TECHNICAL EDUCATION IN AN INDUSTRIALIZING SOCIETY

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INTRODUCTION

In general terms, education constitutes a social system within which technical can be regarded as a sub-system. Given a different frame of reference, technical education by itself can be regarded as a social system. If a further delimination is made to a particular country, any social system may be vividly characterized by a consideration of the roles of its major instrumental organizations or institutions, or of the major policies dominant in the particular social system.

Major policies dominant in an educational system commit the educational system to definite goals, set the strategies for reaching those goals, and determine the long-range destiny of the educational system. Major policy decisions are not just any decisions but are those that have major impact, those that mould the educational system's future. In short, major policies are guides to "critical" decisions not merely to routine ones. However, cognisance must be taken of the fact that issues that seem minor at one point may later prove to be decisive and vice versa. In any case, major policies are those decisions that bind the educational system to important courses of action.

Formulation of major policies imply not a long-range plan, but long-range planning. It is a continuous process being constantly adapted and updated as new information comes to light, new opportunities or needs arise, and services offered are no longer needed. Its value lies in providing advance notice of future serious problems, and in inducing a sensitivity in the leaders of the educational system toward the determinants of future educational system's character in order to make effective direction possible.

In relation to educational systems, major policies may relate to such things as: (a) financing educational expenditure (the relative proportions to be borne by national, state and local governments, as well as by parents, employers and others); (b) administrative sub-systems articulation (as between various levels and types of education); and (c) manpower development targets and institutional enrolments.

A fair proportion of this paper deals with an aspect of institutional roles in an educational system. Because misunderstandings about institutional roles are a common source of difficulty, a proper identification is very important in the design or review of educational systems.

One feature of an institutional role that needs to be clarified is its description. An institutional role is more than a statement of specific educational programmes, it is a set of expectations placed by the educational system on the particular institution in the role. This is so even if the institutional role has been created by the institution itself. If it is an accomplished institutional role in an educational system then the educational system has recognized it, explicitly or implicitly accepted it, and this recognition implies expectations. In turn, these expectations must be communicated to the institution in the role. This means that the general statement of institutional role must indicate what the role is for, what the institutional role occupant is expected to achieve, what objectives are

involved, as well as what activities are required or permitted. The statement must also indicate what access to resources are used. Without such a statement about resources, the definition of an institutional role is incomplete, for activities cannot be carried out unless there is access to the resources that make them feasible.

In other words, the functional content of an institutional role may take the form of general expectations, allocated into the institutional role from external sources or self-induced by the institution in the role. Self-induced expectations are valid if they come within the limits of the general accountability of the institutional role set by the educational system. Otherwise, they should appropriately be 'agreed' with the institution's beneficiaries and/or sponsors. In each case, the basic features of general expectations should be a matter between the institutional role-occupant and its beneficiaries and sponsors. This point becomes very significant when a multiplicity of expectations come from more than one source and the question of priorities arises. It is essential that difficulties are resolved (or disagreed) between the institution and its beneficiaries and sponsors, rather than just left. If left, they fester, and misunderstandings and recriminations are inevitable. If recognized, action one way or the other can be achieved.

THE NEEDS OF INDUSTRY AND THE INDIVIDUAL

There are significant links between education and economic change in general and between technical education and industrial development in particular. That there are such links is undeniable; that this form and relevance are more difficult to define is also abundantly clear. Part of the difficulty arises from the various functions of educational institutions. There is the view of education as a desirable object of consumption by students, and the view of education as an investment in human resources by the community. There is also another distinction, that of the complimentary functions or principles of matching and monitoring based on manpower planning which perhaps is most helpful for the purposes of clarifying institutional roles. The concern here is with the matching principle.

Technological changes in the manufacture, distribution, marketing, etc. of new products and new services result in changes in skills required in the labour force. And as these processes require skill change, the components of education and training offered to the labour force by institutions predicted on the matching principle of the tertiary sector of the educational system must also change. This is an example of the matching principle of education, to minimize the differences between the education and training required by industry, commerce etc., and the education, skills and knowledge that people have. The matching principle provides a basis for analysis both of economic structures now existing and those proposed for the future. It is able, albeit in an approximate way, to relate the supply of labour to the demand for labour in various industries.

The matching principle is several stages beyond a crude vocationalism in both conceptual content and logistic detail. The idea of matching is not in any sense meant as fitting people into slots. A curriculum based on it does not presume to tell individuals what to do, far less imply crudely restricted training for one or more of the areas of activity. In other words, teaching the application of knowledge should not be thought as determined only by the needs of individual students.

In conceptual content, a curriculum based on matching should not be identified with training people for today's jobs. To carry out a function

effectively in A.D. 2,000 requires a type of education that is oriented to change since there is no means of telling what the problems of A.D. 2,000 will be. It requires an ability to identify situations and abstract problems from these situations; the problems themselves may (or most likely may not) be identified with normal disciplines of the conventional curriculum.

Within a curriculum based on the matching principle, it is no use teaching only concepts, the ability to recognize and evaluate counterconcepts must be as effectively inculcated. Thus in business education it is no use simply teaching students to deal with marketing within the present social structure; students must be introduced to the ideas of what might be the equivalent function of marketing in a completely different social structure. Marketing par excellence implies sensitivity to social change, of course; but so do many other areas of operation. They should not be predicted on the assumption of an invariant socio-economic structure.

The key features of the matching principle which shape the orientation of higher education in the polytechnics are:

(a) To enable students to acquire new approaches so that in future situations in which they find themselves they will be able to define and solve problems in a broad context (social, economic, technical, etc.).

(b) To enable present and future students to develop their own answers to the question "In which direction shall we go?" Opportunities - and, at the crunch, capital resources - are matched to the likely development of all activities, not only the growth of manufacturing industries. There is, therefore, a large difference between a curriculum based on the matching principle and narrow training for some single and specific industrial function.

The vital role of educational programmes based on the matching principle of higher education in general and the polytechnics in particular is to cause knowledge to be applied in matching the needs of industry and of individuals.

The idea of making the application of knowledge the central role of technical education institutions has four important consequences. First, at the point of implementation, application of knowledge takes place on an individual basis and the educational programmes offered by the institutions should pay special attention to individual needs. Second, the application of knowledge takes place in a social context. It requires a broad understanding of the behaviour of people, or the moral, ethical and social patterns which - as far as is presently known - give a good indication of the way people behave. Technical education institutions need to provide as much opportunity as possible for students to mature in a real-world context and not in one limited to considerations of the intellect alone. Third, the centrality of the application of knowledge emphasizes the development of initiative, at least in terms of action. This implies that more has to be done by the technical education institutions on the communication of action (coupling) as distinct from the communication of facts. Finally, the idea of teaching and learning how to apply knowledge means that the student should develop those skills that will enable him in future years to apply any further knowledge he acquires. This implies a life-long process of acquisition of knowledge in order to use it.

In summary, the instructional programmes of the technical education institutions span many technologies, many arts and many skills. The technologies related to engineering, environmental design and management, and the basic sciences come readily to mind. There are creative and

expressive arts and skills - painting, sculpture, fashion, textiles, industrial design, architecture, music, theatre and so on. There are also the professional arts and skills - accountancy, business, economics, management, marketing. There are the skills of the community worker - technical teacher, social worker, librarian.

In realization, it is more than that: it is many arts, many skills, for many people. One of the expectations of technical education institutions is that their educational programmes should provide an equal welcome for three kinds of students. As well as those who want full-time and sandwich courses leading to registerable professional qualifications, there are many people looking for an education leading to other qualifications - diplomas and certificates, internal or external - and there are many young people who are already at work and are looking for an education on a part-time basis, by day-release from work or by evening study. It is good for all concerned to have the kind of teaching and learning community which such a mix of students creates.

From all that has been said it should be evident that the role of the technical education institutions is characterized by a dual concern for high academic standards and vocational guidance. Their diverse enabling activities have a bias towards objective creativity and the application of knowledge which is thought to be particularly appropriate to the needs of the times.

Major Policy Considerations

National policies can be broad and relate to the establishment of educational systems or be narrow and relate to specific programmes. For instance, a policy statement may say that every individual has a right to appropriate tertiary education, or it may set out detailed and wide ranging objectives. The former relates to a broad national concept of the type of education needed to achieve broad objectives. The latter implies a much closer and detailed analysis of manpower and related needs. It should not be inferred that the first statement does not have implicit objectives. Constraints relating to the economy, manpower required by industry, commerce and government, and needs seen by different sectors of the public, will generally guide the direction of an educational system. In contrast the objectives in the latter example are explicit.

Major policy statements are usually formulated following the work of an ad hoc group. (These may go under one of such names as Committee, Commission, Working Party, Task Force etc) established to undertake an in-depth study of a defined problem area. Groups of such a nature are usually set up by governmental agencies although there are examples of similar ones set up by non-governmental "voluntary" agencies that have induced equally far-reaching results. Ready examples of the first type (commissioned by governmental agencies) from Commonwealth countries are typified by the following three reports published in the early sixties:

(a) BRITAIN - Robbins Report. Committee on Higher Education, Higher Education: Report of the Committee Appointed by the Prime Minister under the Chairmanship of Lord Robbins, 1968.

(b) AUSTRALIA Tertiary Education in Australia: Report of Committee on the Future of Tertiary Education in Australia. Committee appointed by the Prime Minister under the Chairmanship of Sir Leslie H. Martin, 1964.

(c) NIGERIA - Investment in Education: Report of Commission on Post-Secondary Education. Commission appointed by the Federal Government under the Chairmanship of Sir Eric Ashby. 1960.

Of the second type (commissioned by non-governmental 'voluntary' agencies), similar examples are typified by the following three reports published in the mid-sixties:

(a) BRITIAN - Technical Teacher Training. Policy Statement by the Association of Teachers in Technical Institutions.

(b) KENYA - After School What? A report published by the National Christian Council of Kenya on the establishment of Village Polytechnics, 1966.

(c) NIGERIA - Skapski Report. Comparative Technical Education Seminar Abroad. Report of the Comparative Technical Education Seminar Abroad and Recommendations for a National Plan of Vocational and Technical Education in the Republic of Nigeria. Prepared with support from the Ford Foundation, 1966.

The common threads running through all six examples which are to be noted are:

(a) They are usually ad hoc groups

(b) They are usually established to provide solutions for a reasonably short-term problem with some provision to permit easy extension of the system at a later date.

(c) As conditions change or need to be changed radically new ad hoc groups are established.

(d) Whilst all recommendations are not necessarily accepted, the reports usually provide a solid basis for future development.

Most of these reports related in a large part to manpower needs to achieve national objectives and gave due recognition to the needs of industry. In certain cases, the number of training places to achieve national objectives and the available student input into specific institutions to fill those places were of importance. Thus there were three variables in the equations - the manpower needs in different vocation areas; the number of specialist training places to provide the output to meet these needs, and the input required at various levels and in various areas into the educational institutions to give the required output.

It is suggested that these are basic variables in policy considerations regarding the balancing of "the needs of industry and individual choice". In the economically more developed countries, particularly in times of affluence, the controlling factor is often not the input required to give target outputs but the demand by students for different types of courses in technical education institutions. Where there are no constraints on input, this seems to be the general pattern. The demand for places is probably influenced by the student's general area of interest together with his evaluation - often incorrect - of the long-term market demand for the particular skills. In a reasonably stable economic climate, this situation is probably acceptable.

However, there are severe limitations where the market is comparably small and the required numbers with the particular skills fluctuate. For example, several years ago the number of students opting into geology courses at a particular Commonwealth country's area technical education institution was small. With a local mineral boom there was a shortage of geologists although the total number required was small. Vacancies were advertised at inflated salaries. The immediate result was a big influx of students into geology courses. In the meantime, the market became saturated with imported or expatriate geologists so that the graduate group had great difficulty in obtaining positions. This lag between supply and demand is a fault of the laissez-faire system of matching manpower supply with manpower demand as depicted above.

As resources are usually limited, quotas need to be imposed in various disciplines of study. Once again, in developed countries these are often based on student demand and are determined by the educational institution itself. However, with the current world-wide situation where funds available for education are restricted and there is a questioning regarding the returns from funds invested in education, it is highly probable that limitations will be placed on the inputs into various study areas in developed countries.

In developing countries one of the scarcest commodities is adequately trained manpower, and one of the great needs seen by the population is for education. Here a government will undoubtedly see a balanced development of the country's resources as its prime responsibility, and consequently is almost certain to have a fairly clearly defined development programme which will include manpower required and methods of obtaining it. Priority will be given to methods of obtaining this manpower. It will probably do this by regulating the number of students entering different study areas, by providing appropriate educational training places to achieve its ends, and by ensuring that students enter the training places available. Unfortunately, individual preferences and national aspirations (usually strongly influenced by the needs of industry) will not always coincide.

Where in an effort to satisfy the needs of industry, government wishes to firmly direct students into appropriate programme, what can governments do while accommodating the principle of individual choice?

Where the application for positions exceeds places and where the prospective student is entirely dependent on government for his education and his upkeep during his programme of studies, he can be offered support provided he opts to enter a certain area. There could be opposition to such a scheme in more developed countries. A further possibility is for the government to ear-mark funds so that non-priority courses are minimised or eliminated. A further method of direction - less by coercion and more by persuasion - is to use a system of scholarships to students opting into priority areas.

Status, Remuneration and Job Satisfaction

One of the problems in connection with manpower policy as it relates to reconciling 'the needs of industry and individual choice' particularly in developing countries, is the aspirations - often quite unrealistic in terms of ability of so many students - to want to go to the top level of the work-force. It is significant that one does not see demands to the same extent in economically advanced countries where the responsibility of different levels of the workforce is accepted. Generally speaking, workers are

required at all levels be they unskilled, craftsmen, technicians, professional or management areas in the national development plan. Government educational policy and other policies relating to national salary/wage structure, influenced by other factors will determine this mix.

Status or respectability of different levels of the work force is hardly a matter for legislation. It is suggested that is more a matter for occupational or professional associations of workers (Technician Society, Draftsmen Society, Society of Engineers, etc.) who can and will work for the betterment of the group as a whole and its image in Society. However, governments can assist by avoiding the giving of an impression of elitism, Government must ensure that the educational institutions and instructional programmes for each workforce level are adequate and of good quality, and that the remunerations received will ensure the right proportions of the various levels of manpower.

The crux of the matter is that to the minds of many, the role of formal education is closely linked with the creation of urban elites. It is expected that parents and children will continue to look to urban wage employment for the fortunate few who get through secondary school. The assertion is that so long as fewer than 10 per cent of the age group in a country complete secondary school, and so long as jobs in the modern sector (however scarce these jobs may actually be) pay five to twenty times the country's per capita income, schools will be elitist no matter what they teach.

About less developed countries, one frequently hears the cliche that "school children are unwilling to work with their hands". Clearly, the incentive structure makes it highly undesirable for children to return to the unreformed peasant agriculture or handicrafts of their parents when other opportunities seem to be available. A related latter-day phenomena is one whereby highly qualified technologists practice their specialty (which may be connected with design, construction or manufacture) only for a minimal period and opt for the more lucrative fields of general business middlemen and commissioned agents largely in the import/export trade where the returns are higher through wheeling and dealing.

The situations just depicted call for clearly thought-out and imaginative interventions on the part of government in the national incentive structure so as to assure better returns for money invested in the education and training of scarce specialised manpower.

The Special Needs of Small Industries

See annexure I.

GROUP (C) TOPICS: RELEVANCE TO (SPECIAL) NEEDS OF THE ECONOMY

Environmental

Generally speaking, in each less economically developed country, some parts of the country have had long experience of urbanisation, but the post independence years have seen the phenomenon of rapid urbanisation in these previously urbanised areas and many other new areas. The casual observer might, at first glance, see little evidence of any realistic physical planning in the very great majority of towns in less developed countries and the picture presented is generally one of urban disarray.

Rapid urbanization creates numerous problems of a social, environmental and infrastructural nature requiring, amongst other things, technological and managerial skills for their solutions. In the task of environmental planning, development and management, it is a race against time. There is a great deal to be done to provide reasonable living conditions and an acceptable minimum range of services for those who are already living in the urban areas - in itself a gigantic task, but the needs of the new immigrants to the urban areas also have to be covered.

The process of environmental planning, development and management raises questions regarding the specific plans of development chosen and open up the possibility of others. It touches on the final choice of goods and services as well as on the methods by which these will be produced and consumed. It should induce us to identify the most appropriate technologies, as well as other factors such as location of activities; by which, waste can be minimized, recycling of materials, and the use of natural resources can be made more efficient.

The first point to be considered in environmental education (i.e. technical education for effective environmental planning, development and management) is that problems should not be taken in isolation. Whether one considers the control of disease, pollution, urban squalor, the provision of shelter and meaningful work, or the adequate conversion of the energy on which virtually everything depends, one finds problem interlocked with problem, professions working with and against one another, questions of resource allocation, legal controls versus economic regulation, the needs of one community set against those of another, and long-term aims in conflict with short-term expedients. Technological manpower cannot do much on its own. Any approach needs to be concerted, collaborative and comprehensive. All must take part in it.

The presence in technical education institutions of academic staff who possess expertise in one or more areas of environmental and behavioural science and who have deep motivation for work in problems concerning the interface beteeen man and the environment, invest the institutions for technical education with a capacity to launch on projects which are given an added complexity by the need to take societal attitudes into account. For example, the solution of some of the problems of living in an urban environment will require the co-operative efforts of technological manpower and of social science-based manpower. The climate in which the capacity to work together on complex interacting facets of a problem can and should be fostered in our institutions for technical education so that when environmental projects are undertaken, competent and understanding personnel are available to attempt solutions which take both technological and environmental factors into account.

The plea for a concerted, collaborative and comprehensive approach does not mean that there is global uniformity either in the scale and nature of environmental problems or in the necessary response of technical education. The first thing that must be recognized is that every global region, sometimes every country, has a different mix of problems, different priorities and different educational infrastructures. International and regional collaboration does not imply simple transfer of learning resources, course content and programme structure.

A key factor in developing an effective environmental education for technological manpower is the availability of suitable learning resources, in profession and variety. These would include such things as case-studies designed for participation and active learning by students, games and

simulations, independent-study units for the learning of definable factual information and skills, and the outlines of possible projects with lists and collections of relevant source materials. The preparation of such resources calls for creativity and experimentation. It takes too much time for most teachers working in isolation, and interest should be stimulated in the possibility of setting up networds whereby the production of such resources can be shared on a regional basis. A consideration of learning resources leads to the question of teaching staff development for technical education. A new approach, stressing active and open-ended learning, calls for a switch of teaching skills which is more than some teachers can make without guidance, support and encouragement. The use of resource materials brings new opportunities for the student, but the preparation of such materials also involves the teacher in active learning. As he writes, shares and evaluates materials, as part of a national or regional network, he learns about environmental education from his colleagues in ways which may be more effective than the routine reading of learned journals or attending courses on teaching methods. In other words, he finds himself in an open learning system similar to, and overlapping, that which he is trying to devise for his students.

The need for updating curriculum content and ascertaining its relevance to changing conditions is an issue that is raised more often than any other. Various curricula in technical education are crowded with content whose modification is strongly opposed (for a variety of reasons, practical and conceptual) and the pressures to add even more content grow every year - including the plea now being made for the relevance of environmental education. This issue must be clearly recognized. However, there should also be ready agreement that the fundamental principle underlying considerations of the core curriculum should be the preparation of people who are competent to enter their chosen professions or occupations. Two additional points should be considered by the relevant authorities before they conclude that there is insufficient time for environmental education in technical education courses. The first is that educational technology can offer substantial savings in the time taken to learn some parts of the core curriculum. Each institution should ask itself if it is doing all that it could in the light of modern methods. The second point concerns the size of the core curriculum. Certain questions need to be asked, year after year: "Do our students (still) have to learn this? Can they not learn it later, if they need it, when they need it?" These questions highlight the necessity to assign priorities to the various components of the curriculum content.

The orientation of the content of environmental education is also important. The content should not be uniform for, say, students of mechanical, chemical and civil engineering. As motivation is of crucial importance, the approach should be professional, and the student should see the relevance of the educational content to his future role, to the demands that will be made upon him and to the responsibilities he will be expected to shoulder. This rules out the encyclopaedic, something-of-everything approach in which too much is attempted and too little can be integrated in the minds of the students.

As well as being professional, the education should be ethical. This does not mean simply offering of lectures on ethics in general or even on, say, engineering ethics in particular. It means handling ethical problems as part of the more general process; learning to consider the ultimate implications of engineering decisions and building up a coherent set of values which can be taken into the world and revised and added to in the light of experience. Its success depends on an educational environment in which teachers accept the existence of ethical problems and do not pretend that technical education is value-free.

A consideration of the programme structure for environmental education should first be in relation to the general education of all technological manpower, regardless of speciality. There should be ready acceptance that changes in formal education (which is relatively short) cannot be the whole story. Life-long informal education and re-education (which follows after formal education) cannot be ignored, partly because of changes in technology and partly because we cannot wait until current formal education programmes have their effect. All levels of technical education - certificate, ordinary diploma, higher diploma, professional diploma and post-experience - must begin to reflect environmental problems in the broadest sense, and here we must not forget the contribution which professional bodies can make through their influence and authority and such means of dissemination as their professional journals and meetings. Also related to programme structure of environmental education are matters of academic organization and management. If changes are to occur, attention must be paid to the mechanics of collaboration and support between departments; to the incentives and rewards which human beings need where new efforts and sacrifices are required.

Production and Safety Standards

Product Standards

A clear definition of standards is possible in terms of the process of standardization. In turn, standardization is a discipline by which human activities of all kinds can be ordered and regulated, on the basis of experience and technological development. According to the definition given by the International Organization for Standardization (ISO), standardization is:

> The process of formulating and applying rules for an orderly approach to a specific activity for the benefit and with the co-operation of all concerned and in particular for the promotion of optimum overall economy taking due account of functional conditions and safety requirements.
>
> It is based on the consolidated results of science, technique and experience.
>
> It determines not only the basis for the present but also for future development it should keep pace with progress.
>
> Through standardization:
>
> (a) Standards are draw up which relate to: definitions, terminology or symbols: fundamental or derived units; specifications with regard to quality or operation; procedures for testing requirements (physical or chemical tests, etc.); procedures in general (registration, calculations etc.).
>
> (b) It is ensured that these standards correspond to the economic level of the environment in which they will be applied, in the hope of raising that level and benefiting the community in general.
>
> (c) Maximum efficiency and yield is obtained from raw materials; processes and products.

The less developed countries are now facing, or have in the past had to face many problems in connection with standardization. These can be summed up as the following set of conditions: inefficient industry and high

cost of production; lack of technical development in industry and education; low quality of output; high prices; markets limited by high prices; high rate of repair for products.

In the less developed countries, recognition must be given to the important role of standardization, introduced at an early stage, in accelerating the industrial process in developing countries and avoiding waste of capital and human and other resources in disorderly growth. Standardization has another part to play in the transfer of technology by providing organized information and by codification and classification of data on a uniform basis.

Efforts in international and regional collaboration in standardization could minimize production inefficiency in engineering industries and reduce repair, maintenance and servicing costs of equipment by ensuring that plant components are easily interchangeable with the minimum of spare parts. The expansion of export markets and the substitution of domestic products for imports would both be facilitated by the acceptance of standards ensuring consistent quality and in products packaging for exports and also by giving the local consumer confidence in domestic products. In the latter case, standardization should assume an aducational function, making the consumer aware of the level of quality and performance he is entitled to demand. There is no better starting point for this type of consumer education than in the technical education institutions.

Safety

Somewhere in the chain of circumstances which lead to injury, we find the human factor. The challenge of true accident prevention is to change attitudes of mind by efficient and regular safety training for all levels of technological and managerial work force. The aim must be to make every individual in industry have more regard not only for his own personal sefety but also for the safety of others.

Attention to safety in education institutions has two main aims: to ensure that the actual working conditions are safe, and to inculcate in the students a knowledge, of, and a respect for, the principles of accident prevention as a preparation for their later life in industry where safety training is essential for everyone in any industrial undertaking - operators, supervisors as well as top levels of management.

Finally in respect of the needs of industry for safety, what proportion of wastage due to accidents derives from the involvement of the technological and managerial work force in road traffic accidents? What are the implications for formal education programmes in institutions and for continuing education programmes in both industry and institutions? What then is the place of driver education and road safety training in the various educational programmes?

Self-Employment

As indicated earlier, the function of technical education institutions is to meet the needs of the community (industry as well as individuals) for technical education with due regard to cost benefit. In this connection various problems may arise. For example, the need may be obvious but the demand lacking among the unenlightened needy. Again the need, though serious, may involve such a small group that even when the demand is clear, it is doubtful whether a viable provision can be made to meet it. In development work, therefore, those in charge of institutions (as distinct from manpower

planners who contribute to national development plans) will be faced continuously with the assessment of needs and should have a clear policy in taking action on such assessment. Where the need is clear and the demand is found to be sizeable, then there is justification in going ahead with the provision even though the demand is still not fully developed, provided steps are taken to stimulate demand. If, however, the demand is small and is not likely to increase, consideration should be given to the idea of using existing facilities in other establishments, These cases are relatively simple to tackle. The real difficulties arise in dealing with latent needs, that is, needs which will clearly arise in the future as the economy develops. Vigilant and competent adivsory committees with strong representation from employers should be set up to consider the demand for each need and to determine the appropriate and opportune time for actually introducing a training course to meet the need.

In order to meet the manpower needs of the high productivity sector or modern sector of industry effectively, economically and without frustration, institutions should devise an education and training system that, quantitatively, relies less on statistics and long-range forecasts and more on signals emanating from the day-to-day workings of the employment market (i.e., the economy's capacity to absorb labour into productive employment). These signals include salary trends for specific occupations, employment experience of the products of the technical education institutions, improved data on unemployment, periodical employment market information, and establishment surveys.

There is no doubt what the Ashby Commission had in mind when it commented, "It would be a short sighted policy to allow the educational system of a country to be controlled solely by 'consumer needs' for manpower. However, it is part of the duty of an educational system to meet these needs, and in a young country particularly they must be given prominence." It is increasingly being realized that the "consumer needs" include the stimulation of self-employment. There must be a studious and detailed examination of the real requirements for self-employment, of those activities most probably related to the production of new wealth, and of the curriculum content and training methods best suited to these requirements.

The terms self-employment and entrepreneurship are often used interchangeably. It is true that, both are "agents" of economic development - important contributors to the rate of economic growth. But the term "entrepreneur" should be used only in reference to a type of business activity and not to the ownership of the means of production. It is not just about the capitalistic entrepreneur - it is about the man who undertakes or "enterprises", and such a man may be in the public sector or in the private sector.

In other words, the entrepreneur may be, but need not be, the one who furnishes the capital. It is leadership rather than ownership that matters. Therefore capital investment risk bearing is no part of the entrepreneural function. The capitalist bears the risk, the entrepreneur brings about the changed production function. The two may, or course, be done by the same man and often are in today's world. Probably, there is no single more confusing distinction today than that between entrepreneurship and risk taking generally. The entrepreneur clearly takes great personal risk in the process of bringing about the introduction of often traumatic new production functions. The entrepreneur may also put his own money into the new project and thereby becomes a financial risk taker - probably even self-employed.

The cause-effect testimony ready at hand is that a certain type of human motivation, which has been styled the Need for Achievement (N/A), is a link to economic development via the entrepreneur. That is to say, successful

entrepreneurs generally have more of this particular human characteristic. There are six converging lines of evidence which lead to the conclusion that N/A is essential for really successful entrepreneural performance and hence contributes to economic development. They are:

(a) Men with high N/A prefer to take moderate risks and do better when they are operating under a condition of moderate risk. This line of evidence came from technical laboratory and theoretical work in psychology over a 20-year span.

(b) A high concern for improvement or doing well is associated quite generally with rapid rates of economic growth. This line of evidence came from longitudinal studies of popular literature on achieving and non-achieving societies - both historical and contemporary.

(c) Minorities who have played key roles in most economic development were higher in measures of the N/A characteristic. For example, certain groups of Jew in the West are cited as having demonstrably higher N/A.

(d) Businessmen score higher on N/A than professionals of comparable education such as lawyers, doctors, priests and bureaucrats. Within the business group, those who have higher N/A tend to do better in the sense of being promoted faster.

(e) Business concerns in the private sector headed by men with higher N/A grow faster. This line of evidence derives from a Scandinavian field study.

(f) Training aimed at injecting some N/A into businessmen leads to relatively rapid growth of the focal businesses whose subsequent activity could be followed. The training programmes have been used in certain parts of Asia, North America and Africa for several years.

Special Training Needs of Women and Girls

It is important that increased opportunities should be provided for women and girls to benefit from technical education. A fuller participation of women and girls in technological and managerial careers is vital, not only in terms of fuller utilization of their capability, but in terms of the humanizing effect that they bring to the jobs, the work place and the social processes at large.

Amongst constraints reported as operating against fuller participation of women are: differential wages and salaries, hardships involved in the job, other cultural factors whether at the conscious and sub-conscious levels, and lack of training facilities and training support.

Remedial measures or actions known to have been taken include:

(a) Identifying occupations where the participation of women and girls is deemed unsatisfactory and requiring active support.

(b) Organizational involvement of women in recruitment, promotion and other committees.

(c) Training.

(d) The creation of specific opportunities.

Steps need to be taken to promote the education and training of women and girls for a wide spectrum of technological manpower. For example, they should be trained not just as engineers but as technicians as well. Not only should the barriers in the way of participation of women and girls in technological and managerial occupations be overcome, but also active educational training and employment support should be given within the context of the social and cultural conditions.

On this matter, one view has been expressed that problems of developing countries might require a separate approach to that used for the developed countries. Another differentiation has been made between the problems of labour surplus countries and those of countries with labour shortages. In this context, it is worthy of note that one country where there were labour shortages, plans to depend more on "woman manpower" by stimulating their recruitment into jobs for which they are suited, and by inducing men to transfer from soft office jobs to active work in production.

Interdisciplinary Activity

See Annexure II.

ANNEXURE I

POLYTECHNICS AS NUCLEUS FOR SMALL SCALE INDUSTRIES

(An extract from Polytechnic Resource Letter, July 1976,
Vol. 7, No.7, p.2-3)

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Polytechnics, which are correctly imparting technological training to students only have a wider role to play. The small scale industry lacks the following facilities and utilities which are vital for efficient functioning and can be classified as under:

IN THE FIELD OF OPERATION

(a) Technical information.

(i) Technical reference material.

(ii) Specialized knowledge and ordinary knowledge of certain skills and techniques.

Problem solving in processing and manufacturing which includes engineering, technological and chemical problems.

(b) Production planning and control management.

IN THE FIELD OF PLANNING

(a) Planning and design of product. Information on norms and standards.

(b) Marketing information on product planning.

(i) Marketing information (marketing research or accumulated experience of marketing) about what product to produce.

(ii) What should be product characteristics.

IN THE FIELD OF QUALITY CONTROL

In this field two types of needs are revealed:

(a) Information on standards quality, i.e. what are the prevailing standards of quality. This will acquaint the small scale manufacturer with the standards by which his products are judged by others and unrecognized specifications.

(b) Making available the analytical testing and assessment facilities available to the SSI unit.

It is well known that many, rather most of the polytechnics have sufficient testing equipment, laboratories and qualified (many times experienced) people on staff who can undertake such testing and analysis work. It is also known that many of these facilities, equipment and talent lie dormant because it is not used.

This resource which exists must be exploited on the basis of selling this service at nominal cost and much of the difficulty of an SSI unit is about this respect.

We know that in most of the polytechnics a large amount of plant, equipment and machinery is, underutilized. This blockage of money on underutilized on macnines and plant and equipment which is partly in use is idle production capacity.

While the country suffers from shortage of power and lack of foreign exchange for import of sophisticated machinery we should consider whether better use can be made of machinery, plant and equipment capable of precision work.

The small scale industrialist lacks funds, facilities and time to acquire these machines. If such machines or plants are made available to him, his capital investment will be reduced and profitability (because of availability of more funds as working capital) increased. Machines, plant and equipment may be made available as follows:

(a) The Polytechnics offer the use of these plants, machinery and equipment on time sharing basis.

(b) The SSI unit sends its own personnel to operate the machines.

(c) The raw materials is supplied by the SSI unit.

(d) Or an alternate method can be evolved to employ paid efficient personnel in production and sub-contract the facility of the plant, machinery along with hire charges for the man.

IN THE FIELD OF MARKETING

The main difficulty with an SSI unit is that it lacks marketing knowledge. The entire profitability is dependent upon the selection of the right production, the current pricing and the use of marketing efforts (strategy included).

Polytechnics must develop facilities of management and marketing in order to help the SSI act efficiently. A little guidance by a management expert on organization, finance, personnel and profit planning can turn a closing unit into a profitable unit.

I have tried to enumerate broadly the aspect that require our attention. The earlier the polytechnics start the above facilities which are of two types- one conventionally technical and the other belonging to the group of management technology the better.

A small scale unit (SSI unit) will benefit immensely from the provision of these facilities. The Polytechnics can promote new SSI units and also help the existing units to survive.

ANNEXTURE 11

An Extract from

PAPER D. PROGRAMME DESIGN

by

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Paper written for

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Instructional Programmes in Technological Institutions

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BREADTH AND INTER-DISCIPLINARY STUDIES

General

Programmes of study can be classified under the following headings:

Uni-disciplinary
Multi-disciplinary
Inter-disciplinary

Programmes can be specialized or broad although the uni-disciplinary type tends to be the most specialized because of the greater time available to concentrate on the one discipline. In technical education great emphasis placed on the specific needs of industry and commerce, and there is a distinct trend to be over-vocational - a form of over-specialization, espeically from the student view-point. In general, most secondary and tertiary levels. However the basic aim must surely be to produce people who can think for themselves and who are equipped to do a useful job; but who are also capable of becoming good citizens and enjoying the cultural aspects of life.

In industrializing societies increasing industrial sophistication demands better standards in design, manufacture, handling and materials control. Furthermore there is the strong world influence for environmental conservation arising from such factors as excessive noise, air and water pollution, waste of all kinds, odious smells and deteriorating urban environment. All of these factors, together with the fact that small firms need more generalists than specialists, leads to a progression from uni-disciplinary to multi-disciplinary to inter-disciplinary educational programmes.

Breadth

There are good reason, therefore, to suggest that most educational programmes

should be approached from the standpoint of breadth of study. This implies thinking across disciplines and an institutional structure and organization that encourage breadth. (The systems approach discussed in Section 2 above indicates a way in which this can be achieved.)

The subject matter of the three classifications of programmes can be broken down into units and/or modules in such a way that study cores re present inter-disciplinary studies. Such cores, or parts of them, will be common to a number of different programmes. Specialization or further breadth can then be obtained by appropriate additional specific units and modules (see also Section 5 and Figure 4.). Such an approach is clearly economic whilst meeting the needs of the general community and the student. It also facilitates a rapid development from a broad base unto new areas of study through the addition of new units or modules as need arises. Thus a much quicker process can be achieved than by the more usual production of a fully tailor-made programme.

Inter-disciplinary Structure

The key to the provision of breadth and of inter-disciplinary study lies in the institutional structure. The convectional faculty/departmental structure centred on basic disciplines tends to produce a sense of "not belonging" amongst both students and staff. The two structures can be compared to function and project systems encountered in industry. A good solution is to adopt an interlinking system by superimposing a secondary-type structure of inter-disciplinary institutes, schools, and centres upon the more conventional faculty/departmental structure. Such a dual structure is outlined in Figure 3.

Institutes, schools and centres are relatively autonomous activity groups which bring the more basic disciplines together trhough multi-, inter- or trans-disciplinary study activity. Essentially they facilitate the process of cutting across the traditional boundaries of divisions and departments. Such needs can arise through a large broadly based servicing function, the co-ordination of scattered but related aspects of a broader based subject area or through a truly trans-disciplinary activity. This latter concept is of particular developmental importance placing considerable emphasis on synthesising a number of relevant disciplines, e.g. the synthesis of technology, urban planning, economics and social science into the broad subject area of transport studies.

Such activity groups generally function in close co-operation with industry, government agencies and public bodies and depend to a large extent on policies generated through strong advisory educational institutions. They generally contain permanent staff of an inter-disciplinary kind and include associated staff from relevant departments. Equally the permanent staff of inter-disciplinary activity groups can be associated with particular departments for more specific uni-disciplinary work. In this way, interactive staff attitudes are encouraged.

The decision concerning the designation of an institute, a school or a centre depends upon the type of level of activities and the extent to which department boundaries are crossed. However, the common requirements for all such groups must be an academic validation procedure meeting both the internal and external regulations of the Polytechnic. Hence for such purposes the groups are linked through the Academic Board, a Divisional (or Faculty) Board, or a Department according to the size and primary nature of their broad subject area. Clearly the larger institutes will have greater internal administrative, academic and other resources than the smaller centres.

It will be evident that there may be some confusion over the nomenclature through the use of the words institute, school and centre. This is not an uncommon situation for titles of various activity groups, e.g. a computer centre for a servicing activity group and a transport studies centre for an academic activity group. This indicates the advantage of defining institutional function in terms of activity group. For example:

	Functional Activity Group	Possible Nomenclatures
(a)	Education	Institute
	(i) Uni- or multi-disciplinary	School
	(ii) Inter-disciplinary	Centre
(b)	Practical/Training	Unit
(c)	Supporting services	Department
		Group
		Services

It is only then necessary to choose a consistent nomenclature to bring together the above two sets of functions and names.

The general definition of activity groups within an institution also has advantages in the costing and management information function.