to ignore the contribution of the existing educational system, thus leading to low cost estimates for the technology because the associated costs are excluded. Technology-based systems tend to be "added on" to conventional educational systems, rather than supplanting them, thus resulting in rather high costs when everything is considered.

Making Practical Judgments

Any educational environment has constraints. Some environments are also more receptive to, and can sustain, change. Deciding whether or not to introduce educational technology requires reasoned judgment about the educational setting under consideration. There are no hard-and-fast rules to follow, but rather one has to assess the constraints at hand, consider alternatives, and make a judgment as to the best course of action to follow. Practical judgment, in the final analysis, may be the best way to reach a decision--if not the only way when confronted with the lack of data in many LDCs. Stake (1978) suggests that, "the very idea of evaluation is one of coming to know the worth of the program, partly through subjective judgment."

One of the first steps in decision-making is to clarify the problem addressed. Why is the technology being introduced? Is it intended to result in:

- Cost economy,
- Improved teaching,
- More effective learning,
- Introduction of new technical content, or
- Extension of opportunity?

Obviously, it is important to bring as much information and insight as possible into the process of clarifying these outcomes. This includes an examination of the capability of the actual technology being considered; it also includes an assessment of the actual and potential capability of the existing instructional system to use the technology, (Woodbury, 1979; Klein, 1978; Webster, 1976). Actual capability includes an assessment of:

- Current management ability,
- Supply of trained supervisors, instructors, and maintenance personnel,
- Availability of facilities for storage, development, dissemination, and repair, and
- Extent to which the technology can be incorporated into the existing instructional system.

Assessment of potential capability includes the following:

- Extent and level of staff training required,
- Extent new facilities are needed,
- Kinds of alterations that have to be made to existing programs, and
- Extent to which existing programs will need to be phased out.

An assessment of potential long-term use includes:

- Durability of the technology and its potential life expectancy,
- Estimation of future resource commitment,
- Capability of existing infrastructure to support long-term change, and
- Capacity to use without donor support.

The political environment; human, physical, and financial resources; as well as social and cultural norms can constitute constraints, adversely affecting the implementation of technology. It is important, for example, to be able to anticipate whether the technology will be resisted by instructors or other concerned groups, the extent of long-term support that can be expected, or whether the technology will conflict with cultural and social norms (Schramm, 1977). An assessment of environmental constraints includes:

- Those who will lose resources if the technology is introduced; those who will gain;
- The source of financial support, its stability, and who controls it;
- The extent that there is opposition to the introduction of the technology, community and professional;
- Possible social and cultural norms that may be violated;
- The extent that the technology is imposed top down. The extent that those most involved in implementation participate in planning; and
- The extent that the use of the technology is a political decision.

Finally, it is important to determine whether there are means other than the introduction of the technology for realizing the outcomes. In order to determine if the technology represents the best alternative, one should assess:

- The extent needs are being currently addressed;
- Other possible ways of achieving the outcomes; and
- The consequence of not introducing the technology.

Making practical judgments is a subjective activity. "As the evaluator attempts to judge the worth of a program" Abramson (1979: 146) observes, "he/she is faced with the dilemma that arises from the different views and values of the various constituencies operating within the program." It is the evaluator who must elicit these views, assess their meaning, and accommodate them "in the conceptualization of the major properties to which attention must be given...."

Assessing Instructional Qualities

The ultimate worth of the educational technology is best judged by its instructional use. Is technically accurate information provided in a form that can be easily understood and used by student and teacher alike? In judging the instructional quality of the technology, focus is mainly on the software--the instructional materials which present the content. In fact, a strong case can be made for selecting educational technology on the basis of available software, and not the other way around. Knapper (1982: 82), for one, suggests that the major problem "inhibiting the effective use of technology-based approaches to teaching is the shortage of material to teach in the new systems--the so-called software and courseware problem." Development efforts have tended to be concentrated on the technological devices, and not on the companion software used in teaching. In the case of high technology systems, this is a particular problem in vocational and technical instruction because of the relatively small student population served and the highly specific nature of the instructional content. Except in cases where the instructional development capability is in-country, the availability of high quality instructional materials should be perhaps the major criterion used in selecting instructional technology.

The selection of instructional materials has to be done on a case-by-case basis, carefully analyzing the content of the material and its potential usefulness. This requires the services of technical experts, skilled in the content area, as well as individuals capable of assessing its usefulness in an instructional setting. Following are a number of guidelines for instructional materials selection (Webster, 1976; Klein, 1978; Woodbury, 1979):

Quality of Content

- What is the scope of content covered?
- Is the content accurate and up-to-date?
- Is the content consistent with the objectives of instruction?
- Is the content a substantial technical contribution, not available through other instructional means?

Learner Effectiveness

- Is the technical difficulty level appropriate?
- Is the vocabulary level appropriate?
- To what extent does the material relate to the characteristics of the users?
- To what extent is the material free from ethnic, cultural and social bias?
- Are prerequisite skills needed to use the material?

Teacher Use

- Are special skills needed to use the material?
- What methods of instruction are suggested?
- Is extensive preparation required?
- To what extent does it supplement other instruction?
- Are teacher's manuals and instructions provided?

Instructional Quality

- Is the purpose clear?
- Is the overall technical quality high?
- What is the quality of the auditory, visual or print and graphic presentation?

Practicability

- Is the material easy to use and store?
- Are there special administrative and logistical requirements?
- Is the material adaptable to a range of teaching situations?
- Are required support materials available?
- To what extent is the material durable, and what consumable and replacement parts are required?
- Is the material reasonable in cost?

The Identification And Use of Instructional Resources

Before making decisions regarding the use of instructional technology, it is necessary to identify potential technology--devices, software, and otherwise. Educational technology is mainly produced in developed countries (DCs) and transferred to LDCs. Educational specialists in LDCs are thus faced with the task of identifying and locating appropriate materials.

General Sources

In the United States there are a number of general sources of information that are useful. These sources are a comprehensive guide to the location of commercially available vocational training resources:

- National Information Center for Educational Media, University of Southern California, University Park, Los Angeles, California 90007. Over one-half million audio visual materials are annotated and catalogued. Indexes are provided, identifying products by media format and subject areas.

- Curriculum Product Review - A Bobbitt Publication, P.O. Box 1904, Clinton, Iowa 52732. New curriculum products are reviewed in nine publications per year.

- Curriculum Review - Curriculum Advisory Service, 500 South Clinton Street, Chicago, Illinois 60607. Bi-monthly publication of reviews and evaluations of texts, professional books, and supplemental materials. Grades K-12 in all subject areas are covered.

- Media and Methods Educator's Purchasing Guide - North American Publishing Co., 134 North 13th Street, Philadelphia, PA 19107. This annual guide contains information from every known supplier of educational materials and equipment. Part I includes an index to educational materials. Part II covers educational equipment and supplies.

- Material for Occupational Education: An Annotated Source Guide - (2nd ed.), 1982. New York: Neal-Shuman Publishers, Inc. The focus is specifically on occupational education materials.

- Training Film Profiles (vol. 14) - Hoboken, NJ: Olympia Media Information, 1981. A current collection of training films in occupational education is listed and reviewed.

- International Yearbook of Educational and Instructional Technology (Howe, 1980) provides a comprehensive list of producers of programs, audio visual software and hardware. In addition, this publication is a rich source of educational technology information in general.

Specific Sources

In the U.S., there is also an extensive collection of training materials, varying in quality and content, training format, specificity, intended training population and required support material (Cuervo, 1982). A variety of training needs can be addressed with a limited need to develop completely new materials. Following is a review of specific sources of training resources. There is, however, no one source for identifying available instruction resources. Cuervo (1982), however, provides a good guide to resource location in the U.S.

Producers of Technology. Many companies develop instructional materials to train operation and service personnel or as an incentive to prospective buyers. As more complex technology is used in business and industry, the need to train prospective users becomes greater. In many cases, the material is relatively inexpensive, requires moderate cost hardware, such as filmstrip/cassette players, and the material is current and job specific. Such materials are suitable for in-country industrial training programs if the particular firm uses the specific technology addressed in the training material.

Producers of Industrial Training Materials. Specialty companies produce training materials in specific technological fields. These materials are usually of good quality and comprehensive, because the firm is addressing various training needs in the field. Materials can be purchased with a full range of support materials varying from projectors to tools and materials. Some companies provide instructional materials specially tailored to use in LDCs. In many cases, a total "training system" is sold. Cost can be from moderate to high.

Experts in the Field. Experts in the field constitute an often overlooked source of training information. These individuals, often associated with universities, governmental agencies, or associations, may not develop materials themselves, but they are aware of existing resources and can advise on the quality and substance of the material. Moreover, their knowledge of resources usually relates to companies, research groups, and associations spanning the complete business or industrial field in question.

Trade Associations and Unions. Many business and industrial fields have trade groups, unions or professional associations directly associated with them. In many cases, these groups develop and provide training materials that are specific to the industry and applicable to LDC settings.

Commercial Publishers. A large volume of material exists on the commercial market, often in varying degrees of quality. Most commercial publishers produce for a mass, formal education market, so their material may not be suitable for highly specific training needs, particularly in the nonformal sector. In using these materials, a major task is prior screening for quality and specificity. Commercial products can be identified through the references identified under general sources (page 104).

Research Groups. Private research groups, such as the American Institutes for Research, produce training material for specific users, such as public school systems, industrial firms or government agencies. This material is usually specific, addressing the specifications of the buyer, and of good quality.

State Curriculum Centers. Many states have developed curriculum centers, often associated with major universities. Funded through state and federal educational funds, these centers produce a wide range of instructional materials. In general, these materials vary widely in quality, are produced mainly for formal education, grades 9-12, and are low cost. They are potentially useful for adaptation to LDC needs. Individual state departments of vocational and technical education are a source of curriculum information.

Regional Curriculum Centers. Three regional centers produce material for participating states. These are the Mid-American Vocational Curriculum Consortium (MAVCC), the Vocational Technical Education Consortium of States (V-Tecs), and the American Association for Vocational Instructional Materials (AAVIM). This material is intended mainly for formal education use, is uneven in quality, but is relatively low cost. It has the potential for easy adaptation to use in LDCs.

Networks. There are various networks that are a rich source of instructional materials. These include the State Instructional Laboratories found in 42 states; the National Network for Curriculum Coordination in Vocational and Technical Education (NNCCVET); the Educational Resources Information Center (ERIC); and the National Technical Information Services (NTIS). These networks basically disseminate curriculum and instructional materials, and contain a vast amount of materials in their collections. In general, these materials are low cost, but vary greatly in quality.

Other Government Agencies. Federal agencies are the source of various training materials. The Job Corps, in particular, has a large collection of training material that is suitable for use in LDCs. Other sources of material include the Bureau of Apprenticeship, U.S. Department of Agriculture and the U.S. Military. The Department of Labor (DOL) operates the National Employment and Administration Clearinghouse Resource Center, an information-sharing resource among DOL regional locations.

International Organizations. Considerable instructional resources are available through international organizations. The International Labor Organization (ILO), for example, has developed between four and five hundred training modules in various occupational areas. The World Bank has a collection of training materials, and materials are also available through UNESCO.

Specific country or regional centers are established which provide training technology. In Singapore, for example, the Industrial Training Board (ITB) coordinates the development and dissemination of instructional technology for use in government and private industry-sponsored training programs. In Brazil, instructional and curriculum activities are coordinated through SENAI (National Service for Industrial Apprenticeship), organized to provide

assistance to private industry. The Interamerican Research and Documentation Center on Vocational Training (CINTERFOR) develops curriculum material for use by Latin America and Caribbean Training Centers, thus serving a wide region. These, and other centers, serve as a depository of instructional resource materials, can provide training and instructional assistance, and can provide assistance in identifying and adapting materials. Probably the best source of worldwide curriculum and instructional centers is the International Yearbook of Educational and Instructional Technology, (Howe, 1980). The listing is comprehensive and by country. While the listing is general, vocational training centers are identified.

The Problem of Locating Instructional Resources

A major problem faced in LDCs is gaining access to instructional technology. Probably the main source of information in developed countries is commercial publishers and vendors. Another source is professional organizations and journals. In LDCs, restricted commercial markets, currency controls, relatively high costs, and the inability to directly use U.S.-developed materials tend to restrict access to an extensive source of training technology in the commercial sector. Furthermore, effective professional organizations may not exist in LDCs.

Specialists in LDCs, thus, simply may not have sufficient information to be able to locate materials. This is also true in the case of noncommercial agencies; materials from these sources, however, may be potentially the most adaptable for instructional purposes in LDCs because they are mainly in print form, deal with specific skill areas, and address special populations. In addition, the majority of this material is in the public domain.

Perh[illegible]e of the best sources of information about instructional technology in [illegible] is suppliers of machinery and equipment. Sources of relevant materials can often be obtained directly. In addition, as previously discussed, some manufacturers produce high quality instructional materials. However, the major drawback is that only a restricted range of instructional materials is dealt with. Also, small employers in the rural and informal sectors usually do not have direct contact with major suppliers of equipment and machinery.

Personnel trained in the U.S. are another source of instructional technology information. This information, however, may be only fragmented. In addition, without a formal information network established, individuals in LDCs quickly lose contact with U.S.-based sources.

Providers of donor assistance are in a position to coordinate resource needs with sources of U.S. technology. This link, however, must be structured within assistance projects to be most effective. At the in-country site, it is essential to fully assess the training need and capacity to provide training. This includes the specification of the content to be covered, student characteristics, teaching capability, the capacity to use the technology as well as available resources. In the U.S., the major task is screening resources and matching these to the specific requirements in the LDC.

U.S.-developed technology must be specific to the instructional requirements of the LDC setting.

The specification of instructional needs and identification of resources can be perhaps best facilitated through regional or local centers. Resources can be more effectively used, and the process of locating materials must be considered ongoing and long-term. Few individual employers in LDCs have the capability to conduct extensive, long-term searches for instructional resources. A relatively small, specialized center staff can locate, revise, maintain, and distribute instructional resources to multiple training sites at lower costs than if individual resource centers are established within specific firms.

Modifying and Supplementing Resources

Few instructional resources developed in developed countries can be used directly by instructional systems in LDCs. A major reason for this is because the mix of machinery and equipment used in a developing country is different from that used in a LDC, which is often drawn from a number of foreign and local manufacturers. In addition, materials developed in developed countries are for a specific target population which may vary from intended users in LDCs. Also, building codes, manufacturing procedures, material standards, and engineering concepts may vary due to the use of non-U.S. standards and procedures. U.S.-developed instructional materials may also require the use of instructional resources not readily available to LDCs. As previously suggested, the most direct application of U.S.-developed instructional technology occurs with specific training based on industrial and business sytems manufactured in the U.S.

This is not to say that instructional resources from the U.S. are not useful. What is meant is that modifying and supplementing is to be expected to facilitate the use of these materials. Supplementing need not be extensive. It may only include an explanation of U.S. standards for bolt sizes, for example; or information may be provided to convert U.S. measurements to metric measurements. Supplementing can be thought of as adding to the existing material, and this can usually be done easily.

Modification, on the other hand, is usually more extensive, and requires changing the materials or the companion hardware. Print material can be most easily modified. Film and filmstrips are least easy to modify, and it may be better to convert to another media, such as video tape, rather than attempt to directly modify film. Modifying includes:

- Adjusting the language and vocabulary levels of the material to accomodate the target group;
- Downgrading the technical complexity of material to conform to the level of instruction. Downgrading can be done more easily than upgrading;

- Including tools, equipment, machinery and procedures used in the training location, and eliminating those not available or used in-country;

- Accommodating or eliminating cultural, ethnic or sex-related factors. Materials may have to be modified to accommodate the social and cultural setting; and

- Adapting materials to the teaching and learning style of the users.

Concluding Comments

Instructional technology, then, includes a wide range of technological devices and resources, supplied through an even wider range of producers of the technology. To what extent is instructional technology effective in enhancing vocational instruction in LDCs? And, is it a good educational investment? Obviously these questions are complex, and the answers can vary from one instructional setting to another. Generally speaking, however, instructional technology can contribute to the improvement of the quality of vocational training. One should not expect that educational technology is less expensive than conventional instruction. Also, it is probably unrealistic to think that substantial changes can be produced in a relatively short period of time. But, instructional technology can help to offset the lack of qualified teachers; it can assist in improving the quality of instruction through materials that are superior in content and design; new subject matter can be introduced; and instructional opportunity can be extended, thus expanding the range of vocational training to include many individuals formally bypassed.

Perhaps the most difficult problem faced in using instructional technology is the development of an effective system to collect, manage, disseminate and update resources. This is an area in which substantial research and development work appears needed, particularly in regard to the use of educational technology in specific instructional and country settings. Most instructional technology simply cannot be introduced into an educational environment without prior development of the necessary infrastructure. Sufficient support services may be needed, including media and instructional design specialists. It may be necessary to train teachers, and familiar instructional methods and conventional ways of managing instruction may have to be altered.

Most perplexing, however, is the need to balance a centralized system of large-scale collection and development with local use. On the one hand, the size of the investment involved, the degree of technical specialization required, the efficiency realized through large scale operation, and the extent of overall coordination needed, all point to the advantage of centralizing services. On the other hand, the effectiveness of instructional technology depends largely upon how well it addresses local instructional needs. Failure to consider these needs often results in the failure of the technology. Above all, the technology must be specific to the instructional

requirements of the user, it must be easily used by the local instructor, and it must be accepted by those who have the ultimate influence on its implementation. In particular, additional research and development is needed to facilitate the use of educational technology with local employers in the context of nonformal and informal vocational training.

The extent of local participation that can be maintained in decision-making and development, while at the same time relying on the necessary centralized structure, is probably key to the successful use of instructional technology for vocational training. The practical issues in effectively using instructional technology may, in fact, be where the focus of development effort needs to be placed.

RESOURCES

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