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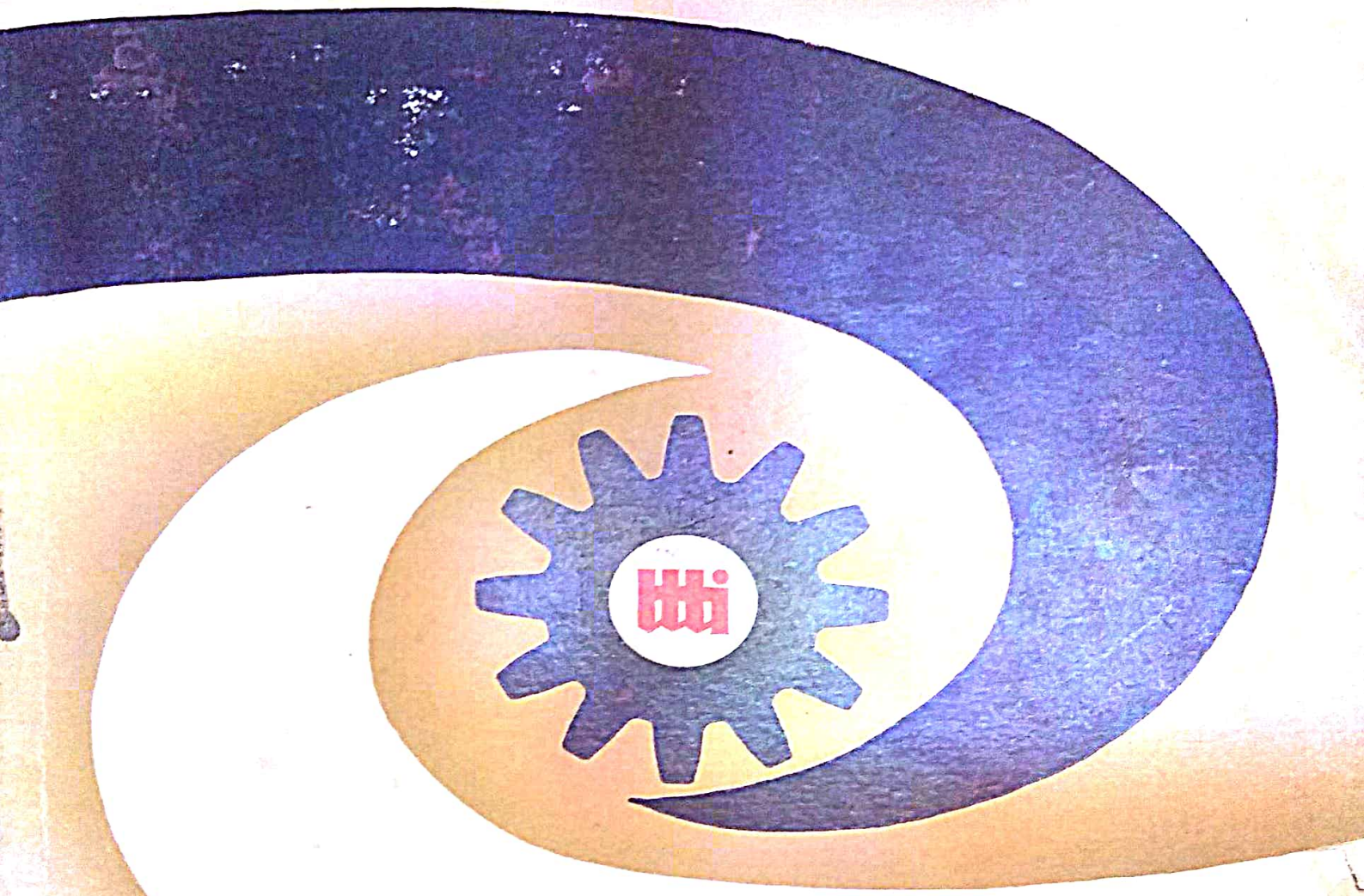

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CONTENTS

EDITORIAL

This eighth issue (1991) of the Journal of Technical and Vocational Education is published in the year of the Silver Jubilee of Technical Teachers' Training Institute, Madras. In the next issue there will be significant contributions arising from the Silver Jubilee workshops, seminars and addresses.

The General Articles section of this issue contains three papers contributed by Mr. A. Dyankov of UNESCO, Mr. Okolie and Mr. Ugochukwu of Nigeria. The first paper presents a descriptive comparison of didactic as well as organizational models in technical and vocational education responding to new developments in production and informational technologies in various countries. The two articles from Nigeria seek to touch upon Mathematics and Science Education and their roles in Technical education which contributes to the industrial and economic development of the nation.

The Research Papers section carries six reports from various parts of the world. The first paper presents three case studies on technical teacher training in the Arab states of Iraq, Tunisia and Morocco and indicates the trend in the development of this aspect of technical education. The study of technician education in the Colombo Plan countries is a survey of problems and issues collected through a questionnaire responded to by 532 persons from 16 countries. Needs assessment is an important area of research in educational expansion and development as can be seen from the third report on Manpower Needs in the Graphics Arts Industry in the Midwestern States of USA. By way of applying technological advancement in the teaching of skills, the report on Effectiveness of Microcomputer Aided Instruction in Television Troubleshooting describes an experiment conducted in Iowa State University. The Japanese experiment of management style in industrial innovativeness is reported in the next paper as a Case study collaborated by the Governments of Singapore and Japan in a productivity development project.

Contemporary Systems of Technical and Vocational Education

A. DYANKOV

ABSTRACT

The paper outlines how the contemporary systems technical and vocational education respond to new developments in the field of production and information technologies and to some changes in work patterns, by adopting new didactic methods and organizational structures in collaboration with industrial, commercial and agricultural enterprises. The author makes a comparison of various models in technical and vocational education, at two levels : at micro level – describing various didactic models and at macro level – describing three basic organizational models.

I. **At micro level,** on the basis of the different national structures, developed for inculcation of productive skills, four basic didactic models of organization of vocational education **can be distinguished:** on-the-job training, course instruction, project instruction, and learning in school-run enterprises.

These basic models may be distinguished from one another on the basis of **where** and **how** professional competence is being acquired, aiming to meet certain learning goals.

1. On-the-job-training.

This is the oldest and most frequently met type of technical and vocational education in all societies. In principle, this is a preparation for an occupation as skilled worker in some core areas of industrialization-manufacturing, maintenance, and repair-by means of industrial vocational training.

Typical examples of it can be observed in Nigeria, Egypt and many other developing countries. It could be characterized by the following features:

* The trainee usually acquires certain skills in the enterprise by observing, joining in, assisting and by imitation of what he or she observes.
* Working on real jobs in the enterprise makes some economic sense: The products which the trainee has helped to produce reach the market. and their quality is controlled by the demand for such products. The trainee's work is always practical, at all times, it is related to real demand, and it provides the prerequisite for the trainee's future ability to earn a living.
* The teaching staff has the task to make decisions, to grant or refuse permission to the trainees, to instruct them and evaluate their work, to settle certain conflicts, etc. Usually the teaching staff

comprises the professionally competent craftsman, the journeyman and the experienced worker. Often these people negotiate with clients and pass on appropriate tasks to the trainees. They also plan the work and work processes, and impart instruction, usually through a four-stage method, comprising: preparation, demonstration, imitation and practice. The teaching staff controls work progress and evaluates work results.
On-the-job training is frequently regarded a natural type of learning system; in which technical and vocational education is provided as part of the jobs to be done at the work place.

The other three models of instruction, namely the course instruction, project instruction and learning in school-run enterprises, are usually regarded as artificial types of learning systems, in which technical and vocational education is provided in non-work place situations.

2. Course instruction

This model applies to a methodological approach that is opposite to the approach of the "on-the-job training". Typical example of it could be observed in France. The method of training is based on the so-called "basic metalwork course", which has been developed in the late nineteenth century, and since then has been introduced in company-based training centres, vocational schools and inter-company or other off-plant training centres, with its basic methodological structure unchanged.

The course instruction could be characterized by its place of learning and organization of learning:

- The place of learning is usually a specific place, separate from real work situations in the enterprise, with specific jobs to be learned, for example: an introduction to welding, or basic hydraulics, pneumatics, etc.

- Organization of learning:
The complex working skills are broken down into a series of individual learning units and practice periods, determined by degrees of difficulty, progressing from easy to difficult jobs and from simple to complex tasks; i.e. progressing from one training phase to the next.
The course instruction leads to a high level of performance of students within relatively short training periods. Due to its favourable experience, this approach has been adopted also for other occupational fields (e.g. electrical engineering, building and woodwork technology, plastics technology, printing technology, textile technology), including also theoretical instruction in some subjects.

The course instruction has many advantages, such as its simple and regular nature, with a logical breakdown into sequences and full transparence. These advantages contributed to its wide popularity. Soon after it was spread throughout Europe and the United States, many developing countries adopted the course instruction model in their technical and vocational education systems. Especially its polyvalent nature has contributed to the popularity of this model since it replaced the old - traditional mode of training in a single occupation, with a polyvalent training for a variety of related occupations and activities.

These advantages of the course instruction could, however, become counter-productive, if learning at separate places of learning takes place outside the

company for too long and loses contact with the real work situations.

* Teaching staff:
  These are specially trained teachers and instructions possessing the necessary theoretical competence and practical skills, in addition to certain familiarity with the teaching methods, applicable in the course instruction model of technical education.
  In course instruction, teaching staff can rely on well-designed learning aids in order to give instruction and to evaluate learning results. The whole learning structure is highly independent of the individual teacher and ensures fair evaluation; this is way long and costly training of the teaching staff is not necessary. It is sufficient to familiarize the staff only with relevant teaching methods, provided that each staff member is sufficiently competent in his/her own professional field.

3. Project instruction

This is an alternative model of instruction, which is quite different from the previous model of course instruction. It has been developed to overcome some weaknesses of the course instruction, and it is very popular in Germany.

* Place and organization of learning – specially equipped workshops and laboratories, which are separate from the real work situation, but the project tasks are taken from the actual manufacturing process. In other words, the project instruction imitates the complexity of real work situations in the enterprise and the simulative learning is close to reality, providing students opportunities to use their own initiative in solving problems and difficulties which they encounter.

* Teaching staff – its role and functions: while the teaching staff involved in course instruction has to follow specific rules and regulations, the project instruction depends on teaching staff's initiative in planning, implementating and evaluating the results of the training. Thus, the instruction requires more time for preparation, greater commitments and responsibilities.
  Along with its advantages to imitate the complexity of real work in the enterprise, the project instruction has also some disadvantages: it is expensive to redesign the places of learning, which require more floor space for learning groups to move about, with specific arrangement of work benches and machinery, use of mobile machinery and the learning processes cannot be planned beforehand precisely, therefore learning goals cannot be controlled and guaranteed as in course instruction or in subject–related vocational school instruction.

4. Learning in school-run enterprises

School-run enterprises are explicitly organizational, economic and didactic models which link technical and vocational education to production for the market. The manufactured products and the production processes are used for vocational education and the students are allowed to work for production as they acquire more skills.

This model is typically implemented in the people's Republic of China and in Singapore.

* Place of learning: School-run enterprises are separate industrial training

institutions, which are equipped similarly to the manufacturing plant, having in addition the necessary training equipment located in appropriate laboratories, classrooms, a.v.a. rooms, lecture theatres, etc.
Practically, some general education schools enter in partnership co-operation with adjacent industrial enterprises and local or regional markets. The output of training are marketable products, whose production is optimizing learning opportunities with preference to labour – intensive processes, involving production of prototypes, various devices, as well as repair and maintenance jobs, rather than mass production.

Goods produced are sold either by the school or by partner enterprises or by special agencies.

The proceeds from the sale of products provide some relief for the school towards investment and current cost.

School-run enterprises are suitable for providing vocational orientation on skilled occupations and on opportunities for continuing technical and vocational education for schools in the neighbourhood.

* Teaching staff: being recruited with different backgrounds, the teaching staff must possess variety of skills in technical, economic and didactic areas, in order to provide sound education while maintaining high quality production for the market.
Generally, school-run enterprises are more common in countries where the enterprises do not play active role in providing vocational education.

* Summarizing the observations of the main characteristic features of the above four basic didactic models, one comes to the conclusion that the efficiency of technical and vocational education depends upon the methodology and relevance of training.

In different countries, a variety of training modalities and various different forms of co-operation between educational institutions and industrial, commercial or agricultural enterprises have been implemented in accordance with their social and economic conditions.

II. **At Macro level,** on the basis of the role of the government in technical and vocational education, three basic models have been developed: market model, school (or bureaucratic) model and co-operative model.

1. In the **Market Model,** which is typically introduced in Japan, the government plays a minor role or no role at all in vocational qualification processes.

The large majority of Japanese enterprises provide training according to their own company concepts without any government intervention. Thus technical and vocational education is an integral part of enterprise activities.

In Japan, there are neither government-recognized occupations, nor any generally valid certificates of vocational qualification. Qualifications have a practical value only for the enterprises concerned but no exchange value on the labour market.

The top segment of the Japanese labour market is the so-called "regular" staff, with permanent employment and promotion as well as pension rights being guaranteed by the enterprise. Regular staff is recruited each year directly from among the school leavers

and university graduates. This segment is estimated at 30 % to 35 % of the entire Japanese work force. Only this "regular" staff receives the necessary technical and vocational training within the enterprises.

The Japanese education system does not determine the pupils' vocational careers either by differentiating school curricula or by awarding school leaving certificates.

About 95% of primary school leavers pass on to the three-year secondary school, and about 45 % of secondary school leavers enter one of Japan's approximately one thousand universities. This increasing enrolment in post-primary education adds to the marginal character of technical and vocational education at school. The percentage of students attending vocationally oriented courses has fallen from just under 50% to under 30%, and the downward trend continues. Vocational secondary schools have become a refuge for compulsory school leavers who have not been successful in the educational competition. Although learning at schools and universities is not related to working life, the results of such education seem to meet the requirements of the employment system. Despite the virtual insignificance of technical and vocational education, the "secret curriculum" of the Japanese school system aims to prepare the pupils for a smooth transition to the world of work. It is not so much the acquisition of knowledge, as the training of behaviour and orientation patterns, which make the school such an important agent of socialization.

In summary, the **market model**, where the government plays a very minor role in the vocational training process, practised also in some other countries, besides Japan, has the following characteristics:

- The market model determines the quantity of qualified training. Vocational qualifications are provided according to demand. Demand is determined by the customers, i.e. the enterprises.
- The type of qualification is determined exclusively by its presumed application in the enterprise.
- In the market mechanism of vocational qualification, the potential customers provide training themselves and control the results.
- In this case, training is financed by the customers, i.e. the enterprises. It is usually related more to productive than to pedagogical principles (on-the-job training).
- Providers of vocational training select their trainees, providing equal opportunities.

2. In the second model, known as **school** or **"bureaucratic" model**, the government is the sole authority responsible for the planning, organization and control of technical and vocational education.

This model is implemented in FRANCE, ITALY, SWEDEN, and in many "Third World" countries, as well as in some socialist countries. All school-based systems of technical and vocational education are similar to a great extent in structure and origin. Their special feature is a graded vocational school system closely linked with general education, which in the "developed" countries is provided at the upper secondary level.

Private enterprises do not play a role in such systems of technical and vocational eduction, except in providing places for

students to spend some practical work periods in industries.

However, in some cases the enterprises co-operate indirectly in these systems: in France, for example, the major chambers operate their own vocational schools which are subsidized by the government, but they are required to observe the training rules and regulations issued by the government. A typical example of this system is the SWEDISH system of technical and vocational education. In Sweden, technical and vocational education is a part of the integrated secondary school. About 80% to 90% of the Swedish youth belonging to the 16 to 19 year age group are students in this school system. About 50% of them belong to the vocational stream. At present, about 100,000 students are undergoing a two-year technical and vocational eduction course in Sweden, which could be characterized as follows:

* The system of technical and vocational education consists of three branches: education for crafts and industry, commercial education, and domestic education.

* Education for crafts and industry is organized at three different levels: apprenticeship schools, vocational schools and technical schools.

* The apprenticeship schools are occupying eight to twelve hours a week over two to three years, as a complement to the practical component of the technical and vocational education, organized in workplaces.

* The vocational schools are organized as voluntary schools for those who want a further education in vocational theory related to their own jobs. The curriculum of some local community vocational schools comprises vocational theory and general knowledge.

* The technical schools are organized without reference to the apprenticeship schools and the vocational schools. In their funding and their curriculum, these schools are very similar to secondary grammar schools.

The technical and vocational education of this second model, practised in some other countries, is more or less similar to the Swedish system of technical and vocational education.

In summary, the so-called **"bureaucratic" or "school model"**, in which the government plays an important role in the vocational training process, could be characterized as follows:

* The quantitative relations between qualification requirements and technical and vocational education are determined by public planning authorities.

* The type of vocational qualification is not primarily determined by practical work situation, but usually also takes account of individual and social requirements.

* Planning, organization and control of the process of technical and vocational education are determined to a great extent by bureaucracy; the implementation of the related universal principles tends to guarantee the provision of systematic training, strongly influenced by teaching theory.

* School-based technical and vocational education is financed from public funds.

3. In the third, so-called **"Co-operative model"**, the government provides a more or less tight framework for technical and

vocational education in private enterprises or other private training institutions.

This system, which is in fact a government-controlled market model, is also popular as **"dual" system**. It can be found in Germany, Switzerland, Austria, Singapore, Brazil and some other countries.

These systems are called "dual" because two places of learning, namely private enterprise and government-supported vocational school, co-operate with the common air of providing the trainees with vocational qualifications. In some cases, however, like in the South American countries, the dual system of technical and vocational education, may involve inter-company training centres as the second place of learning, these centres are financed by the enterprises as a whole.

In Germany, for example, where about two thirds of all 16 to 19 years old obtain their vocational qualification in the dual system (enterprise and part-time vocational school) usually the government is responsible for curriculum, finance and control, and only indirect control of technical and vocational education is executed by industry's self-government bodies (chambers); and some individual financing is provided by the enterprises; while the design and recognition of vocational qualifications (recognized occupations) is largely regulated by the government.

Another typical example of the "dual" system involving inter-company training centres, could be illustrated by the Brazilian National Industrial Apprenticeship Service, known under its acronym SENAI, which was introduced in 1942. SENAI provides a few different types of training:

* Vocational apprenticeship (training of skilled workers, by theoretical and practical programmes for the 14 to 18 year age group).
* Vocational qualification training, which may have variable duration, dependent on the type of trade involved, intended for preparing skilled or semi-skilled workers).
* Vocational qualification (training provided at the secondary level, whose programmes entail general education and special training components, for preparing technicians and assistant technicians).
* Training of technologists (carried at a tertiary level, with programmes covering components of both general education and special training).
* Vocational training intended for workers of the various vocational categories, whose training involves a limited number of operations and takes a relatively short time.
* Vocational upgrading and vocational specialization (This process enables a worker in a particular trade to acquire in-depth knowledge in a particular part of the range of activities involved in his occupation).

Having observed a few typical examples from various countries, however, we must bear in mind that the different types of training and work organization are part of different cultures, each with its specific historical background and its own network of individual and social values. Therefore, it would not be appropriate to compare the systems by analyzing their advantages and disadvantages, trying to establish the superiority or inferiority of the one system vis-a-vis the other. One can hardly find suitable solutions for improving his own national system by looking at other systems.

Teaching the Applications of Mathematics in Science and Engineering: A Theoretical Perspective

OKOLIE, T.O.

ABSTRACT

This paper discusses two views on the teaching of applications of Mathematics in science and engineering - the "minimalist" and the "maximalist" views. The paper started by reviewing the general applications of mathematics in various disciplines. It is the contention of the author that while these two approaches have their advantages and limitations, a necessary environment should exist in our institutions of higher learning to try them out.

Introduction

Mathematics has been described as the "language of science" (Obi, 1987), the "gate and key of sciences" (Abiodun, 1987), "essentially a language which discusses, powerfully, quantity and logical relationships" (Rivett, 1980:429), "the study of all structures whose form can be expressed in symbols; it is the grammar of all symbolic systems" (Black, 1954:4). These statements point to the importance of Mathematics in the present day technological and scientific society in which we live. In the words of Professor R.F.A. Abiodun, a distinguished Professor of Mathematics in Nigeria when he quoted Francis Bacon (1561-1626) and Roger Bacon (1214-1292):

* "for many parts of nature can neither be invented with sufficient subtlety, nor demonstrated with sufficient perspicuity, nor accommodated unto use with sufficient dexterity without the aid and intervention of Mathematics" (Francis Bacon).
* Neglect of Mathematics works injury to all knowledge, since he who is ignorant of it cannot know the other science or the things of this world. And what is worse, men who are thus ignorant are unable to perceive their ignorance and so do not seek a remedy" (Roger Bacon).

The importance of Mathematics, therefore, need not be over-emphasized. Lassa (1981:21) wrapped up the importance of Mathematics in the following words:

> "There is no disagreement today, nor will there be in the foreseeable future - on the vital importance of Mathematics, both to the scientist, engineer or other specialist and to the intelligent layman in his everyday life".

It is on the foregoing background that the teaching of the applications of Mathematics in science and engineering will be examined. In these areas, most problems are couched in expressions with mathematical toga. It takes the mathematical fore-sight and

hind-sight of a student to untie the mathematical strings encasing these ideas in order to be able to transform them into a language that is intelligible to him or her. In this way, he or she can then visualize the various dimensions and ramifications of a problem and thereby devise means on how to and where to start in tackling it. This, though, is not a mean job for many a student. Some teachers of Mathematics share the blame for these lapses. They teach mathematical topics in science and engineering without emphasizing its usefulness and relevance so much so that students fail to get the import of their teaching. The foregoing observations necessitated this paper.

Basically, the paper reviews some of the general applications of Mathematics so as to have a proper perspective on which to base our discussions, examines the approaches for teaching the applications of Mathematics in science and engineering, and lastly takes a look at the implications of the controversies raised for Mathematics teacher's preparation.

General Applications of Mathematics:

It is a general agreement among Mathematicians (and others who are so inclined) that Mathematics instruction in the present scientific and technological era should be geared toward generating interest in the subject and providing a solid foundation for everyday living; making learners develop necessary competencies in problem-solving, computational skills, estimations and approximations, a desire and ability to be accurate to a degree relevant to the problem at hand, and computer literacy; and development of mental faculty.

Mathematics, therefore, has a wide application in many areas of knowledge. Authors such as Ibebuike (1986); Lighthill (1980); Hodson, Kendall, and Tautu (1971); Harrison and Boyce (1972); Bailey (1975); and Riggs (1963), to mention but a few, have treated these areas so well. It appears worthwhile reviewing some of these applications. The summary here draws heavily from that of Ibebuike (1986). These applications include the following:

1. The primitive man used the knowledge of Mathematics to keep record of the number of his domestic animals, to design his tools and to do his paintings which have mathematical bearings on the walls of his caves and other forms of his early homes.

2. Mathematics was used for curative medicine and bringing fortune: In ancient China and India, wearing stones or ornaments engraved with magic squares were thought to have mystical powers. In Middle Ages, it was used in parts of Europe to drive away diseases and bring fortune.

3. Mathematics is used in the study of sciences and social sciences; Physics, Chemistry, Engineering and technology, Architecture and Surveying, Medicine and allied courses, Statistics, Social sciences courses (such as Economics, Geography, Finance and Accountancy).

4. Mathematics is used in the study of arts;
For instance:

   (i) **Philosophy:** The language of philosophy is logic and logic is

a branch of Mathematics. Even the word "philosophy" was said to have been first invented by Pythagoras, a Mathematician.

(ii) **History:** Keeping records in History applies Mathematics, eg. Nigeria got her independence in 1960. In Archeological studies Mathematics plays most important role for it helps to tell the age of excavations. This process of finding the age of these excavations is called "Carbon dating". (See no.9).

(iii) **Law:** Logic which is the most essential ingredient of law is a branch of Mathematics. Logic - the science which directs the operations of the mind in the attainment of the truth was introduced by Zeno the Stoic about 3000 B.C; but the history of logic is associated with Aristotle (384-322 B.C.) who laid the foundations of the science by treating logical questions separately from other parts of philosophy.

5. Mathematics has been used to develop computer science. The use of computers in the modern day world is both fascinating and intriguing.

6. Mathematics is used in Aeronautics. The use of compass and the general mechanism of controls, take-offs, landings, heights and piloting of air crafts, make great use of knowledge of Mathematics.

7. In Business and Industry, Mathematics has a wide application. Linear programming, another branch of Mathematics is widely used here. By this method one can know in advance from a given supply of raw materials the maximum or minimum number of each item of the products so as to maximize or minimize profits.

8. Mathematics is used in Astronautics (i.e. space technology and travels). Generally, all successes of space journeys and ventures depend mostly on the fitness of Mathematics involved in

(i) control of Rockets and Sputniks;

(ii) angle of firing rockets and satellites;

(iii) time of landing on the planet (e.g. moon);

(iv) position of the locus of the moon, say, at the time of landing.

9. Mathematics is used in Radio-Carbon Dating (RCD) which has been used to find the age of the Earth. The following illustrates how to do this: Let a be the quantity of a radio-active element (e.g. Uranium 235-238) and x be the quantity that decays in time, t, then the formula

$$\int \frac{dx}{a-x} = \int k dt$$

is used to calculate the half life period of the radioactive element. This formula is also used in determining the age of rocks, a factor which of great importance in prospecting for petroleum.

10. Mathematics inculcates self-discipline in people who study it.

Teaching the Applications of Mathematics in Science and Engineering:

The world of today places much emphasis on the balance of theoretical and practical knowledge in solving our everyday life problems. This approach is needed in science and engineering, for according to Lowe (1982:137):

> "It has long, if not universally, been recognized that engineering, for the most part, is a problem-solving activity with the 'good' engineer being traditionally recognized by his ability to solve problems. The idea that engineering may be considered as a single activity, however, is carrying simplification to the extreme and, in practice, most engineering activities are broken down into easily definable subdivisions, and even sub-subdivisions. Examples of such subdivisions would be design, research, development, production and marketing. Each of these functions itself could be described as a problem-solving activity. Traditionally each activity has developed its own techniques for dealing with the types of problem, which it usually faces".

Special skills and techniques therefore, are needed in both science and engineering. Mathematics provides such skills-computational, problem-solving, prediction, etc.

Most often, our students are heard complaining openly that they cannot make out the relevance and practicability of some of the topics in Mathematics they are meant to "memorize and pour down for teacher on demand". This phenomenon poses a concern for those who are interested in the relevance and functionality of the mathematics we teach and learn in schools.

Considering the different backgrounds, biases, and the inclinations to want to learn mathematics, and subject specializations of these students (in sciences and engineering) it becomes necessary that students should be made to "see" the relevance and utility of what they are taught. In recognition of these factors, two approaches have been found to yield good results in teaching and learning the applications of Mathematics: the "maximalist" and the "minimalist" views. The maximalist view postulates that we introduce applications through mathematical models that solve a significant real world problem. The minimalist view suggests that we can enrich mathematical topics with problems that come directly from science and engineering. These problems are derived from actual experiences and by going through the literature to search for them and simplifying them appropriately for the understanding of the student. In applying the maximalist approach, Pinker (1978) points out that the Mathematics teacher faces educational and organizational problems such as:

1. Most students have a poor background in the sciences to appreciate the applications.
2. They (teachers) are not trained to be able to teach confidently applications drawn from a wide spectrum of disciplines.
3. Some applications require equipment and demonstrations.
4. Significant applications require much time.
5. Significant applications require a number of mathematical skills which

are normally attained at the end of the mathematics programme; and

6. The spectrum of interests in an average group of students is so diverse that it is impossible to provide examples of meaningful applications for each.

The minimalist approach has its own problems and promises. Basing his views on actual classroom engagements Pinker (1978) concludes that such problems derived from actual experiences (arising from science and engineering) when expressed in "word problems" is "probably the most practical vehicle for demonstrating the relevance of each major mathematical topic under discussion" but caution that in formulating such problems teachers must realize that:

(a) the students are in particular interested in, and will be motivated by word problems which are relevant to the discipline of their choice;

(b) word problems can be utilized for acquainting the student with facts in the discipline of his choice, and they should, therefore, contain real datas;

(c) the relevance of the word problems must be apparent to the student without additional explanations, or with a minimal amount of explanation;

(d) the background knowledge should not be such that it requires research, but rather can be assumed to be known to the student or easily acquired in a short time; and

(e) the problem should contain a reference (if selected from relevant literature) allowing interested student to pursue further the implications stemming from the posed "word problem".

Summary and Conclusion

The two approaches to teaching the applications of Mathematics - the minimalist and the maximalist views have their promises, problems and limitations. This leads to the assumption that no one of them is a better approach to be adopted, at least in theory. There is a need to find a habitable region between them and if need be outside them. We therefore call for a reconsideration of the objectives, content, methods and means, and evaluation of the training or retraining of teachers of Mathematics to bring them in tune with the realities of modern scientific and technological age. Drastic changes are needed in the entire curriculums of most of our schools. Adequate environments for exploring the two methods outlined in this paper, therefore, seem worthwhile. Students, on the other hand, need to be trained to be the architects of their fortune by making it possible for them to search for relevant and necessary information and knowledge through guided observation, enquiry, and experimentation. There is therefore a considerable utility in the view expressed by Annie Alexander Selden that:

> "Mathematics is not a spectator sport", that one cannot sit on the sidelines and watch, but rather one must do it to learn it. By **doing it** I mean not only the ability to solve problems by selecting

an appropriate known technique or algorithm, but also, and more importantly, the ability to create new mathematics, to provide original insights into problems", (Seldon, 1981:42).

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Science and Technical Education: The Pivot for Cultural Advancement; The Nigerian Situation

UGOCHUKWU, C.A.

ABSTRACT

Science and Technical Education is the medium through which various cultures interact. The commonest area of interaction is agriculture which affects other aspects of national life. In the Nigerian case, Science and Technical Education affect the oil industry which is the main source of revenue to the country. And because of the serious need for technical education for industrialization and development, the new education system-the 6-3-3-4 was introduced.

Introduction:

Science has been widely acclaimed by all people of varied cultural backgrounds the world over. The growth of science between 1500 and 1800 has been recognized as the era of Scientific Revolution. Contemporary historians believe that the unfolding of scientific thought during the above mentioned period was critical in the creation of modern civilisation. This belief, which has been reached recently, is itself the result of the powerful impact of science on the life of our generation. In this era, we find in our conflicts and aspirations a continual and growing involvement of science, men live in fear of destruction by the innovations of Science. On the other hand, there is hope of improved living standards through the application of science in agriculture, medicine, engineering and other areas of human endeavour.

Often times, there seems to be an overlap in the meaning of Technical education and Technology. In the context of this paper, Technical Education can be defined as "that aspect of education which leads to the acquisition of practical and applied skills as well as basic scientific knowledge". Technology according to Mkpa (1987), is thus:

> human undertaking, through trial and error and thought, the utilisation of the accumulated scientific knowledge to produce gadgets and procedures to do or make something.

From the above definitions it becomes clear that they all have their intersection as scientific knowledge. The technologist who is the product of Technology invents the models, techniques and skills, the technician who is the product of Technical education, acquires the skills for production. The

Scientific knowledge is universal while the technical education and technology tend often to reflect the cultural background. Hence the scientific knowledge is the unifying factor of all the technical education and technologies the world over. At this juncture, it becomes necessary to know a little bit of what culture is all about. According to Elkin/Handel (1972):

> A culture is a way of life developed by a people in adaption to the physical and social circumstances in which they find themselves. It tends to be passed on from generation to generation, but it changes as circumstances change. It includes some elements that are highly valued by the people themselves and other elements that are accepted as necessary or "realistic" adaptations but are not especially valued.

The important thing is that culture is a way of life of a people, passed from generation to generation and changes as circumstances change.

Science and Technical Education:

Prior to Nigerian independence in 1960, Science and Technical education were not adequately emphasized. The grammar school which was imported by the colonialists dominated the scene of the educational system. There were very few technical schools and those who attended them were looked upon as people with inferior education or people with lesser academic ability

> Government deplores the general public attitude which regards technical education as inferior to other types of education.

In the grammar schools the study of science was not seriously encouraged. The effect of this situation was that after independence, the economy of Nigeria was over dependent in the hands of foreign technicians and experts. This in no little measure contributed to the slow pace of economic development and industrialisation. But much sooner after independence when the mantle of leadership was in the hands of Nigerians, the educational system was reviewed and high emphasis was placed on science and technology.

According to the Nigerian National Policy on Education,

1. A greater proportion of education expenditure will be devoted to Science and Technology; and

2. Universities and other levels of the education system will be required to pay greater attention to the development of scientific orientation. To this end, more colleges of Technology and Polytechnics will be opened in a bid to improve technological and science Education.

Sequel to this, the ratio of science to liberal Arts students in our universities has been fixed at 60:40 during the Third National Development Plan period - 1976 to 1980. There are about five types of technical education institutions outside the universities:

1. the pre-vocational schools
2. the vocational schools

both at post primary level

3. the technical colleges
4. the Polytechnics
5. College of Technical Teacher Education,

at the post secondary level

The aims of technical education among other things will include:

(a) to provide manpower in applied science, technology and commence, particularly at sub-professional grades;

(b) to provide the technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development;

(c) to provide people who can apply scientific knowledge to the improvement and solution of environmental problems for use and convenience of man;

(d) to give an introduction to professional studies in engineering and other technologies;

(e) to give training and impart the necessary skills leading to the production of crafts-man, technicians, and other skilled personnel who will be enterprising and self-reliant, and

(f) to enable our young men and women to have an intelligent understanding of the increasing complexity of technology.

In pursuance of these objectives, the Federal Government of Nigeria, set up a board, known as the National Board for Technical Education (N.B.T.E.). This body is charged with the responsibility of maintaining standards, supervision of manpower and equipment requirements especially in the last three types of institutions at the post Secondary level. This is usually carried out through the process of accreditation visits to the institutions.

Agriculture and Culture:

Every culture has an agricultural system for which it is known. This includes, the type of crops, the implements in common use and of course all these are dependant on geographical factors. But with the knowledge of science and technology, it has become possible for people to adapt to agricultural systems other than their culturally inherited ones.

In Nigeria, for example, the main food crops for Southern part of the country, include yams, cassava, cocoyam and maize while in the Northern part of the country, you have rice, beans, soya-beans, potatoes, onions and groundnuts. The knowledge of science and modern agricultural techniques have made it possible to grow these crops interchangeably and at all seasons with the application of irrigation. The subsistence farming is now greatly giving way to mechanised farming with government heavy investments in agriculture to meet up with the high demand for food to match the teeming population. On the other sectors of agriculture, like animal husbandry, a lot of advancement has taken place.

All these are aimed at averting the warning of Food and Agricultural Organisation (F.A.O.) on the imminent spectra of hunger, starvation and famine on the Black African Continent if African Governments fail to concretise their agricultural food production programme. It is now possible not only in Nigeria, but the world over, for people to prepare dishes outside their cultural menu. This in a way is a form of cultural advancement.

Technical Education and the Nigerian Oil Economy:

Nigeria is a country that is highly blessed with abundant mineral oil resources,

especially the petroleum. It would be stressing the obvious, if one says that the knowledge of technical education is indispensable in the oil industry. This is so because technical education is highly rooted in Science.

According to Mkpa (1987):

> Science enables man to understand nature in its various aspects, and technology enables man to use organised knowledge to tame and exploit nature.

The Nigerian oil industry was for so many years manned and exploited by foreign entrepreneurs through their technicians and technologists. That was why after several years of oil operations in Nigeria, the technology of the oil operations and industry still remained foreign because of institutional inadequacies and lack of co-ordinated manpower development policy. The foreign entrepreneurs of the oil companies were not interested in developing indigenous experts. Most problems in the oil fields arising from the oil operations were solved by seeking advice from their home government, and in more serious cases, flying down experts from their home offices. In realising the obnoxious treatment and policy of the foreign oil companies, Nigeria drew up the Petroleum Decree in 1969 to force the oil companies to train Nigerians to man the industry. In addition, to help improve the situation in training Nigerians in the oil industry, the Third National Development Plan (1975-1980) made provision for a sum of five million naira to be spent on manpower training during the period. Another special Fund (Petroleum Training Development Fund) for training Nigerians in Oil matters in universities at home and abroad was established. One would not be surprised at the huge investments and profound interest the government has on the oil industry. This has to be so because after the civil war in Nigeria in 1970, the crude oil from petroleum became the dominant revenue earner for the country. For example, the price of Nigerian crude oil was at $3.56 per barrel by January 1, 1973. By October 20, 1973, the price has attained a height of $8.31 dollars. By January 1981, the price has reached $40.00 a barrel. But the oil glut of 1981 forced down the price to $36.50 dollars per barrel. The table below shows the revenue that accrued to the government between 1958 and 1980.

Year	Million Naira (N)
1958/59	0.2
1959/60	3.4
1960/61	2.4
1961/62	17.0
1962/63	17.0
1963/64	10.0
1964/65	16.0
1965/66	29.2
1966/67	45.0
1967/68	41.8
1986/69	29.6
1969/70	75.4
1970	176.4
1971	603.0
1972	735.0
1973	1,368.6
1974	4,184.0
1975	4,568.0
1976	4,834.0
1977	6,299.2
1978	5,183.7
1979	10,433.1
1980	13,123.4

From the figures above, it became clear that the 1970's was the golden era of Nigeria when their life style changed because they had a lot of money to spend. For the impartial observer, it will seem as if the revenue was not properly invested, hence the present economic crunch in the country.

Technical Education and the 6-3-3-4 education System

The 6-3-3-4 education system means six years primary school, three years junior secondary, three years senior secondary and four years university education. This system of education came into operation in September 1982. It is a bold step to practicalise education and brings to focus technical education for self-reliance. The system lays serious emphasis on technical education and technology, especially the introduction of Introductory Technology in the junior secondary schools. Still in support of the development of technical education, the Federal Government created the ministry of Science and Technology, the National Board for Technical Education (N.B.T.E). The new system of education also has provisions for assisting the development of crafts and trades. The 6-3-3-4 education system aims at reducing the unemployment problem in the country if properly implemented. For example, the products of the system who learnt some crafts or are technically trained in fields like electrical/electronics, automobile mechanic, shoe-making, cabinet making, metal work, engineering et cetra, who cannot get job with any establishment, can open up their own workshop and be self-employed. This is the advantage the technical education has over literary education. Technical education is the answer to the nation's economic, industrial and technological development.

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Present Trends in Technical Teacher Education in the Arab states

HASHIM M.S.ABDUL–WAHAB

ABSTRACT

In the last two decades, all the Arab states have witnessed a great increase in the demand for skilled and technical manpower to meet the needs of socio-economic development. Consequently, the considerable and continuing expansion in technical and vocational training that has taken place recently has resulted in an urgent demand for technical teachers of all types and specializations. It has emphasised the need to institutionalise and develop more rational methods of technical teacher training, compatible with the available resources of the Arab states and in line with modern educational trends.

In this study, a review is made of the demands for and problems and methods of training technical teachers in the Arab states. Special reference is made to the attempts made to meet the needs of educational and industrial development. Selected case studies are also included for the integrated approach to training from three Arab states, namely Iraq, Tunisia and Morocco.

Introduction

In the last two decades, all the Arab states have witnessed a great increase in the demand for skilled and technical manpower to meet the needs of social and economic development. As a result of the rapid economic change and transformation, considerable expansion in technical and vocational education and training has taken place in recent years. However, despite this expansion the proportion of such education continues to be significantly small in most of the Arab states, in comparison with general and academic education.

The need for continued qualitative development as well as quantitative expansion of technical and vocational education has resulted in an urgent demand for technical teachers of all types and specializations. It has emphasised the need to formalize and develop more rational but realistic methods of recruitment and training of technical teachers compatible with the available human and material resources in each of the Arab states and in line with modern educational trends. However, the complex requirements for the selection and training of such teachers are serious problems in all developing countries. It has received, and continues to receive, considerable attention at national, regional and international levels. For example UNESCO has made persistent efforts to highlight the importance of this problem culminating in the adoption in November 1989 of the 'Convention on Technical and Vocational Education'.

From the early seventies, the trend in some of the Arab states was to adopt the integrated approach to the training of technical teachers; and specialised technical teachers training colleges were started. Various attempts to develop adequate and

flexible methods for the basic training of technical teachers, as well as methods of continuing education and training are currently being pursued.

In this study, a brief review is made of the demands for and methods of training technical teachers in the Arab states. Special reference is made to the attempts to meet the changing needs of educational and industrial development. Selected case studies are included for the integrated approach to training from three Arab states, namely, Iraq, Tunisia and Morocco.

The Need for Technical Teachers in the Arab States:

The Arab region, which is made up of 22 states, covers about 14 million square

Table (1): Summary of basic data of education in the Arab states.

	State	Population $\times 10^6$	First level $\times 10^3$	2nd. level $\times 10^3$	3rd. level $\times 10^3$	Vocational education	Technical education
1	Jordan	3.66	531	339	63.1	31,493	37,223
2	U.A.E.	1.38	165	68	7.6	638	500
3	Bahrain	0.41	58	–	4.2	7,710	2,169
4	Tunisia	7.23	1,327	459	40.8	79,354	4,732
5	Algeria	22.42	3,635	1,999	154.7	98,300	13,678
6	Djebuti	0.46	25	7	–	1,877	–
7	Saudi Arabia	12.01	1,460	654	130.9	12,302	11,496
8	Sudan	22.18	1,738	557	37.4	25,610	3,796
9	Syria	10.61	2,159	912	174.9	56,664	39,328
10	Somalia	4.76	194	44	15.7	7,154	283
11	Iraq	16.45	2,921	1,179	157.8	139,296	41,964
12	Oman	2.00	198	54	2.2	2,989	1,632
13	Palestine	2.00	129	43	15.0	1,816	5,706
14	Qatar	0.33	43	22	5.3	856	310
15	Kuwait	1.79	176	246	23.7	854	7,319
16	lebanon	2.71	329	287	77.1	37,036	1,238
17	Libya	3.74	789	341	44.9	28,363	3,080
18	Egypt	49.61	6,214	4,827	899.6	877,399	97,847
19	Morocco	22.48	2,228	1,281	166.8	16,408	27,260
20	Mauritania	1.15	151	38	4.8	2,002	1,217
21	N.Yemen	7.05	907	135	12.6	2,193	–
22	S.Yemen	2.36	294	35	7.2	4,341	2,997
	Total	197.59	24,827	12,567	2,046.3	1,434,652	303,775

Source: Unesco Stational Yearbook 1988 and Abdul-Wahab and Al-Ausi (1989)

kilometers and has a population of about 200 million. The total number of students in all the Arab states has risen to about 25 million at the primary level, 12.5 million at the secondary level and over 2 million at the third level, as shown in Table (1). Universal compulsory education at the primary level has been implemented in most of the Arab states, and compulsory education is expected to be extended to age 15 by the year 2000. Nevertheless, illiteracy is still high in some of the states, estimated at about 40% on an average.

Vocational education has expanded rapidly in the last two decades with over 1.4 million students. This represents 31.8% of the upper secondary level compared with a ratio of 5%-10% in the seventies. The rate of development, as is to be expected, varies in the Arab states, with the ratio of vocational education being as high as 56% in Bahrain, 55% in Egypt, 34% in Iraq and as low as 0.5% in Kuwait, 55 in Qatar and 6.4% in Saudi Arabia. The general trend and policies adopted in some states is to exceed the 50% distribution ratio students between the general and vocational education at the secondary level, with some states aiming for a 70% ratio before the year 2000.

Technical education at the post-secondary level, which was unknown in most of the Arab states in the fifties and sixties, has developed rapidly in recent years. At the present time, with student enrolment of over 300,000 in 326 technical institutes, technical education forms about 15% of higher education. The trend is also to increase further the number of students in this type of higher education and regulate or even reduce the pressures of social demand for admission to the over-crowded universities. A ratio of 1:2 of university: technical education admission has already been adopted in some cases (for example: Iraq and Egypt). Table (2) gives the change in enrolment at the various levels of education between 1982 and 1986.

Technical teachers are needed to work in technical institutes, vocational schools, industrial training centres and in the general secondary schools or comprehensive type of schools where elementary skills are introduced. There are two main categories of

Table (2): Development of student enrolment at various levels of education in the Arab states.

Level of education	No. of students ($\times 10^6$)		Annual change (%)
	1982	1986	
First (primary)	21.645	25.671	4.65
Second (secondary and vocational)	9.426	12.567	8.33
Third (university and technical)	1.461	2.046	10.0
Vocational education	0.920	1.435	14.0
Technical education	0.195	0.304	13.93

Source: Unesco Stational Yearbook 1988 and Abdul-Wahab and Al-Ausi (1989)

teachers that are usually needed, namely: 'Technical Teachers' for the theoretical and practical subjects and 'Technical Instructors' for the technical skills in workshops and laboratories. The second category is usually trained at special departments of the technical institutes of which there are several in the Arab states. However, the first category is the main obstacle to the efforts to expand technical and vocational education. The shortage of trained technical teachers is evident in all the Arab states, which rely mainly on the recruitment of untrained graduates from the universities. A ratio of students to technical teaching staff of 15:1 is considered necessary and an upper limit in vocational and technical education suggests the need for about 120,000 technical teachers in the Arab states, excluding the needs of industrial and other training centres. From surveys made by the Arab League Educational, Cultural and Scientific Organization and the Arab Federation for Technical Education, this number is evidently not available at present, and extensive reliance on part-time teaching staff of expatriates is still common in several of the Arab states.

It is worth noting that technical and vocational education in the Arab states is not confined to technological or engineering and industry related specializations but cover all other specializations needed by society such as agriculture, commerce and trade, health and medicine, and applied arts and crafts. However, industrial and technological studies have the major share in vocational and technical education usually forming about 50%-60% of the total.

Industrial and Educational Development

In all developing countries such as the Arab states, the educational structure was initially created to meet the need for clerical and administrative manpower in the post-independence era. The need for skilled and technical manpower emerged at a later stage with the advent of industrial development and the impact of the world-wide technological revolution. In the last decades, and especially in the Arab oil producing states, industrial development gained momentum. Petrochemical, light and heavy industries are now wide spread in all the Arab states, and greater emphasis is being placed on improved agriculture, transportation and services.

The movement of the labour force from agriculture to the new sectors of the economy is marked by the continuing drop in the ratio of the labour force in that sector to the total, and a rapid increase in employment in construction, transportation and services. Of the estimated total labour force in the Arab states of 53.5 million in 1986, 21 million (40%) were in agriculture compared with about 70% in the fifties, and 15.1 million (28%) were in industry.

However, the changes that have taken place in the type and distribution of manpower structure and skills cannot be considered an adequate response to the need for new skills in industry. The imbalance in the input to the labour market from the educational systems at all levels, will result in a continued shortage in skilled and technical manpower with a surplus of unskilled and semi-skilled labour and even university graduates in some states. As shown in Fig.1, the estimated input from the educational system to the labour market indicates that the ratio of university graduates (specialists): technicians (post-secondary technical institutes):skilled workers (from vocational schools) is 1:0.35:1

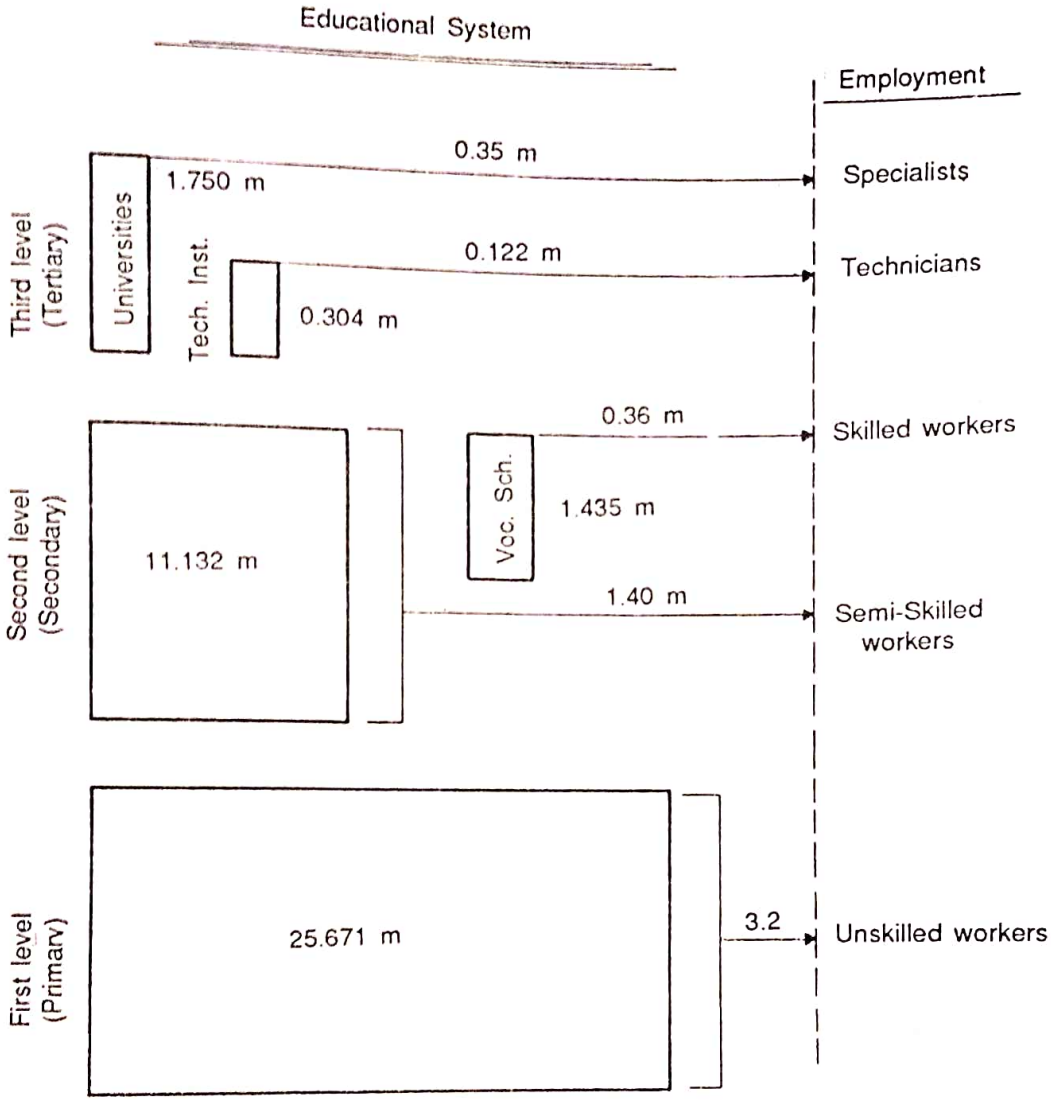

Fig. (1) Education - employment relationship for the Arab states

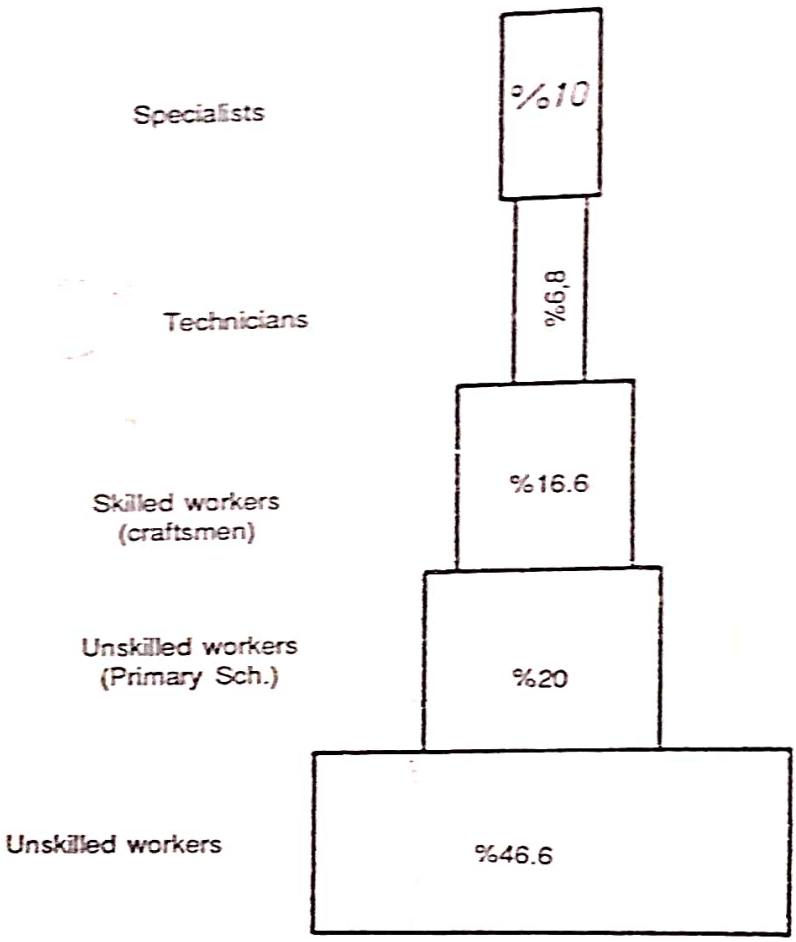

Fig. (2) Typical Arab labour force profile (Iraq 1987)

as an average for all the Arab states. In comparison, the internationally accepted ratio for the efficient running of the economy is 1:(3-4):(20-40). The existing stock of the labour force has a similar distribution with regard to skills. As shown in Fig.2, which is taken from Iraq and is typical, 10% of the labour force are specialists, 6.8% are technicians and 16.6% are skilled workers.

In the field of engineering and technology, the imbalance in the labour force structure is even greater. The ratio for all the Arab states of engineers:technicians: skilled workers is estimated at 1:0.47:0.48. However, and a result of the big drive to expand engineering and technological education during the seventies and eighties, the total number of engineers in the Arab states has risen to over 320,000 with over 100,000 engineering students in the engineering colleges. To put this aspect into perspective, Table (3) and Fig.3 show a comparison between the number of engineers

Table (3): Comparison of engineers in the population and the labour force in the Arab states and other countries.

	Country	Population ($\times 10^3$)	Civilian labour force ($\times 10^3$)	No. of engineers	Eng. in labour force %	Eng. per 1000's of population
1	France	53,962	22,813	265,000	1.16	4.91
2	W.Germany	61,660	26,970	450,000	2.23	7.31
3	Greece	9,707	3,678	27,000	0.73	2.78
4	Italy	57,197	22,610	100,000	0.44	1.75
5	Spain	37,654	13,135	79,000	0.60	2.10
6	U.K.	56,348	25,979	250,000	0.97	4.44
7	U.S.A.	229,905	110,204	1,520,000	1.38	6.61
8	Japan	117,645	57,740	733,000	1.27	6.23
9	Jordan	3,660	378	22,358	5.92	6.11
10	Syria	10,610	2,174	29,756	1.37	2.80
11	Iraq	16,450	3,956	41,842	1.06	2.54
12	Eygpt	49,610	11,037	170,157	1.54	3.43
13	Arab States	197,590	36,077	322,224	0.89	1.63

Sources: Unesco Statistical Yearbook 1988 and Berghe 1986.

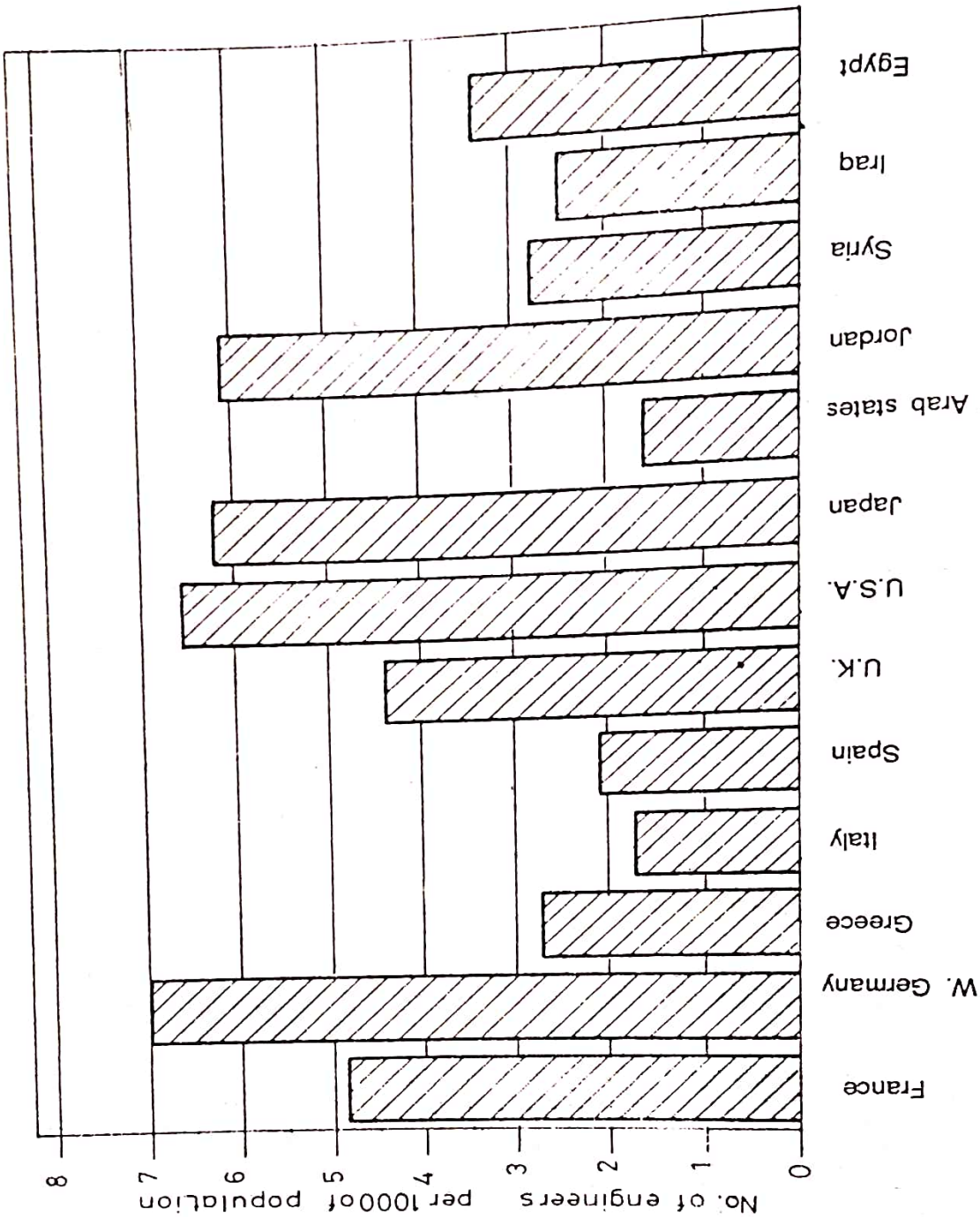

Fig. (3) Comparison of engineers per 1000 of the population in the Arab states and other countries

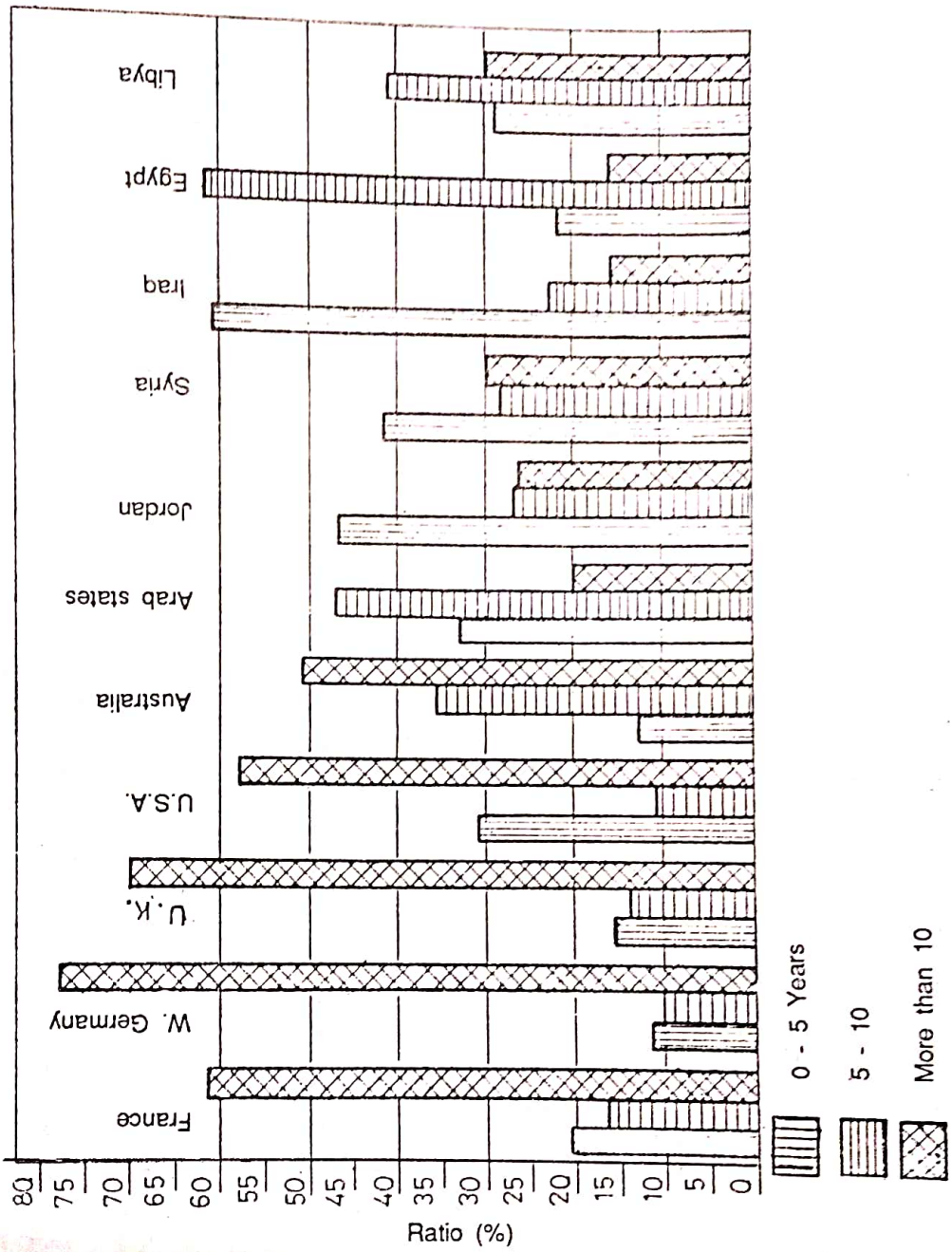

Fig (4) Distribution of engineers by years of experience in the Arab states and other countries

in the total population and the labour force in the Arab states and some other countries. Allowing for the aviation in the distribution of engineers between the Arab states, the average ratio of 0.89% to the total labour force is comparable with that for the United Kingdom (0.97%), Spain (0.60%) and France (1.16%). In some of the Arab states like Jordan, Syria, Iraq and Egypt, there is clear over-production of engineers. However, the shortage of technicians and skilled manpower has meant that a large number of engineers are filling the jobs designated for technicians and skilled workers. This poor utilization of high level manpower has led to greater awareness of the need for urgent measures to expand technical and vocational education and regulate admission to the universities.

The above figures for engineering manpower indicate that technical teachers may be recruited more easily in the 1990's from among university graduates. This may be one solution for the acute shortage in technical teachers, but the problem remain with the quality of and the method of training such teachers. In addition, as shown in Fig.4, the majority (about 80%) of the engineers in the Arab states are young and have graduated in the last 10 years. In comparison, 80% of the engineers in the developed countries have more than 10 years of experience. A good potential for retraining such manpower is certainly available.

Present Methods of Technical Teacher Training

The "job description" for technical teachers include two main functions, one as a "specialist" in his subject and the other as a "teacher". The Unesco's 1974 "Revised Recommendations Concerning Technical and Vocational Education", and the Unesco "Convention on Technical and Vocational Education" of 1989, as well as other studies, give a comprehensive list of training elements that must be provided for the preparation of technical teachers. It is assumed that fully trained technical teachers should have adequate academic and technological knowledge, theoretical and practical, as well as appropriate teaching skills consistent with the type and level of the courses they are required to teach. Experience gained by the teacher with time will enhance his abilities as a "specialist" or as a "teacher" or both.

However, as elsewhere in the developing countries, technical and vocational education lacks teaching and pedagogical knowledge and skills as well as the work experience in their field of specialization. The attraction to work in industry as the new and expanding sector of the economy is far greater in developing countries than to work in the "traditional" profession as "teachers".

Generally, there are two main methods of recruitment and training of technical teachers in the Arab states:

1. The consecutive approach where a young graduate is trained in stages, before and/or during his employment, and is given pedagogical skills as well as work experience in industry in installments. This is by far the most common method in use at the present time. The depth and extent of pre-service and in-service training and continuing education and training that the teacher may be subjected to varies a great deal from one state to the other, depending on the available resources and qualified manpower.

2. The integrated approach where pedagogical studies as well as some practical work experience are included in special training

programmes provided by technical teacher training institutions usually at the university level. This method assumes close cooperation between the authorities responsible for technical and vocational education, as the prospective employer, and the technical teacher training colleges. In the last decade, a clear trend to adopt this approach has become evident in the Arab states, and several technical teacher training colleges have been established.

In either method or their several variations, there are numerous problems that are usually encountered. The early selection of students at the age of 18 to become technical teachers in the integrated approach has a clear disadvantage. There are also complex problems related to the training of students in industry in all the developing countries. On the other hand, technical and vocational education can only expect to recruit those graduates who see education as the last resort for employment.

In some of the Arab states where qualified manpower is in short supply, expatriate technical teachers are employed. The mobility of teachers between the Arab states is one source as well as teachers from other regions.

5. Case Studies on Technical Teacher Training in the Arab States

While teacher training colleges for general education are well established in all the Arab states, technical teacher training institutions (colleges or departments) are still endeavouring to find their place in the educational systems. In the following, three case studies for the training of technical teachers by the integrated approach in the Arab states are briefly discussed. They highlight the efforts made to develop this form of higher education and the problems faced due to various educational and socio-economic factor.

5.1 Iraq

The first vocational schools in Iraq date back to 1870, but vocational education did not noticeably develop until 1968. The number of vocational schools has risen from 44 in 1969 to over 300 in 1989, and the number of students has risen from 11,000 in 1969 to over 155,000 in 1989. Most of the students in vocational education are in industrial schools (53%), and the rest in commercial schools (30%), agricultural schools (10%) and health education (7%). The proportion of students in vocational schools to those in the general (academic) schools has risen from 5% in 1970 to 39.3% in 1989, and efforts are being made to exceed a 50% ratio in the near future.

Technical education at the post-secondary level has also witnessed an exceptionally rapid development in the last two decades. The number of students in technical education has risen from about 700 in 1970 to over 52,000 in 1989. The number of technical institutes has risen from 5 to 34 over the same period. Most of the technical institutes have a polytechnical structure, but the majority of students (over 60%) are in technological and engineering specializations, the rest being in commerce and management, health and medicine, agriculture, and applied arts. More than 50% of the admission to higher education is now taken by the technical institutes, and a ratio of 1:3 is aimed for by the year 2000 in favour of technical education.

The need for the formal training of technical teachers in Iraq was recognised as early as 1961 when the Higher Industrial Institute was established in Baghdad with the set aims of training such teachers in addition to training engineers with a more practical orientation. This institute was later changed to the College of Technology and then became the University of Technology in 1975. However, technical teacher training was not started until 1973 when the department of technical education was established.

Initially, two programmes were offered in mechanical and electrical engineering. A third programme in civil engineering was later added in 1977. The duration of study is four years leading to the degree of B.Sc. in technical education. Post-graduate studies leading to the Post-graduate Diploma and M.Sc. in educational technology were started in 1977.

The admission policy to the department has fluctuated over the past 17 years as shown in Table (4). Secondary school graduates from general education (science

Table (4): Students admission in the Technical Teachers Department, University of Technology, Baghdad.

Year	Mech. Eng.		Elect.Eng.		Civil Eng.		Total
	Science	Indust.	Sci.	Indust.	Sci.	Indust.	
1973/74	–	23	–	20	–	–	43
1974/75	60	60	60	60	–	–	240
1975/76	150	–	150	–	–	–	300
1976/77	158	–	188	–	–	–	346
1977/78	35	70	34	68	70	–	277
1978/79	44	60	45	60	80	–	289
1979/80	77	69	82	68	58	10	364
1980/81	109	73	125	67	115	9	498
1982/83	135	20	140	19	67	1	382
1983/84	51	82	64	78	26	9	310
1984/85	-	163	-	161	72	-	396
1985/86	–	106	–	131	69	–	306
1986/87	–	152	–	153	75	–	380
1987/88	–	126	–	140	56	–	322
1988/89	281	31	127	35	–	–	474
1989/90	55	–	41	–	–	–	96

stream) and from industrial vocational schools are admitted to the three specializations. The proportion of students taken from each group has varied continuously, reflecting some of the problems that face this kind of education. Nevertheless, over 2800 technical teachers have graduated from this department so far. Admission to the civil engineering programme has been stopped since 1988/1989 because of lack of employment opportunities at the present time.

The annual intake to the department is usually about 300 students, and the total enrolment is about 1300 students. The number of full time teaching staff in the department is 61, but teaching support is also provided by the other 10 departments of the university.

The integrated approach is used in the training of technical teachers and of the average total contact hours of 3300 about 11% are allocated to pedagogical subjects, as shown in Table(5). Fourth year students must spend 6 weeks of supervised teaching practice in industrial schools. Summer training in industry after the first, second and third year is also required for all students.

In order to train technical teachers in specialization other than engineering, special departments were started in 1975 in the Colleges of Agriculture and College of Management and Economics at both Baghdad and Mosul universities. The training of agricultural teachers, with an annual intake of about 50 students covers six specializations, namely, animal production, food industry, horticulture, plant protection, soil and field crops. Technical teachers for commercial schools are trained in the same integrated approach, with an annual intake of about 50 students to each department. The structure of technical teacher education in Iraq is shown in Fig.5.

It is worth noting that technical teacher training at the university level has not developed as yet in the eastern group of Arab states, except in Iraq. Also, the constant change in curriculum, admission policy, staff and student enrolment highlight the complex problems facing this kind of education in a rapidly changing society.

Table (5): Distribution of contact hours in the curriculum for the technical education department, U.o.T., Baghdad.

Specialization	Mech.Eng.	Elect. Eng.	Civil Eng.
Total hours	3300	3420	3360
Basic science (%)	18.4	19.3	10.7
Eng. subjects (%)	38.9	41.2	44.7
Labs. (%)	24.1	20.3	23.2
General education (%)	9.2	8.7	10.7
Educational subjects (%)	11.1	10.5	10.7

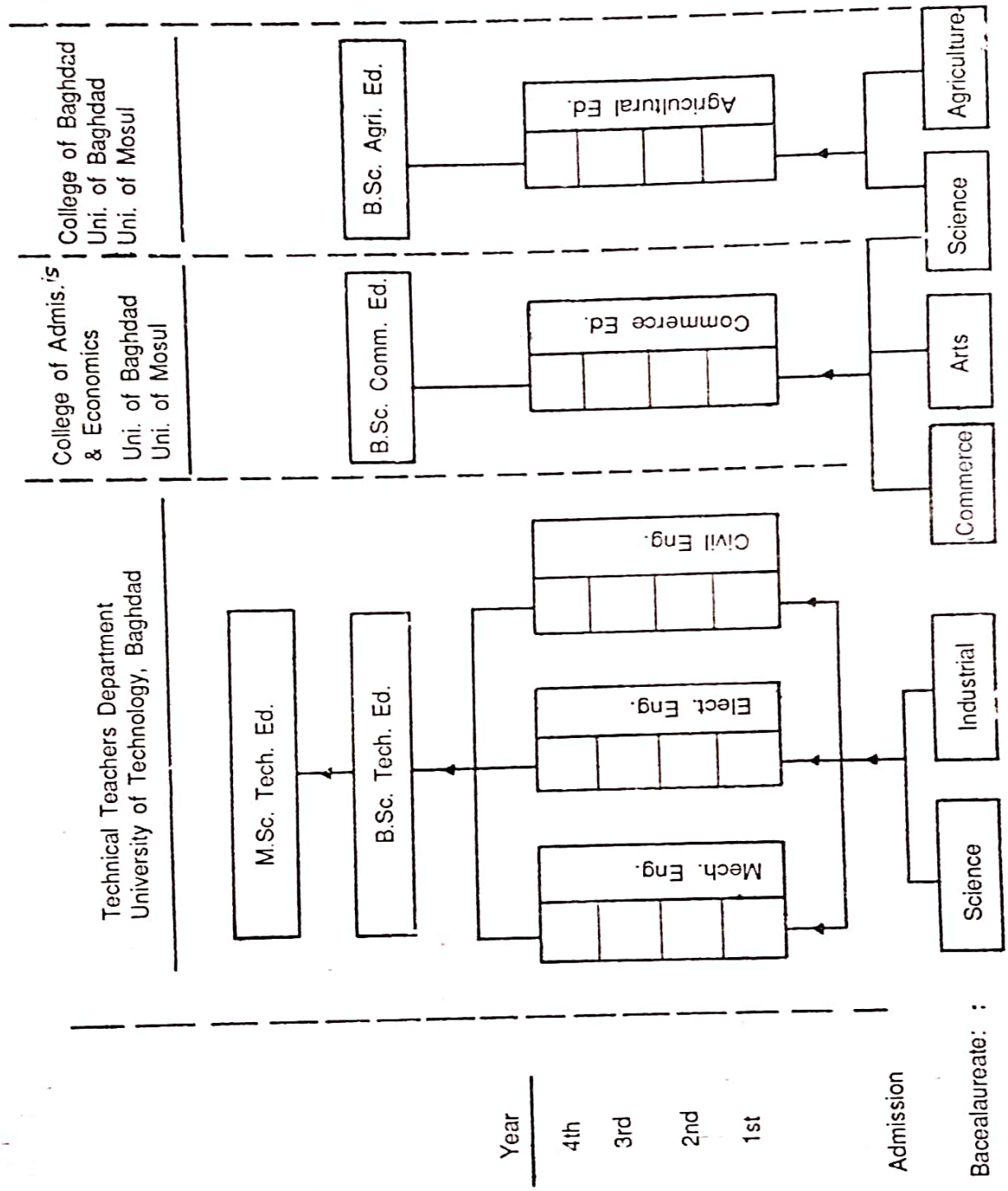

Fig. (5) Educational structure of technical teacher education, Iraq

5.2 Tunisia

Technical and vocational education has developed rapidly after Tunisia's independence in 1956, and in the last two decades in particular. The number of students in vocational education has risen from 22,813 in 1976/77 to 79,354 in 1987/88. Post-secondary technical education has developed also, with more than 5,000 students enrolled in 1987.

To meet the need for qualified technical teachers and inspectors of technical and vocational education, the Ecole Normale Superieure de 1' Enseignement Technique (ENSET) was opened in Tunis in 1973. As part of the University system, ENSET not only offers academic training in engineering specializations but includes required courses in teaching methods and psychology of education. ENSET graduates are all expected to work for the Ministry of Education, having signed a contract to teach for a period of ten years after graduation in return for government financial support while at the teacher training school. In addition, the school offers refresher training courses for teachers and inspectors in technical education as well as opportunities for research in technical education topics. ENSET's academic programmes lead to a four-year degree in electrical or mechanical design, civil engineering and electrical and mechanical manufacturing. As shown in Fig.6, students in the electrical design programme can specialize in applied physics by following a separate programme during the last two years of study. Similarly, students in mechanical/manufacturing or design may select automobile mechanics as their specialization beginning in the third year. Students fulfilling the academic requirements are awarded the Maitrise de Sciences Techniques. Holders of the Maitrise having successfully completed the supervised teacher training programme at a secondary technical school are awarded the Certificate d'Aptitude a 1' Enseignement Technique. Students having completed requirements for both the Maitrise and CDA are then awarded the Diplome de 1' Ecole Normale Superieure de 1' Enseignement Technique.

Post-graduate studies are also offered in automatics and electrotechnics leading to the Diplome d' Etude Approfondies (DEA). The Doctorat de Specialize is obtained by research and normally requires two to three years.

The programme for study for the four year courses follows the integrated approach for the training of technical teachers. The total number of contact hours for qualifying as a teacher is about 3,600 of which 17.5% is allocated to basic science subjects, 72% to technical and specialized subjects, 1.7% to languages, and 8.3% to pedagogical subjects. The curriculum is divided in the ratio of 2:1 between theoretical lectures and practical work in the workshops and laboratories.

The number of students admitted annually is 240, and the total enrollment capacity of ENSET is 1,000 students. The number of full-time teaching staff is 140 most of whom are Tunisians (60%), with some expatriates (40%). The number of post-graduate students is about 70.

As the enrolment capacity of ENSET at Tunis was reached, a new technical teacher training school was started in 1987 in Nabil (a city located 87 kilometers southeast of Tunis). The new school is fashioned after the Tunis model in structure, organization and degrees awarded, but offers programmes in automobile mechanics,

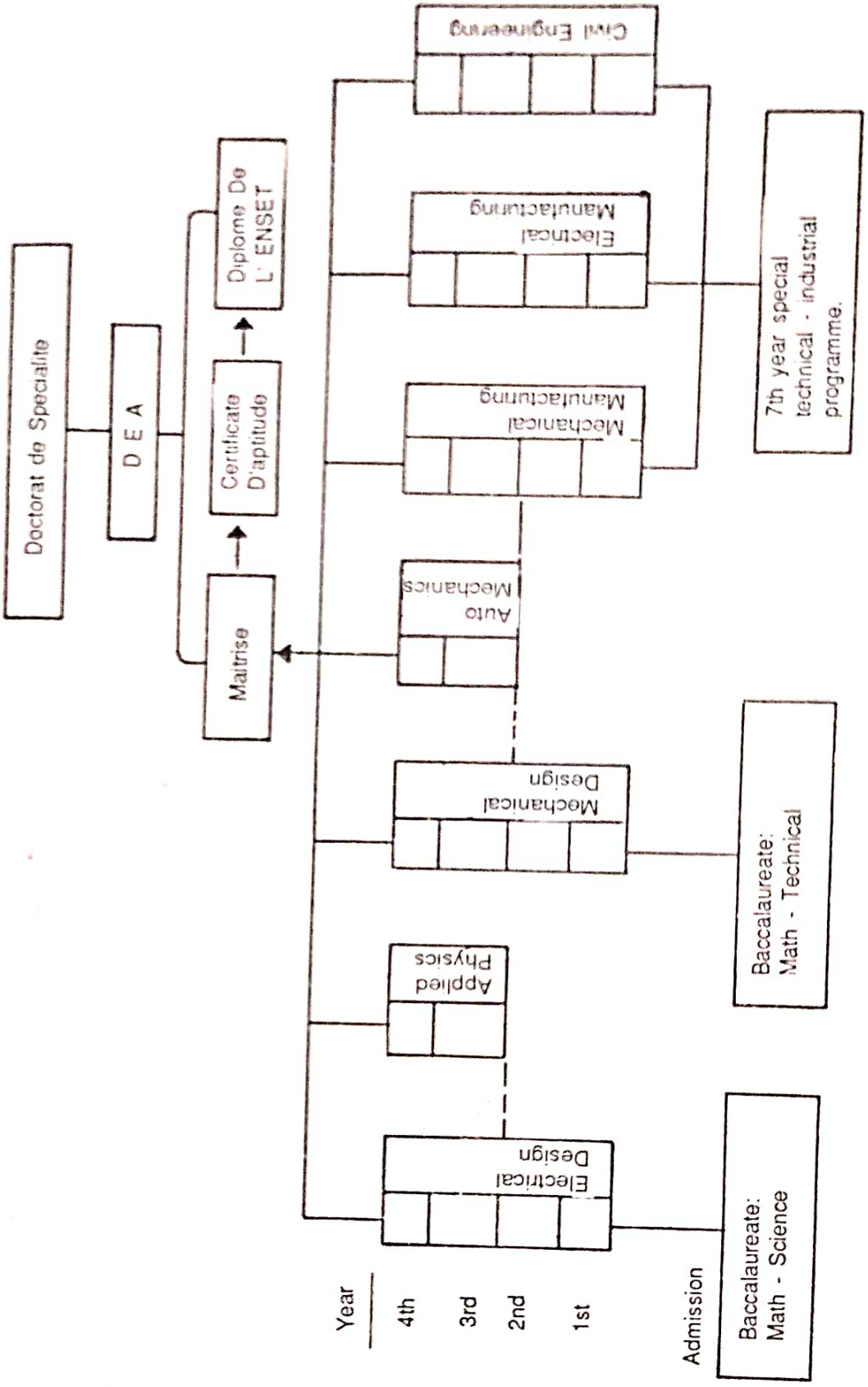

Fig. (6) Organizational chart – ENSET, Tunis

carpentry, construction, metallic construction and clothing manufacture.

It is worth noting that ENSET, Tunis, was one of the first schools of its kind in that Arab Maghreb and Africa and remains a forerunner of technical teacher education in the region. It has assisted in the development of similar schools in Morocco and Cameroun, by providing consultants and advice, training teaching staff, and secondment of teachers under cooperative technical exchange agreements.

5.3 Morocco

Vocational and technical education has developed rapidly since Morocco's independence in 1956. The number of students in vocational schools and training centres was over 34,000 in 1986, forming 11.5% of the total number of students at the secondary level. The number of technical schools and institutes at the post-secondary level, or first (short) cycle university programmes was 46 in 1986. The number of students in technical education has risen from 12,500 in 1980 to 19,500 in 1986, forming 18.3% of the total number of students in higher education.

Vocational and technical education in Morocco relied heavily on expatriate teachers for the technical subjects during the seventies and eighties. To remedy this situation, the ministry of education started in 1980 the "Higher School for Technical Education Teachers" in Rabat, and this was followed by a similar school at Al-Muhammadia in 1985. Two other schools are planned to start at Fas and Marakesh. The planned capacity for each school is 700 students.

The educational structure and organization of the four schools follow the same model as ENSET in Tunis. The school in Rabat offers programmes in mechanical design, mechanical manufacturing, electrical engineering and computer maintenance. The programmes offered at Al-Muhammadia school are mechanical design, electronics, management technology and general technology.

Graduates from the technical teacher training schools are obliged to work for the ministry of education for at least two years. The integrated approach follows the same pattern as in Iraq and Tunisia. Fourth year students must spend eight weeks of supervised teaching practice in vocational schools.

6. Future Trends in Technical Teacher Training

Considering the rapid industrial development in the Arab states and the socio-economic changes that are taking place resulting in the urgent demand for skilled and technical manpower, the following future trends can be outlined:

1. The need for a continuing high-rate of expansion in vocational and technical education in the Arab states will have top priority in the planning for manpower development in the nineties. This will result in an increase in the demand for technical teachers of all types and specializations, but especially in the field of engineering and technology.

2. The recruitment of technical teachers in most of the Arab states will continue to rely on young graduates from the universities. In some of the Arab states sufficient numbers of such graduates may not be available, and these states will continue to rely

on teachers form other Arab states that have a surplus such as Egypt, Jordan, Iraq and Syria.

3. The trend to establish new technical teacher training colleges or departments within the university system will gain momentum. Despite the problems and some disadvantage that are attributed to the integrated approach of training, it has the advantage of ensuring the supply of adequate numbers of technical teachers with good initial preparation.

4. In some of the Arab states where large numbers of university graduates are facing unemployment, the chances are good for attracting sufficiently well qualified teachers. They can be given the additional pedagogical training before entering the technical and vocational education system.

5. Judging from the enthusiastic participation in the activities of the Arab Federation for Technical Education in the past ten years, the need for staff development and training centres is evident in all the Arab states. These centres can provide pre-service and in-service continuing education and training for all the teaching staff and instructors working at vocational school and technical institutes. They can be either independent bodies or linked to the technical teacher training colleges or departments.

6. The complex problems facing technical teacher training colleges will require frequent review and evaluation: in particular, curriculum content and development and the employment prospects for the graduates. The aim of attracting and forming suitable professional teaching staff to work as a closely coordinated team will remain problematic.

7. So far, there has been little distinction between technical teachers working in technical institutes (at the post-secondary level) and those working in vocational schools. With the increase in employment of technical teachers at both levels, a distinction in the qualification and pre-requisite training is gradually developing in some of the Arab states. More elaborate pre-service and in-service training schemes as well as academic up-grading of the teaching staff of the technical institutes will be needed in the nineties.

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A Study on Problems and Issues of Technician Education in the Colombo Plan Regional Countries: Common problems and Specific problems

JIRO YOSHIO

ABSTRACT

This survey study was conducted on behalf of the Colombo Plan Staff College for Technician Education to find out the problems and issues confronting technical education in the regional member countries. The study consisted of three parts, namely questionnaires, K.J.cards and interviews. This paper describes the results of the first part of the series of above mentioned studies. To accomplish the study, a bid allocation type questionnaire was developed and regional associate institutions of the survey. Responding to the request made by the CPSE, 16 countries and 532 people participated in this survey. The respondents indicated that the major common problems facing technical education in the region are:

* *development of appropriate teaching and learning resources including textbook, workbook and laboratory materials*
* *curriculum evaluation*
* *infusion of industrial experience into the curriculum design process*
* *in-service training including industrial training for staff*
* *staff motivation*
* *job opportunity for technician education graduates*
* *planning and organizing of technician institutes and cooperation with other organization including industries.*

Statement of the Problems

Technical education is one of the most effective and powerful ways to develop the qualified manpower in various sectors of the economy and to achieve national development. For this purpose, the Colombo Plan Staff College has been paying utmost attention to support such effort in developing the member countries' technician education systems.

The technician education systems in some of the regional countries may be regarded as well established, but they are still facing many problems, which need to be solved or minimized.

The Colombo Plan Staff College, as a regional cooperative body in technician education, has a vested interest to discover the current situation concerning technician education in the regional countries, so that it can direct the activities of the college with a much sharper focus on relevant problems and issues.

Therefore the primary purpose of the study was to determine the major problems to be solved or minimized in the regional technician education systems. More specifically this study focused on finding out problems in the field of management, staff, students, curriculum and resources. In each field, the issues that were identified by the respondents to be the problems of technician education in the regional countries were analysed and the major results of the analysis are described in this paper.

Methods and Procedures

To accomplish the objectives of the study, an instrument was developed for the collection of data. The strategy for data collection and the method of processing was determined.

Development of Instrument

The design of the instrument was based on exemplary models from a study which was made in 1980 by the same author. Based on the example of the study, the form of the questionnaire was revised from the fish bone type to a tabular format. In addition to this, the questionnaire items were revised, though the areas of the problems remained the same as the previous study. The questions were focused on problem areas of management, staff, students, curriculum and resource. A sample questionnaire is shown in appendix 1.

Bid allocation

In the covering letter sent with the questionnaire form, respondents were directed on how to allocate their points to each item. The direction was as follows;

> "You are given a total of 50 points at your disposal. If you consider all the items equally important you may allocate 1 point to each of them by filling in number 1 in the coded box. But if you have to assign relative weighage to the items you may allocate points in such manner that the sum total of all points does not exceed 50."

Selection of participants and retrieval of questionnaire

The associate institutions of the Colombo Plan Staff College in each country were asked to distribute the questionnaire form within their own country.

The participants were asked to mail the questionnaire back to CPSC after completion of the form.

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Process of data analysis

The data collected was tabulated in a manner designed to facilitate the identification of the view of respondents with

respect to the problems confronting technician education in their country.

The relative frequency percentage of rated point for each section was calculated and illustrated in bar graph. With this bar graph it was quite easy to find out the specific problem area in each country.

Based on the rated points to each item, a Z-score was calculated and dotted in the scatter diagrams of "Z-scores and items" to analyse the common problems in the regional technician education systems. This Z-score treatment was needed because the number of respondents in respective countries was not the same. It was expected that using the Z-score graph it would be much easier to identify the common problems in the regional countries.

Findings

After receiving the questionnaires back from the respondents, the allocated points were processed by a statistical measure. Based on the data from the respondents the following findings have been found:

Respondents

A total of 532 persons from 16 countries participated in this survey. Among these 518 responses from 12 countries were examined in this study. 18 responses from four countries were not included in this study because the number of responses from each country was not large enough to treat in the same manner as the other 12 countries. The total number of valid responses was therefore 500. Singapore had the largest number of respondents with 84 and Sri Lanka the second with 60, and the Philippines the third with 57. On the other hand Indonesia, Korea and Pakistan had the least number of respondents with 20, 18 and 24 respectively. (Although this is rather small sample size, the result has been considered to have no basis.)

To examine the characteristic differences between the job categories, respondents were classified into two groups one administrative and the other teaching staff. The Graph 1 shows the allocation of scores in percent into the five areas (Management, Curriculum, Resource, Staff and Student) by the two groups of respondents. There are some differences on the percentage of allocated point in the five areas between the administrative and teaching staff groups.

In this survey, about a fourth of the scores come from the administrative group which includes the principals and the rest of scores come from the teaching staff which includes the head of departments and the instructors.

Countrywise data

Countrywise relative frequency percentage of allocated points for each item was calculated and illustrated in Graph 2. (In Graph 2, the top five items that received the biggest allocation of scores among the listed items in each country are illustrated.)

When examining the rated scores for each item, it became clear that the top five listed items for each country were allocated more than 3% of total scores that was allocated for the respective country.

The items which were listed as the top five items in the frequency percentage graph shows, "Job opportunity after graduation" appears as the item which was the most frequently listed in the top five items in the regional countries with six counts and "Industrial training for staff" got five counts.

"Development of teaching-learning resources" and "Staff motivation" listed as top five ranking items in each country with four counts. "Curriculum evaluation", "In service training for staff", "Textbook, workbook and laboratory materials", "Cooperation with other organization including industry", "Budgeting" and "Industrial experience in curriculum" got three counts. (The question item "curriculum evaluation" was not included in the format in the previous survey study, carried out in 1980)

It is noted the item "Planning/ organising in management" was not included in the above listed ten items.

Regionwise data

In order to obtain an overview of problems in the region, a z-score was calculated, based on the allocated scores to each item for each country. The itemwise z-score graphs are illustrated in graph-3. (In the z-score graphs, the z-scores were dotted countrywise for each listed item).

Observing the graphs, it might be possible to classify the items into four groups such as:

Group one;	all dots scattered in their plus ranges
Group two;	almost all dots scattered in their plus ranges
Group three;	the dots spread widely from minus to plus ranges, and
Group four;	all the dots scattered in their minus ranges

The z-score graphs show that the items "Teaching learning resources development", "Job opportunity after graduation" and "Industrial training for staff" belong to Group one. The items "Textbook, workbook and laboratory material (Instructional materials)", "Evaluation of curriculum", "Planning and organising in management", "Staff's motivation" and "Industrial experience in curriculum" belong to Group two and items such as "Language problems", "Procurement process", "Staff turnover", "Student dropout" belong to group four. The items which were not mentioned above belong to group three.

There are some items which have rather high scores, with z-score around 3. Those include "Job opportunity after graduation" (Bangladesh) and "Industrial training for staff"(Malaysia).

Items "In-service training for staff", "Budgeting" and "Cooperation with other organizations including industry" are not included in the above mentioned groups.

Data Interpretation

Based on the findings, the following data interpretations were made.

Respondents

The total number of respondents was more than 500. It is a sizable number and bigger than the previous survey study which was made in 1980. However it should be noted that the number of respondents, composition of respondents and involved institutions differ from country to country, and might affect the result of this study. For example, Graph 1 shows, that administrative staff tend to allocate more points to management and curriculum areas rather than student and resource areas, when compared to teaching staff who tend to allocate more points to student and resources areas rather than management and curriculum areas. Another example, "student

dropout" was listed as the item of rather serious problem in Korea with 2.5% of allocation of points. It is guessed that the relatively small number of involved institutions might have caused this result. Actual responses from Korea indicated that the number of participants and the involved institutions were rather limited this time.

Countrywise Data

Since the situation of technician education in each country is not the same, it is understandable that the trend of allocation of scores to the items is not the same. For example, in the case of Bangladesh, as the graph 2 shows, that "Job opportunity after graduation" is listed as the most serious problem in the country, followed by "Curriculum evaluation" and "In-service training for staff" and "Development of Teaching and Learning Resources". But in the case of Fiji, the item "In-service training for staff" and "Internal decision making/Flow of information" appear in the list of the top five item list as well as the item "Development of teaching and learning resources."

In the case of Bangladesh, it is assumed that the economic difficulty of the country affected the matter. On the other hand, in the case of Fiji, it is assumed that the recent political development in the country caused the situation. Like-wise the problems relating to the technician education in the regional countries are different from country to country.

To summarize the result of findings of the items which were listed as the top five problems in each regional country, those items were grouped into five clusters, namely:

(i) Problems on "Job opportunities for students after graduation",

(ii) "Industrial/in-service training for staff and staff's motivation",

(iii) "Development of teaching-learning resources including textbook, workbook/lab.materials",

(iv) "Curriculum evaluation and industrial experience in curriculum", and

(v) "Cooperation with other organization and budgeting in management".

The above mentioned issues are regarded as the countrywise, strongly emphasised, specific problems.

Regionwise data

Based on the data of the z-score graphs the following interpretations were made. These graphs show that the items "Development of teaching-learning resources", "Job opportunity after graduation" and "Industrial training for staff" are regarded as the extremely strongly emphasised problems in the region because these items have all dots scattered in plus ranges of these items. The items "Textbook, Workbook/laboratory material (Instructional Materials)", "Evaluation of curriculum", "Planing and organising of technician education", "Staff motivation" and "Industrial experiences in curriculum" received the majority of dots in their plus range. Therefore these problems are regarded as the strongly emphasised regionwise problems. This means that the above mentioned items are assumed as the common problems throughout the participating countries. It is noted that, "planning/ Organising in management" was not regarded as a strongly emphasised problem as a countrywise specific problems, even

though this item was regarded as the strongly emphasised item in regionwise common problems. This means that this item is regarded as not in the top ranking serious problems to many participating countries, although this problem is regarded as a serious problem common to many countries.

Based on the z-score graphs, the regional problems were summarized as follow:

(i) "Job opportunity after graduation",

(ii) "Industrial training for staff and staff motivation"

(iii) "development of teaching and learning resources and textbook, workbook/lab. material (Instructional materials)"

(iv) "Curriculum evaluation and industrial experiences in curriculum" and

(v) "Planning and organising of technician institution".

On the other hand, items such as "Staff recruitment", "Language problems", "Procurement process", "Staff turnover" and "Student dropout" received almost all dots in their minus ranges. This means that these problems are regarded as lesser emphasised problems of the regional countries. It is supposed that these problems are not regarded as the problems of the region as a whole.

Overall interpretation

Some problems are country specific whereas those, listed as countrywise and regional are common problems which could be approached through regional cooperation, possibly utilising the services of an organization like the Colombo Plan Staff College.

The finding shows that the items "Development of teaching-learning resources" and "Textbook, Workbook/Lab.Material", "Job opportunities after graduation", "Industrial training", "Staff motivation", "Curriculum evaluation" and "Industrial experience in curriculum" can be seen in both countrywise specific problems and regionwise common problems. In addition, "Planning & organising of technician institution" and "Cooperation with other organization" are also regarded as problems in the regional countries. This means that currently all these problems which are mentioned above can be regarded as serious problems of the technician education systems in the region as a whole.

Conclusions

It is rather difficult to define the specific problems of technician education as common matters of concern among the regional countries, because respondents allocated quite different number of scores to the different items from country to country. For a certain country, some specific matters were serious problems, but not so for the other countries. Based on examining the findings and interpretation of data for countrywise and regionwise, a couple of conclusions were drawn.

The following are those major problems in technician education in the Colombo Plan regional countries.

* Development of appropriate teaching and learning resources including textbook, workbook/lab. materials (instructional materials).
* In-service training including industrial training for staff
* Staff motivation

* Job opportunity after graduation
* Curriculum evaluation
* Infusion of industrial experience into the curriculum design and process
* Cooperation with other organisations including industry and
* Planning and organising of the technician institution.

There are some problem items which are not regarded as serious problems in the regional technician education; those are

* Staff recruitment and staff turnover
* Procurement process
* Student dropout and
* Language problem.

Recommendations for further study

It was realised that all the problems in the regional countries are not identical and this is also reflected through the responses recorded in this study. Even though, the result of this survey study enabled the author to get a brief overview about the problems which the technician education systems of the Colombo Plan regional countries are currently facing. It is hoped that such an analysis may assist the sponsors of this study in some small way to better target their resources in alleviating some of the major problems. After completion of the study, the following recommendations for further study emerged.

In-depth study needed: There are some items which received high scores compared to the other countries such as "governance of institution" (Fiji) and "student dropout" (Korea) and several other items need further in-depth study to make clear the real situations.

Improvement of questionnaire format: It might be needed to improve the questionnaire format to combine with an objective type questionnaire, this would possibly make it easier to interpret the data. For example, one country showed the degree of problem on item SU10 "Job opportunity after graduation" around 1, but it was made clear that the government run school graduates face a tremendous problem in getting a job, but private sector graduates face no such problems. However, still the statistical figure showed around 1. In this case if there are some indicators to back up the statistical figure it would have helped to make much more appropriate interpretation for this specific item.

Teaching and learning resources development and Teacher's motivation: these items were also indicated as the major problem items from the previous study result. It is obvious, these problems are common and serious problems which need to be studied in more depth to solve the problems as soon as possible.

Study on management: after interviewing some technician teachers and administrators in the regional countries, it became obvious that there was a need to re-establish a study strategy on the management area. The matters of management are overall matters affecting all aspects of the technician education, and this particular issue presents some difficulty in analysis with the rather simple questionnaire form which was used in this study.

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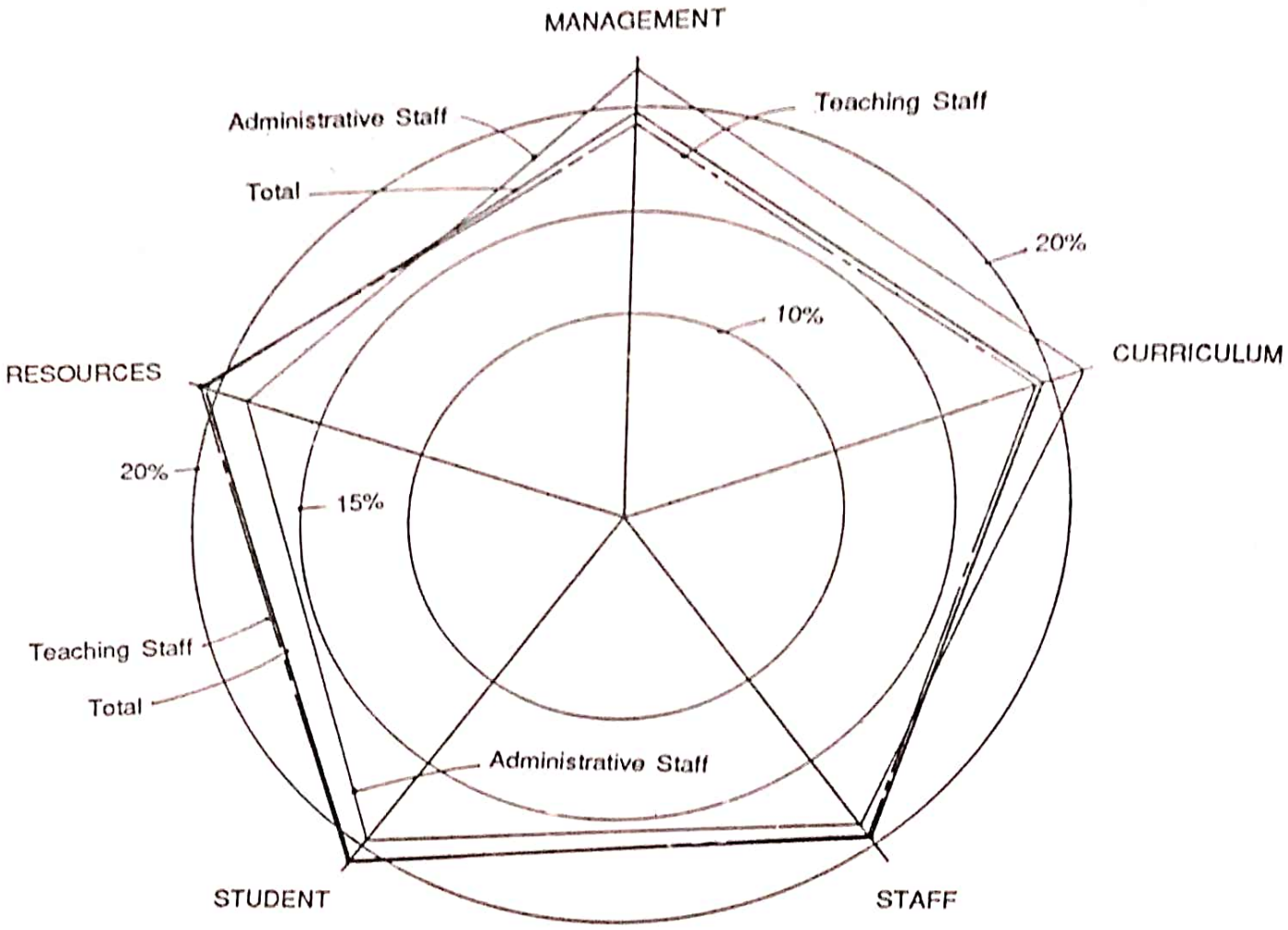


GRAPH 1 The percentage of allocated points in the five areas between the administrative and teaching staff.

BANGLADESH	Score (3.0 – 5.0)
Job Opportunity After Graduation	4.32
Curriulum Evaluation	3.95
In-Service Training	3.53
Development of Teaching-Learning Resources	3.19
Textbook, Workbook/ Lab. Material (Instructional Material)	3.14

FIJI	Score (3.0 – 5.0)
In-Service Training	3.83
Development of Teaching-Learning Resources	3.67
Internal Decision Making & Flow of Information	3.45
Job Opprtunities After Graduation	3.42
Planning/Development (Process Decision Making)	3.38

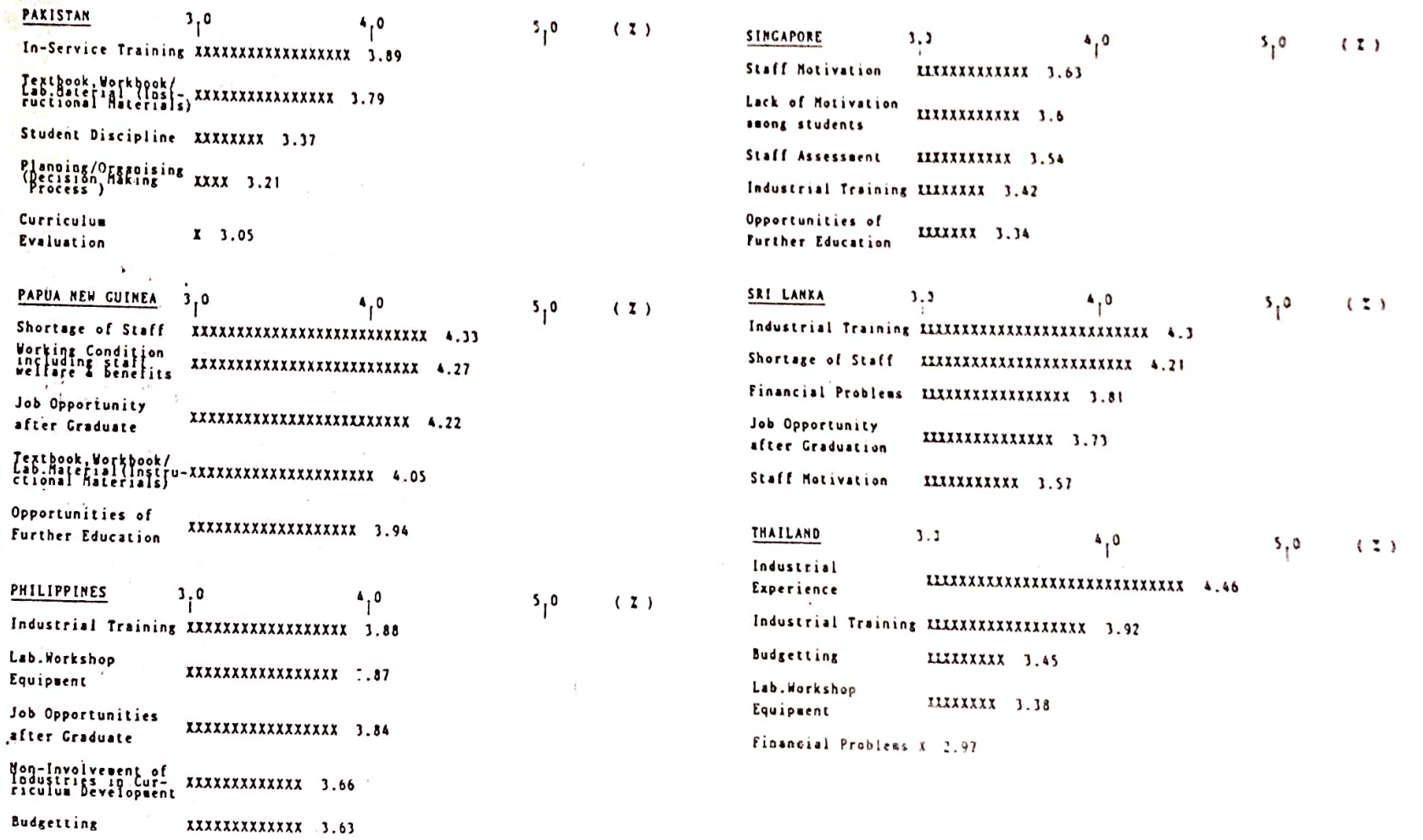
INDIA	Score (3.0 – 5.0)
Staff Motivation	3.65
Lack of motivation among student	3.43
Development of Teaching-Learning Resources	3.11
Curriculum Evaluation	3.08
Shortage of Staff	3.06

INDONESIA	Score (3.0 – 5.0)
Industrial Experience	4.39
Budgetting	4.39
Staff Motivation	4.33
Student's Entry Behaviour	3.79
Cooperation with other Organization Including Industry	3.78

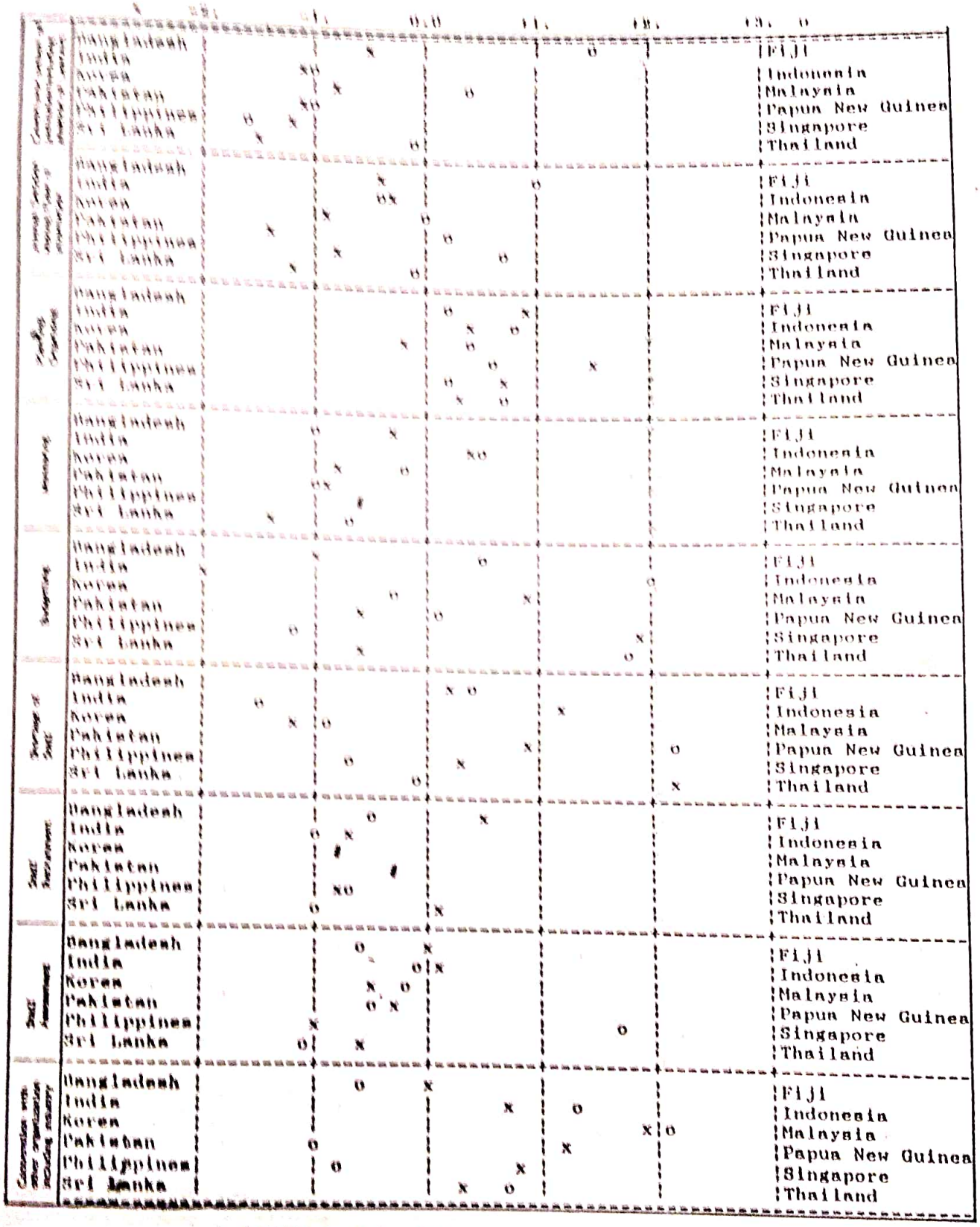
KOREA	Score (3.0 – 5.0)
Development of Teaching-Learning Resources	3.71
Cooperation with other organization including industry	3.71
Teaching-Learning Method	3.66
Staff's Teaching Capabilities	3.5
Social Status of Technical Student	3.34

MALAYSIA	Score (3.0 – 5.0)
Industrial Training	4.87
Non-Involvement of Industries in Curriculum Development	4.5
Cooperation with other organization including industry	4.26
Job Opportunities after Graduate	3.87
Industrial Experience	3.77

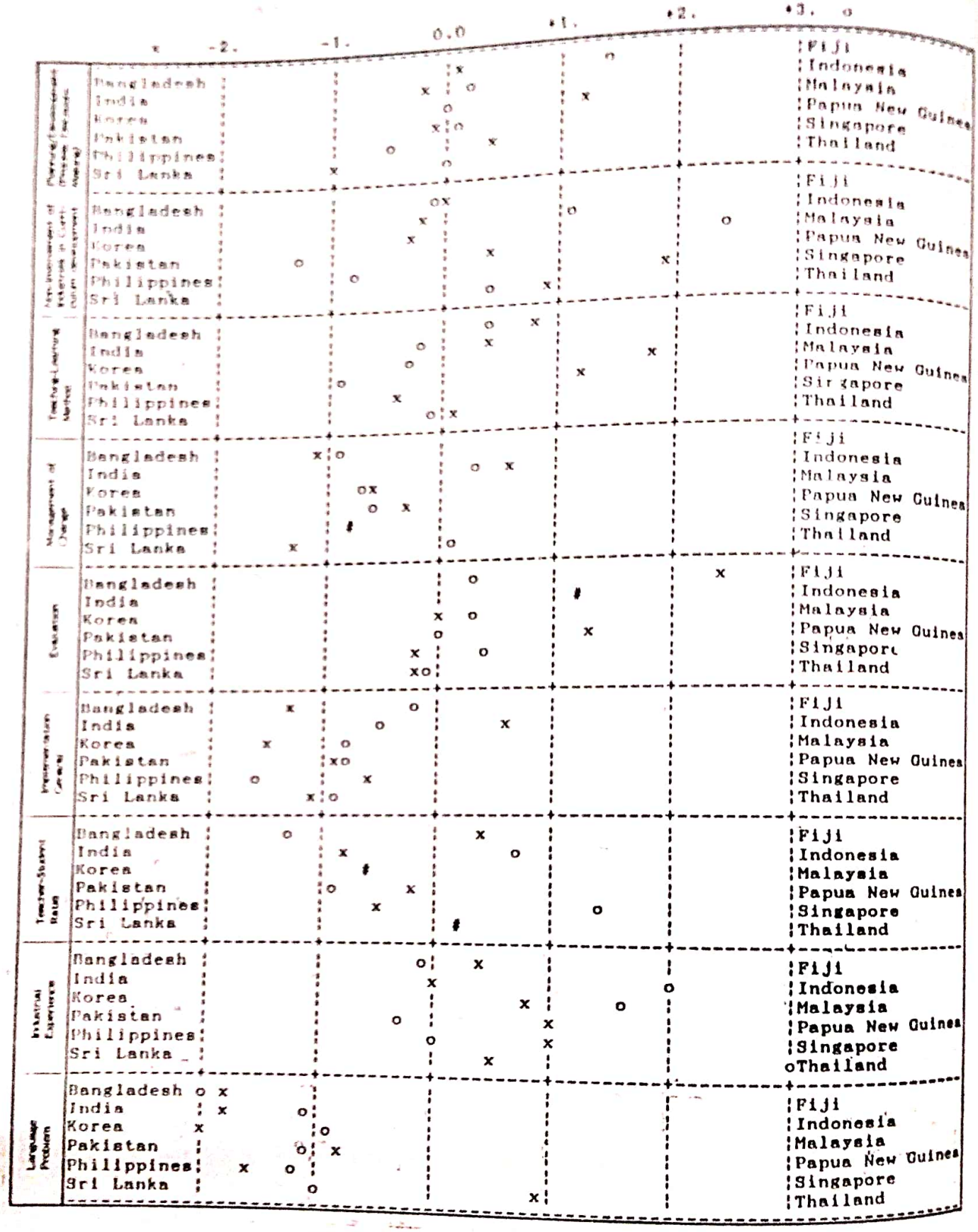
GRAPH 2 - 1/2 The top five items that received the biggest allocation of scores among the listed items in each country.



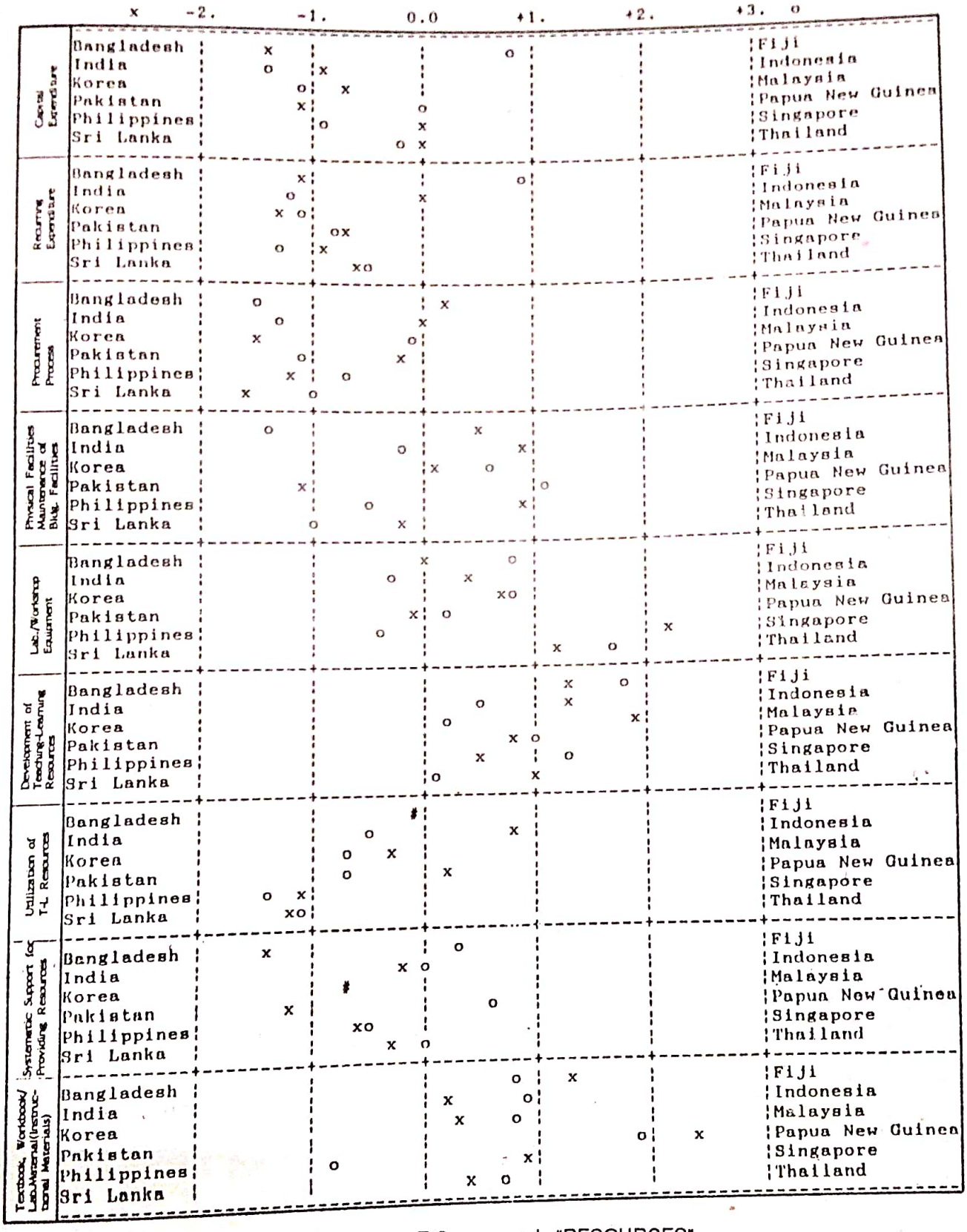
GRAPH 2 - 2/2 The top five items that received the biggest allocation of scores among the listed items in each country.



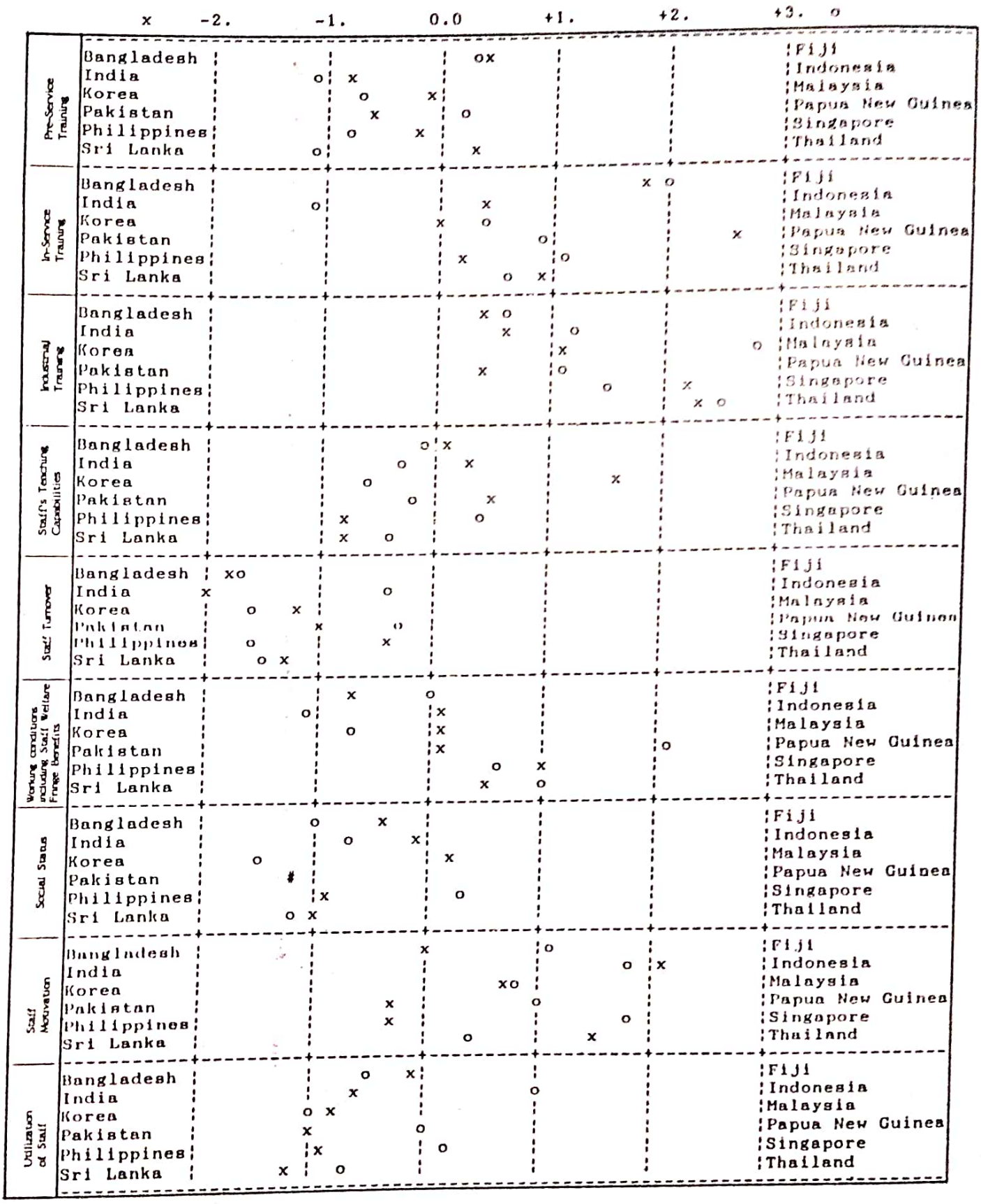
GRAPH 3 - 1/5 Z-Score graph "MANAGEMENT"



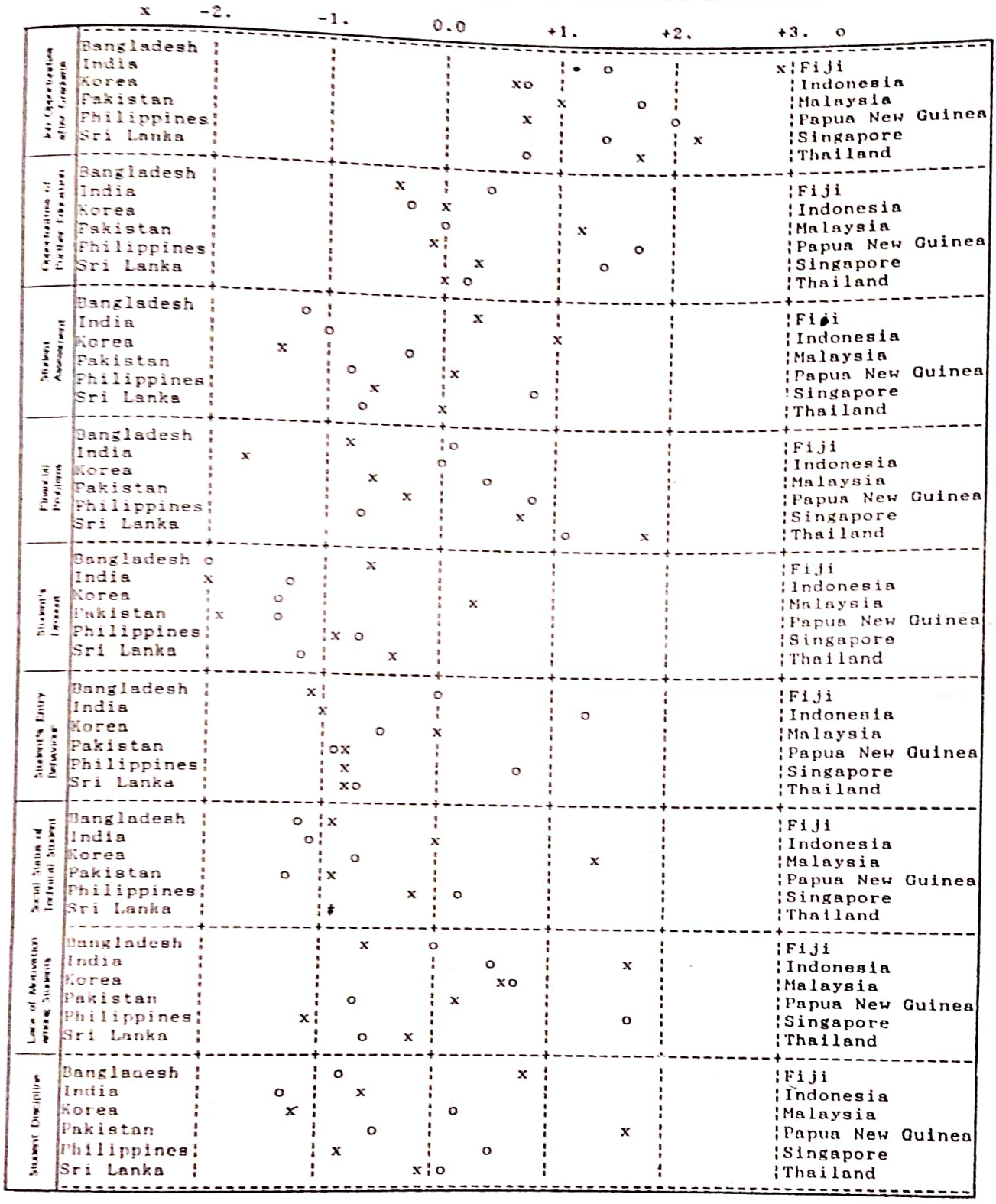
GRAPH 3 - 2/5Z-Score graph "CURRICULUM"



GRAPH 3 - 3/5 Z-Score graph "RESOURCES"



GRAPH 3 - 4/5Z-Score graph "STAFF"



GRAPH 3 - 5/5 Z-Score graph "STUDENT"

APPENDIX 1

FORM 2

PROBLEMS AND ISSUES ON TECHNICAL EDUCATION IN COLOMBO PLAN REGIONAL COUNTRIES

MANAGEMENT		CURRICULUM		RESOURCES		STAFF		STUDENT	
Governance system of institution/including absence of Law/Act	M01	Planning/Development (Process Decision-Making)	C01	Capital Expenditure	R01	Pre-Service Training	A01	Job Opportunities after Graduate	U01
Internal Decision Making Flow of Information	M02	Non-Involvement of Industries in Curriculum development	C02	Recurring Expenditure	R02	In-Service Training	A02	Opportunities of Further Education	U02
Planning/ Organising	M03	Teaching-Learning Method	C03	Procurement Process	R03	Industrial Training	A03	Student Assessment	U03
Monitoring	M04	Management of Change	C04	Physical Facilities Maintenance of Bldg. Facilities	R04	Staff's Teaching Capabilities	A04	Financial Problems	U04
Budgetting	M05	Evaluation	C05	Lab./Workshop Equipment	R05	Staff Turnover	A05	Student's Dropout	U05
Shortage of Staff	M06	Implementation Genaral	C06	Development of Teaching-Learning Resources	R06	Working conditions including Staff Welfare Fringe Benefits	A06	Student's Entry Behaviour	U06
Staff Recruitment	M07	Teacher-Student Ratio	C07	Utilization of T-L Resources	R07	Social Status	A07	Social Status of Technical Student	U07
Staff Assessment	M08	Industrial Experience	C08	Systematic Support for Providing Resources	R08	Staff Motivation	A08	Lack of Motivation among Students	U08
Cooperation with other organization including industry	M09	Language Problem	C09	Textbook, Workbook/ Lab.Material(Instructional Materials)	R09	Utilization of Staff	A09	Student Discipline	U09
Others	M10	Others	C10	Others	R10	Others	A10	Others	U10

* Remarks: In case you assign any priority to "Others" please describe the problem.

An Assessment of Manpower Needs in the Graphic Arts Industry in Selected Midwest States.

OLUSEGUN ODESINA AND W.D. WOLANSKY

ABSTRACT

The study presented in this paper is a result of the manpower needs assessment in the graphic arts industry in selected Midwest States, conducted between January 1987 and August 1988 at Iowa State University. A mailed questionnaire was used to collect the necessary data and a SPSSX statistical package was employed to analyze the data. The findings indicate that the supply of skilled human resources is not adequate in the industry. It is also seen that the largest supply of manpower in this sector will have to come from Vocational High School graduates and there are shortages of trained workers in photography, bindery and finishing areas which need attention.

Introduction

The Graphic arts industry has experienced lately technological changes and consequently changes in human resource training needs. The changes in the industry can be discussed in terms of the evolutionary trends. These trends dated back to the introduction of the moveable type by China and Korea in the 11th century to the introduction of the laser imagers, desktop publishing, electronic scanners and the electronic prepress in the 1980's.

According to the "Future of Print" (1986), "the rate of printing industry technology change will accelerate into the early part of the next century" (P. 44). A result of the direct influence in technology is the change in personnel needs in this industry. Employers are more likely to employ graphic arts graduates who possess today's skills and the ability to keep pace with rapidly changing technology.

As the introduction of new technology continues in this industry, there will be a need for a change in approach to both education and training. "The industry must have appropriate educational facilities to teach industry people how to react and interact with technological changes" (Spence, 1981, P. 38).

In his study conducted at Texas A & M University, on demands for skilled workers in commercial printing as perceived by commercial printers, printing educators and printing trade suppliers, Rodriguez (1979) stated that "the added number of skilled workers needed in the graphic arts industry will require that existing printing programs cater to those needs by curricular adjustments and/or more flexible programs" (P.15). He also stated that "level of

responses to particular issues imply that there is need for regularly conducted surveys to determine manpower needs in the printing industry" (P.15).

Problem of The Study

New technology is currently threatening all of the job descriptions in the graphic arts industry. Changing technology has a direct influence on people since personnel needs in the graphic arts industry change with the technology.

The study is designed to investigate the workforce needs in the graphic arts industry, specifically in the prepess and postpress areas within the selected midwest states.

Purpose of The Study

The purpose of this study was to determine the human needs in the prepress and postpress areas of the graphic arts industries in selected midwest states.

Review of Literature

Several studies (e.g. Kodak Graphic Arts Manpower Study, 1973; Bowling, 1984; Rodriguez, 1979 and Crouch et al 1972, Iowa State Department of Public Instruction, 1975) have stated the problem of manpower needs.

Trends in the employment area show a dramatic change in the graphic arts industry. In the words of Lyman (1982), "The commercial bindery owner of 20 years ago was a rugged individualist who knew the business thoroughly" (P.51). However, things have changed as they confront a major problem of labor. "Trained binding help is disappearing rapidly" (Lyman, 1982, P.51). Lyman contends that Vocational Schools give little binding training. The result of this is that manufacturers have set up training courses to train personnel.

There seems to be the problem of job switching which is an offshoot of the storage of specialized skilled help that is critically needed. Lyman (1982) indicated that "the shortage of skilled help is so critical that good craftsmen do not stay in one job for long. Bindery owners scout other shops for likely recruits" (P.51).

According to Phillips (1986), "employment of the graphic artist is expected to grow faster than the average for all occupations through the mid-1990's" (P.222).

Getting qualified personnel to fill positions in the printing industry is getting more and more difficult. In the words of the head of one printing industry executive search company, "It's a real blood bath out there" (Phillips, 1986, P 42). He stated further:

> Printing companies can no longer find a vice president of sales by putting an advertisement in the local newspaper. The hunt for the right person to fill the right job can be both expensive and time-consuming and can often lead to warfare between competitors (P.42).

In a study conduced by the Iowa State Department of Public Instruction, Des Moines, on Identification of Tasks in Photo-Offset Lithography Occupations in 1975, "respondents ranked the shortage of qualified applicants as the primary problem in employment of skilled occupational personnel in offset-lithography" (P.17).

According to Sundeen (1974), the Kodak Graphic Arts Manpower Study of 1973, found amongst others that "the number one problem of the industry is the growing

shortage of qualified personnel in all phases of graphic arts, including production, sales and management" (P.28).

The survey further revealed that current education is failing to supply adequate skilled workers needed in the graphic communications industry.

Closely related to these studies is that conducted at Clemson University by Crouch et al (1972) on Graphic Arts Industry and Technology in the South Carolina Labor Market with implications for curriculum development where they found that off-the-street applicants and applicants from other shops are the source of labor.

Rodriguez (1979) also found "the great demand being in hand and small machine operations, cutter and folder operations and pasteup" (P.10).

According to Sundeen (1974), "in the future, a knowledge of how to apply ink to paper will not be sufficient, the graphic arts are evolving from craftsmanship to technology" (P.28). He suggested that graphic communications be taught "as a family of major technologies that contribute to overall process of visual communications" (P.24).

At the Rochester Institute of Technology, changes are taking place in order to adjust to the technological changes. Toth (1958) quoted Southworth as saying:

> I'd like to see our prepress area, press area and quality control area work together to help the industry produce better color. We're going to have a required course in color reproduction and elective course in electronic color imaging (P.130), and we're trying to put together a course that ties together telecommunications and electronic prepress. Since the industry has changed direction a bit, we find that some of the courses that we used to require are no longer as important as the courses we don't require. (P.131).

According to Spence (1981), "new technology often results in new equipment; at the same time new skills are required for its operation" (P.38). There should be appropriate educational facilities to reach industry workers how to react and manage technological changes.

To meet these challenges, it is essential that educators meet with graphic arts industry representatives to enable schools to deliver their expectations. In his study conducted at the University of Tennessee on a Needs Assessment of the Knoxville Labor Market to determine a post-secondary Graphic Arts Program for the State Technical Institute, Bowling (1984) stated that "one of the best ways to improve educational systems is to strengthen communication between educators and the lay public" (P.18). When the public is more informed, there is the tendency that they develop more interest in giving assistance to educational programs that will eventually help all the people.

The foregoing review of literature, has revealed that the graphic arts industry continues to grow. Associated with the growth are technological changes that have necessitated the change in production processes. Therefore, employees have to adapt to be able to manage the technology. The printing industry will need skilled employees to manipulate sophisticated machines. Training and retraining of employees will be very essential to keep up with production and management demands. It is important to determine what the manpower needs are in the graphic arts

industry in the midwest states if we are to do a good job of meeting them. According to Bowling (1984), Burt implied that "most geographical areas are made up of a diversity of manpower requirements. Each area is unique in its requirements" (P.26). If graphic arts educators, therefore, know their area needs, they will be more in tune to satisfy those requirements.

METHODOLOGY

Population/Sample

The population for this study consisted of offset printing industries in the states of Iowa, Minnesota, Wisconsin, Illinois and Nebraska.

The sample for the study was made up of 450 offset printing companies. This sample represented small, medium and large offset printing industries.

Instrument for Data Collection

The instrument used for data collection was a questionnaire. This questionnaire was designed by the researchers based on a review of literature related to the study (e.g., Crouch et al, 1972 and Rodriguez, 1979). The instrument consisted of six parts with four major divisions. The divisions were:

* Current and future production processes' needs
* Technology issues
* Manpower issues
* Demographic questions

The instrument was validated by adults with differing backgrounds in the Department of Industrial Education and Technology and the researchers' graduate committee at Iowa State University.

Reliability was performed for all items in the instrument. The analysis used was Alpha Internal Consistency Reliability. The Internal Consistency Reliability estimate for all items was .91.

Data Collection and Analysis

The method used for data collection was a mailed questionnaire. Out of 450 questionnaires sent out, 130 were returned. This represents a 28.8% return rate. Thirty of the returned questionnaires were unusable. The total number of usable questionnaires that supplied data for this study was 100. This represents a rate of 22.22% and provided data for this study.

The data were analyzed using descriptive statistics (mean, standard deviation, frequencies and percentages) as well as inferential statistics. An analysis of variance F (ANOVA), was used to test if a statistical difference existed between groups on each of the null hypotheses stated in the study. A post-hoc analysis was also carried out using Scheffe's multiple range test whenever there were differences among groups for F-values significant beyond possibility level of 0.05.

Findings

Major findings of this study reported are the results of (a) the descriptive analysis of statements about manpower issues and (b) inferential analysis of comparisons of the opinions of the three groups on manpower issues.

Descriptive Analysis

The respondents were asked in the questionnaires to rate their opinions about manpower needs. Table 1 shows the report of the participants' responses.

The scale used was a Likert five-point scale as follows:

1. Strongly diagree
2. Disagree
3. No opinion
4. Agree
5. Strongly agree

Table 1. Item response for manpower issues.

Item	Manpower Issues	Mean	SD
1	The supply of skilled resources is adequate in the graphic arts industry.	2.57	1.07
2	I foresee layoffs of employees in the future because of new technologies.	2.47	0.98
3	The emergence of new technology has created new jobs in the graphic arts industry.	3.80	0.72
4	The largest source of manpower supply will be college/university level graduates.	2.91	1.02
5	The largest source of manpower supply will be community college level graduates	3.57	0.92
6	The largest source of manpower supply will be vocational high school graduates	3.97	0.73
7	The largest source of manpower supply will be off-the-street applicants.	2.56	1.29
8	Graphic arts employees must continually upgrade their skills to keep up with technological changes.	4.34	0.52
9	The present graduates of the graphic arts curricula are well prepared for the industry.	2.82	1.04
10	Graphic arts industries best know their needs and therefore should prepare workers for employment	3.08	1.10
11	There are shortages of trained workers in the type and copy preparation areas.	3.04	1.07
12	There are shortages of trained workers in the photographic area.	3.45	0.88
13	There are shortages of trained workers in the bindery and finishing area	3.34	1.01
14	There is an excess of trained workers in the type and copy preparation area	2.88	1.02

15	There is an excess of trained workers in the photographic area.	2.43	0.84
16	There is an excess of trained workers in the bindery and finishing area.	2.58	0.87
17	There is need for recruiting and training in the areas of type and copy preparation.	3.19	1.05
18	There is need for recruiting and training in the area of photography.	3.65	0.82
19	There is need for recruiting and training in the areas of bindery and finishing.	3.56	0.85
20	There is need for retraining in the area of type and copy preparation.	3.43	0.95
21	There is need for retraining in the area of photography..	0.86	3.64
22	There is need for retraining in the area of bindery and finishing	3.46	0.86
23	Surveys must be periodically conducted to determine the manpower needs in the offset printing industry.	3.99	0.91

It is seen that the following had a mean rating of below 3.00

1. The supply of skilled resources in adequate in the graphic arts industry. (2.57)
2. I foresee layoffs of employees in the future because of new technology. (2.47)
4. The largest source of manpower supply will be college/university level graduates. (2.91)
7. The largest source of manpower supply will be off-the-street applicants. (2.56)
9. The present graduates of the graphic arts curricula are well prepared for the industry. (2.82)
14. There is an excess of trained workers in type and copy preparation area. (2.88)
15. There is an excess of trained workers in the photographic area. (2.43)
16. There is an excess of trained workers in the bindery and finishing area. (2.58)

The following had a mean rating above 3.00

5. The largest source of manpower supply will be community college graduates. (3.57)
6. The largest source of manpower supply will be vocational High School graduates. (3.97)
8. Graphic arts employees must continually upgrade their skills to keep up with technological changes. (4.34)

12. There are shortages of trained workers in the area of photography. (3.45)
13. There are shortages of trained workers in the bindery and finishing areas. (3.34)
18. There is need for recruiting and training in the area of photography. (3.65)
19. There is need for recruiting and training in the areas of bindery and finishing. (3.56)
20. There is need for retraining in the area of type and copy preparation. (3.43)
21. There is need for retraining in the area of photography. (3.64)
22. There is need for retraining in the area of bindery and finishing. (3.46)
23. Surveys must be periodically conducted to determine the manpower needs in the offset printing industry. (3.99)

Inferential Analysis

HYPOTHESIS 1

There is no significant difference in opinion between small, medium and large scale offset printing industry employers regarding the need for competencies for new employees.

Table 2. One-way analysis of variance, mean, standard deviation of size company (small, medium, large) by competencies for new employees.

Sources	DF	SS	MS	F	F. Prob.
Between groups	2	.41	.21	.79	.46
Within groups	95	24.88	.26		
Total	97	25.29			

Group	N	Mean	Standard Deviation
Small (group 1)	32	3.40	.61
Medium (group 2)	33	3.56	.36
Large (group 3)	33	3.48	.54

NOTE: According to Scheffe's Test, no two groups are significantly different at 0.05 level.

Table 2 shows that there was no significant difference between groups at 0.05 level.

HYPOTHESIS 2

There is no significant difference in the perceptions held between small, medium and large scale offset printing industry employers regarding the need for schools to reflect the changes brought about technology in their curriculum.

Table 3. One-way analysis of variance, mean, standard deviation of size company (small, medium, large) by graphic arts curricula adequacy.

Sources	DF	SS	MS	F	F. Prob.
Between groups	2	1.33	.67	.61	.54
Within groups	95	103.34	1.09		
Total	97	104.69			

Group	N	Mean	Standard Deviation
Small (group 1)	32	2.69	1.06
Medium (group 2)	33	2.79	1.02
Large (group 3)	33	2.97	1.05

NOTE: According to Scheffe's Test, no two groups are significantly different at 0.05 level.

Table 3 shows that there was no significant difference between groups at 0.05 level.

HYPOTHESIS 3

There is no significant difference between opinions of small, medium and large scale offset printing industry about what the manpower needs will be in the prepress and postpress in ten years.

Table 4. One-way analysis of variance, mean, standard deviation of size company (small, medium, large) by manpower needs.

Sources	DF	SS	MS	F	F. Prob.
Between groups	2	.20	.10	1.86	.16
Within groups	95	5.11	.05		
Total	97	5.31			

Group	N	Mean	Standard Deviation
Small (group 1)	32	3.19	.21
Medium (group 2)	33	3.08	.26
Large (group 3)	33	3.16	.22

NOTE: According to Scheffe's Test, no two groups are significantly different at 0.05 level.

Table 4 shows that there was no significant difference between groups at 0.05 level.

HYPOTHESIS 4

There is no significant difference between opinions of small, medium and large scale printing industry about the need to conduct periodic surveys to determine the manpower needs in the offset printing industry.

Table 5. One-way analysis of variance, mean, standard deviation of size company (small, medium, large) by conducting periodic surveys to determine the manpower needs in the offset printing industries.

Sources	DF	SS	MS	F	F. Prob.
Between groups	2	1.09	.55	.66	.52
Within groups	87	71.89	.83		
Total	89	72.99			

Group	N	Mean	Standard Deviation
Small (group 1)	29	3.86	1.09
Medium (group 2)	30	3.97	.85
Large (group 3)	31	4.13	.76

NOTE: According to Scheffe's Test, no two groups are significantly different at 0.05 level.

Table 5 shows that there was no significant difference between groups at 0.05 level.

Discussion

The findings reported in Table 1 indicate that:

1. The supply of skilled human resources is not adequate in the graphic arts industry.
2. Layoffs will be minimal in the future because of new technologies; rather, there has been the creation of new jobs in the industry.
3. The largest source of manpower supply will be Vocational High School graduates. Closely following are Community College graduates, college/university level graduates and off-the-street applicants. This is a reversed trend from what Crouch et al (1972) reported about off-the-street applicants being the primary source of labor and Vocational Technical programmes not being given consideration for entry level positions.
4. There are shortages of trained workers in the photography and bindery and finishing areas.
5. There is need for recruitment, training and retraining in the photography and bindery and finishing areas.

Tables 2-5 suggest that employers agreed on the need for competencies for new employees and that schools reflect technological changes in curriculum. They also agreed on what manpower needs will be in the prepress and postpress areas in ten

years and the need to conduct periodic surveys to determine the manpower needs in the offset printing industry.

Conclusions

Based on the research findings reported in Table 1, all issues mentioned under discussion emerged as of utmost importance for the offset printing industry.

Based also on the research findings reported in Tables 2-5, industry employers believe that these issues were very important for the industry's future growth.

Recommendations

Based on the findings of this study, the following recommendations are made by the researchers:

There is need for recruitment and training in the areas of photography, bindery and finishing. There is also need for retraining in these areas and the area of type and copy preparation. As industry does not consider itself solely responsible to achieve this end, there should be collaboration between schools and the industry to be able to achieve this objective.

Schools must reflect changes in curriculum as a result of technology changes to meet the emerging and prevalent industrial practices.

Given the changing nature of the industry, surveys must be conducted regularly to determine needs in the offset printing industry.

This study can also be conducted using graphic arts educators to see how their perceptions about manpower needs compare with representatives of industries.

Further investigations are needed to determine what the manpower needs are in other areas of the industry. For example, flexography is a growing area in the printing industry. Knowing such needs will help the industry to grow further.

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Effectiveness of Microcomputer Aided Television Troubleshooting Instruction Using Digital Image Database

CHUANG, C.P. AND WOLANSKY, W.D.

ABSTRACT

The paper reports the findings of a study investigating the effectiveness of a microcomputer aided television troubleshooting instruction using digital image database. The rules of "proceduralized problem-solving", a knowledge database, an image database and an inference engine have been developed in this instructional system. An experiment was conducted to compare the effectiveness of this instruction method to the traditional television troubleshooting teaching method. The paper concluded with positive results that the digital video interactive instruction was more effective than the traditional method in learning television troubleshotting. It is a time saving method for students in learning complicated technical courses. And it is an application of image processing in technical education.

Introduction

Traditional TV troubleshooting instruction, including classroom lecture and laboratory training, plays a useful role. But it is often inadequate for teaching complex diagnostic and repair skills. The students always repeat the same procedures for dealing with the existing troubles in the different types of TV sets until they are able to combine knowledge with actual experience. It is a time-consuming and less-effective experience for them to apply the knowledge in real troubleshooting work. Moreover, the teachers must spend a lot of time renewing their teaching material in order to meet the proliferation of TV circuits, especially for preparing a lot of pictures for teaching diagnosis.

Since the Digital Video Interactive (DVI) technology has been developed into an available tool for dealing with complicated picture processing, it can be a useful aid for teaching television troubleshooting.

Problem of the Study

The problems addressed in this study were as follows:

1. The difficulty in displaying the troubleshooting procedures reduced the teaching effectiveness.
2. The difficulty in analyzing complicated TV troubles confused the learners.
3. The difficulty in diagnosing malfunction to the right part of the television discouraged students to learn TV troubleshooting.

Purpose of the Study

This study was designed to develop a microcomputer-based TV troubleshooting instructional system that integrated an image database and a knowledge database in order to improve the teaching efficiency for instructing TV troubleshooting. Basically, it came out as an educational expert system for teaching TV troubleshooting.

Review of Literature

The principles of traditional TV troubleshooting, as Schulte (1986), Liff (1985), and Buscome (1984) stated, follow three steps: 1. eliminating obvious defects, 2. isolating the defective stage, and 3. isolating and replacing the defective component. The elimination of obvious defects requires that all senses be used to find the fault. Isolating the defective stage usually consists of three methods: 1. cause-and-effect reasoning, 2. signal tracing, and 3. signal injection. And it is necessary to use an oscilloscope, multimeter, signal generator and several more instruments to isolate and replace the defective component.

No matter how efficient the traditional methods became, there were still some unsolved problems. The intermittents and oscillation troubles still bother the service technicians. In addition, the work of TV troubleshooting is still time-consuming. This means that the teaching method needs to be improved to attain maximum efficiency.

Some research studies evaluated the effectiveness of implementing the microcomputer in school laboratory work. For example, the investigations done by Castro (1990), Steinick (1987), Taylor (1987), Trollip and Johnson (1982), and Knerr and Nawrocki (1978), showed that the microcomputer played an important role in student's studying processes. These researchers discovered significant differences in student achievement when comparing computer-assisted instruction to conventional teaching methods. On the other hand, Morrison and Witmer (1983) found that there are no significant differences between computer-assisted instruction and conventional teaching methods.

The results were somewhat inconclusive of studies regarding the comparison of computer-assisted instruction and traditional instruction. However, more research results are positive for computer-assisted instruction. The different conclusions are somewhat related to the way in which the researchers designed their studies. The hardware, software, and the personnel all contributed as variables in these results. The application of artificial intelligence techniques and computer simulation to laboatory instruction are better than paper work in the laboratory type of learning. It also saves much time and money for expensive training equipment such as aviation training, naval training, or technical courses requiring expensive equipment or requiring the operation of equipment with certain accident risks during the learning process.

According to Luther's (1989) research, digital video refers to a system where all of the information that represents images are in some kind of computer data form, which can be displayed or manipulated by a computer. The final purpose of DVI technology is to enable every user an application of this technology to every needed place if he/she knows how to key in simple instructions. The most significant feature of DVI is its frame-based data processing model. It can merge text and color images on a single

monitor. The user can edit any picture or graph on it and can change the data already setup. Thus, it is more flexible than video discs for most cases.

In order to use DVI technology in the educational environment, it is helpful to know how to develop an available software for DVI hardware, especially for developing courseware for teaching TV troubleshooting. Clancey (1987) and his colleagues developed an intelligent tutoring system for teaching medical diagnoses. The methodology proved to be a practical help for designing a tutoring system. They stated that too often experimental analysis seems to fall short by not being able to be programmable. This is the problem that limits the flexibility of a fixed program. The simplification may eliminate the very points that are needed to build a working system.

Woolf et al. (1986) analyzed knowledge into four types for an expert system. All declarative, procedural, heuristics and simulation rules are needed for a quality expert system. The effectiveness of a good courseware must provide clear knowledge in condensed text, quality interaction, and a visible structure. Basically, the structure of the courseware for teaching technical troubleshooting is nothing less than an expert system.

The review of the literature provided to the researcher several insights into the complexities of creating an expert system; the limitations of particular systems and the research methodology shortcomings. There are many variables which enter into a carefully designed research problem, if ignored can invalidate the research results. Inconclusive findings generally stem from research designs which have ignored the very critical variables that influence outcomes or analyses which fail to control the interactive effects.

Methodology

In order to test the effectiveness of the DVI-type courseware, eight hypotheses were formulated in the study:

Hypothesis 1: There was no significant effect of audio-video electronics scores upon the achievement scores in learning TV troubleshooting knowledge and skills.

Hypothesis 2: There was no significant effect of electronic instrument scores upon the achievement scores in learning TV troubleshooting knowledge and skills.

Hypothesis 3: There was no significant effect of CAI scores upon the achievement scores in learning TV troubleshooting knowledge and skills.

Hypothesis 4: There was no significant achievement difference between the two groups of students who studied TV troubleshooting knowledge by traditional method versus the DVI method.

Hypothesis 5: There was no significant achievement difference between the two groups of students who studied TV troubleshooting skills by the traditional method versus the DVI method.

Hypothesis 6: There was no significant time consumption difference between the two groups of students for dealing with the same defective circuits

Hypothesis 7: There was no significant achievement difference between junior and senior students in a university in learning TV troubleshooting knowledge and skills.

Hypothesis 8: There was no significant preference among the students of the experimental group in applying image database for TV troubleshooting instruction.

Sampling Subjects

The subjects used in this study were the junior and senior students enrolled in the Industrial Education Department of National Taiwan Normal University during 1989-90 school year. They were all majoring in Electronic Techniques and already studied TV theory and troubleshooting skills during their vocational high school periods. And they were randomly divided into two groups in each class with the aid of a random number table. Each group contained eighteen students.

Group I: An experimental group in which eighteen students formed nine subgroups and each subgroup consisted of two students used a microcomputer (386/286) a pattern generator and a multimeter to learn TV troubleshooting during class sessions.

Group II: A control group in which no computer was provided. Only traditional instruments (multimeter, oscilloscope, pattern generator, sweeper, marker and TV analyzer) were provided for learning TV trouble shooting. They were organized into nine subgroups and each subgroup consisted of two students.

The experiment model was designed as follows:

Group I	R	O	X	O
Group II	R	O	T	O

R stands for simple random selection of subjects
O stands for observation, either a pretest, posttest, or skill test
X stands for experimental treatment
T stands for traditional treatment

The Procedure of the experiment

The experimental process included the following activities:

1. Obtained permission from the students and their teachers for doing the experiment.
2. Students were randomly assigned into two groups. They were not told the experimental plan until the end of the data collection process.
3. A pretest was conducted during the first meeting before the teaching process began. It took thirty minutes and was given to both groups at the same time, but at different classrooms and with different teachers. The test items were selected from NHK television service technician test.

4. Both groups studied the same knowledge units but with different methods.
5. Both groups studied the actual TV troubleshooting skills. Group I were asked to become familiar with the DVI courseware. Whereas, Group II were asked to become familiar with traditional TV troubleshooting methods.
6. Both Group I and Group II were given a posttest at the end of the experiment for checking the knowledge achievement.
7. Both Groups were given a skill test after the knowledge test. The skill test consisted of troublehshooting vertical circuits, horizontal circuits, and color circuits of Z-20A color TV set. The time each student spent for the skill test was recorded as speed score which represented a part of the total score.
8. A questionnaire was given to Group I for surveying the student's response to the DVI courseware after the experiment.
9. A multiple covariance analysis using the GLM (General Linear Model) procedure with the aid of a SAS package was used to test the eight hypotheses.

The Development of the Instructional Expert System

The development of the television troubleshooting expert system consisted of the following procedures:

1. Collecting expert knowledge for TV troubleshooting
2. TV troubleshooting analysis
3. Identifying logical control rules
4. Sequencing system flow-chart
5. Organizing system hardware
6. Organizing system software and coding
7. System testing
8. System refining

The researcher spent almost one year to classify the color television symptoms. And then used the following control rules to simplify the dicision-making procedure. They are represented as IF/THEN statements and the algorithms are shown in Fig.1 and Fig.2. These rules are easy to understand and apply for teachers and students. However, the menu that displays every possible defective circuit guides the learners to make a quick decision for the next step activity. This type of interactive learning is proved to be beneficial for teaching television troubleshooting.

1. IF <predicate> THEN <consequent>

Example:

Rule 1: IF one horizontal line in the middle of the raster
THEN breakdown (vertical deflection)

2. IF <a> AND <b> THEN <c> OR <d>

Example:

Rule 2: IF no raster
AND no picture
AND no color
AND no sound
THEN breakdown (power supply)
OR breakdown (horizontal deflection circuit)

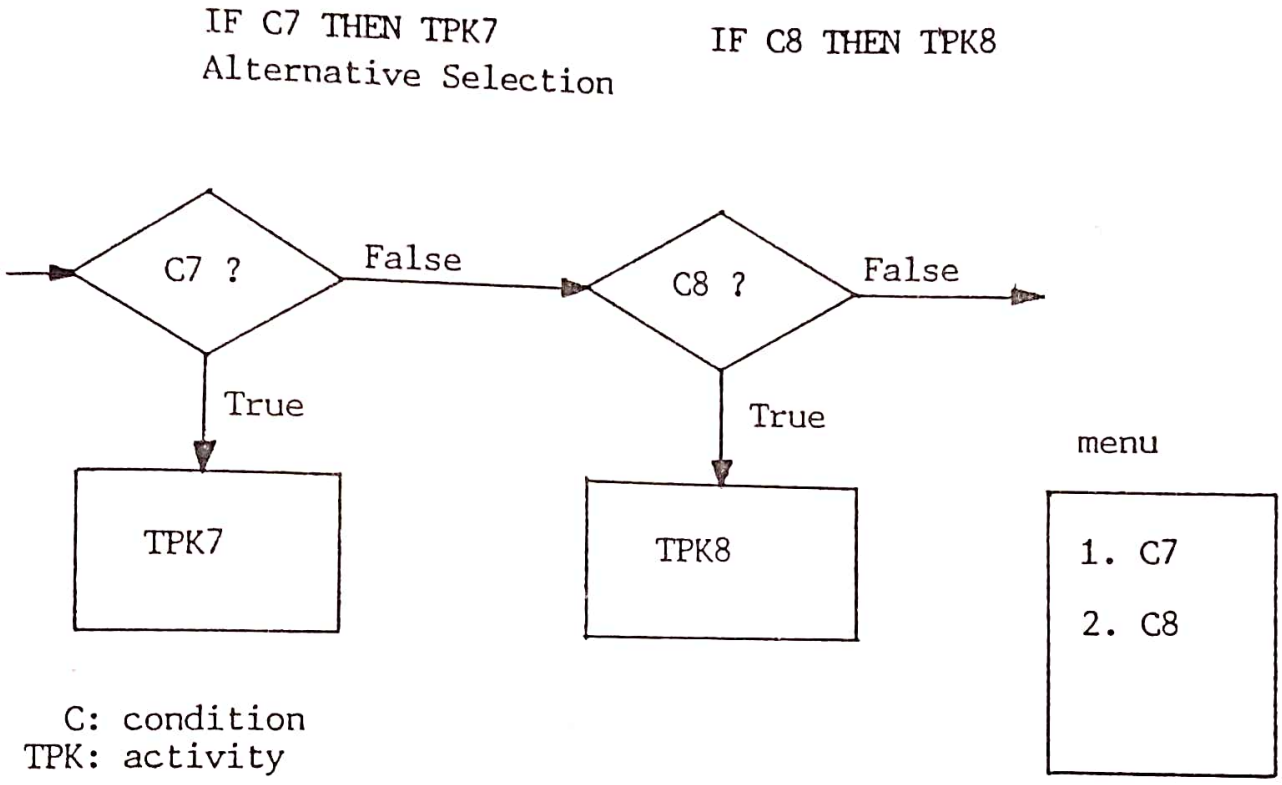

Fig.1: The first control rule for TV troubleshooting

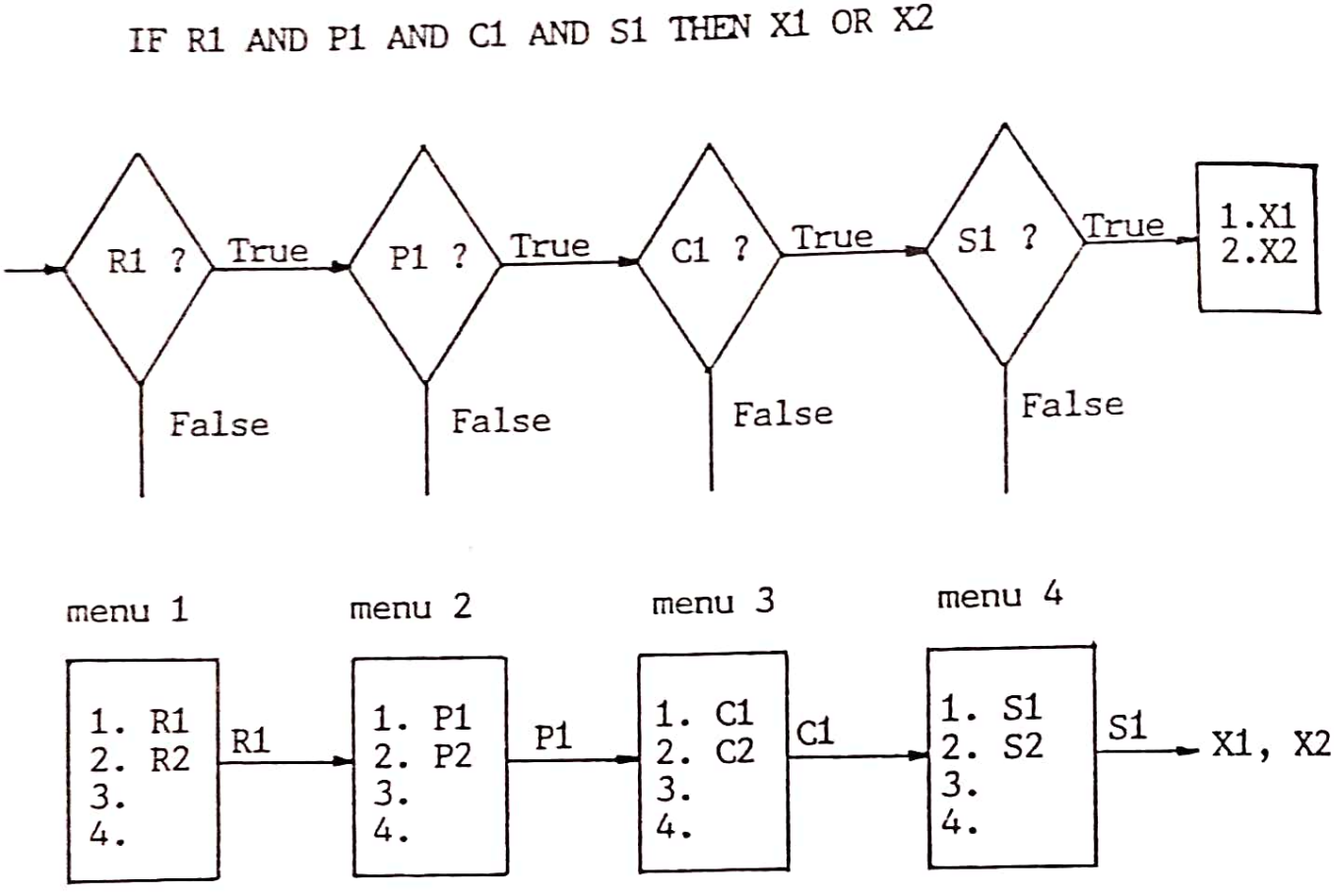

Fig.2: The second control rule for TV troubleshooting

The Four-Factor Diagnosis (FFD) method was used to analyse and classify TV symptoms. The four criteria: raster, picture, color and sound are the essential factors in color TV signal. Each one factor can be divided into several subfactors. (In this study, there are 14 subfactors in raster, 12 subfactors in picture, 10 subfactors in colour, and 6 subfactors in sound). Once the user makes the decision through the subfactors in the associative menu, the expert system will automatically show the symptom image that is already stored in the image database. If the image is different from the defective TV set, the user must make other possible decisions. If the output image is the same as the defective TV shows, then the necessary troubleshooting procedure will be seen after the user activates the key. Fig.3 shows the tree structure for selecting proper troubleshooting strategy.

System Organization

Basically, the expert system used in this study included three parts: user interface, knowledge database, and image database. They were constructed with both hardware and software as shown in Fig. 4. The hardware organization is shown in Fig.5. It included a 386 IBM PC with multisync monitor and a CFG-512N frame grabber built in the microcomputer. A CCD TV camera is necessary for editing image database. Any real time picture can be caught through this camera. All teaching material stored in the hard disk can be printed out as a papar material.

The system software consists of five parts: standard patterns, block circuits, functions of section circuit, function of adjustment controls, and the troubleshooting procedures. They are organized in a logical sequence of control rules. The linking program was coded with C language, but the editing programs were coded with PAL (PC Album Application Language). It is easy to learn and easy to do the editing. Fig. 6 shows the organization of the system software. The students may select any part as their first learning unit.

For the limitation of time, the learning units only covered the following items in this study:

1. functions of block circuits
2. functions of adjustment controls
3. functions of test patterns
4. major defective images
5. vertical sweep section circuit

Findings

After conducting the four weeks instructional experiment, the researcher got the response from the sampled students. The research findings are briefly stated as follows:

1. The instruction of Audio-Video Electronics and CAI did not have a significant effect on the learning of television troubleshooting knowledge and skills. (For Hypotheses 1 & 3)
2. The instruction of Electronic Instrument had a significant effect on television troubleshooting skills learning. (For Hypothesis 2)
3. The DVI instruction method was more effective than the traditional method on learning both television troubleshooting knowledge and skills. The academic achievement of DVI method was 10.89 points (shown in comparison table) more than the traditional method. (For Hypothesis 4)

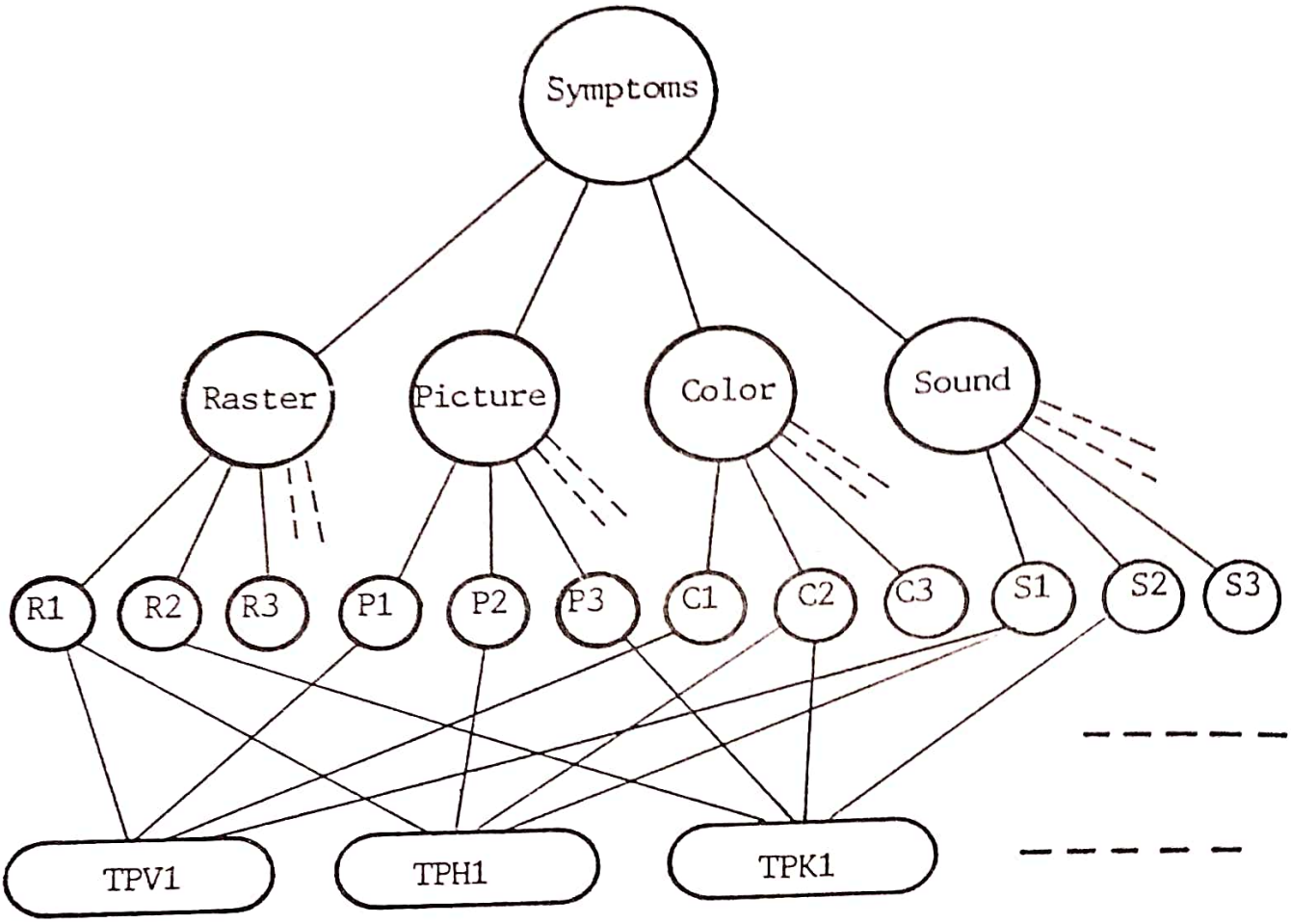

Fig.3: The tree structure for TV troubleshooting

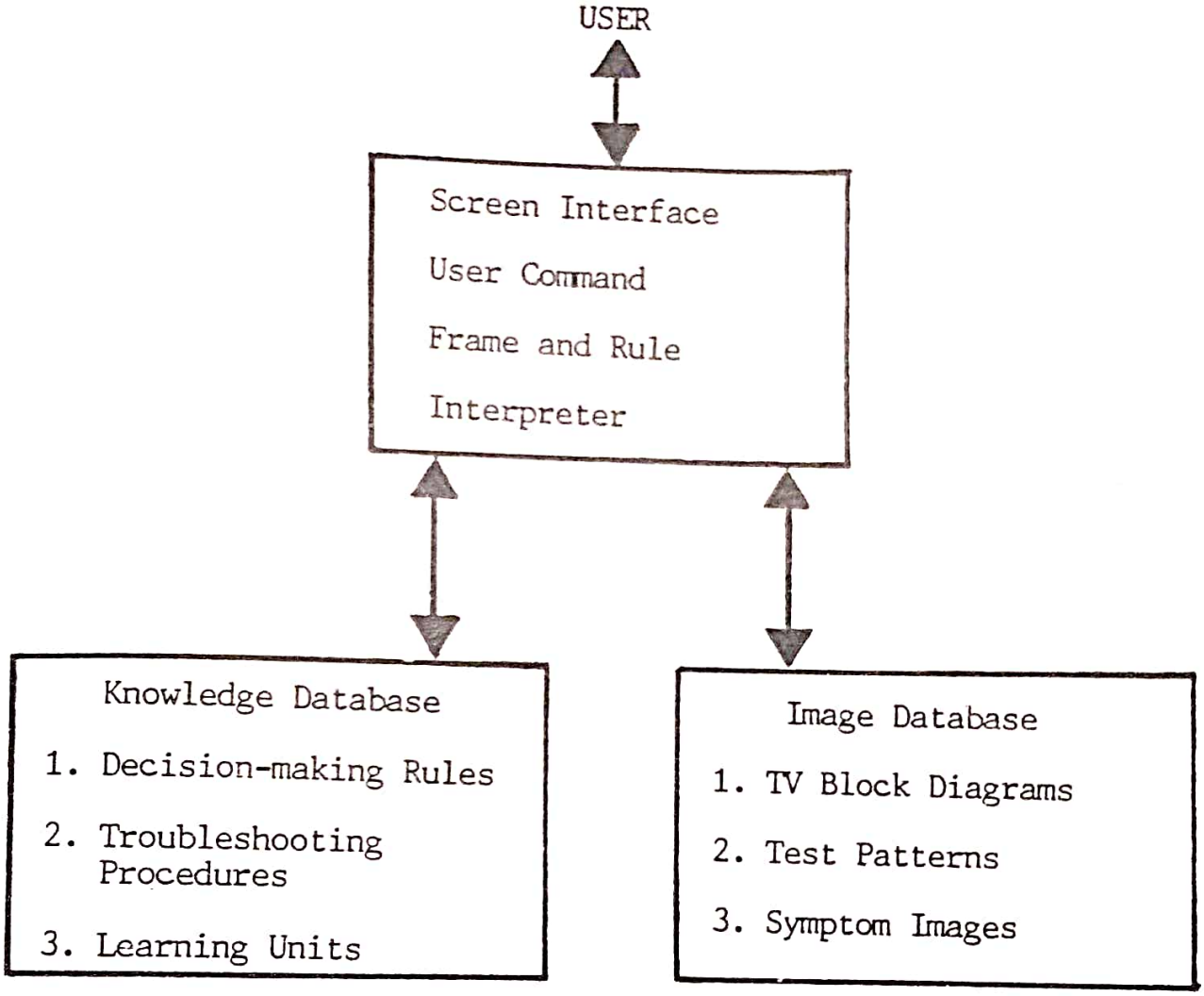

Fig.4: TV troubleshooting expert system

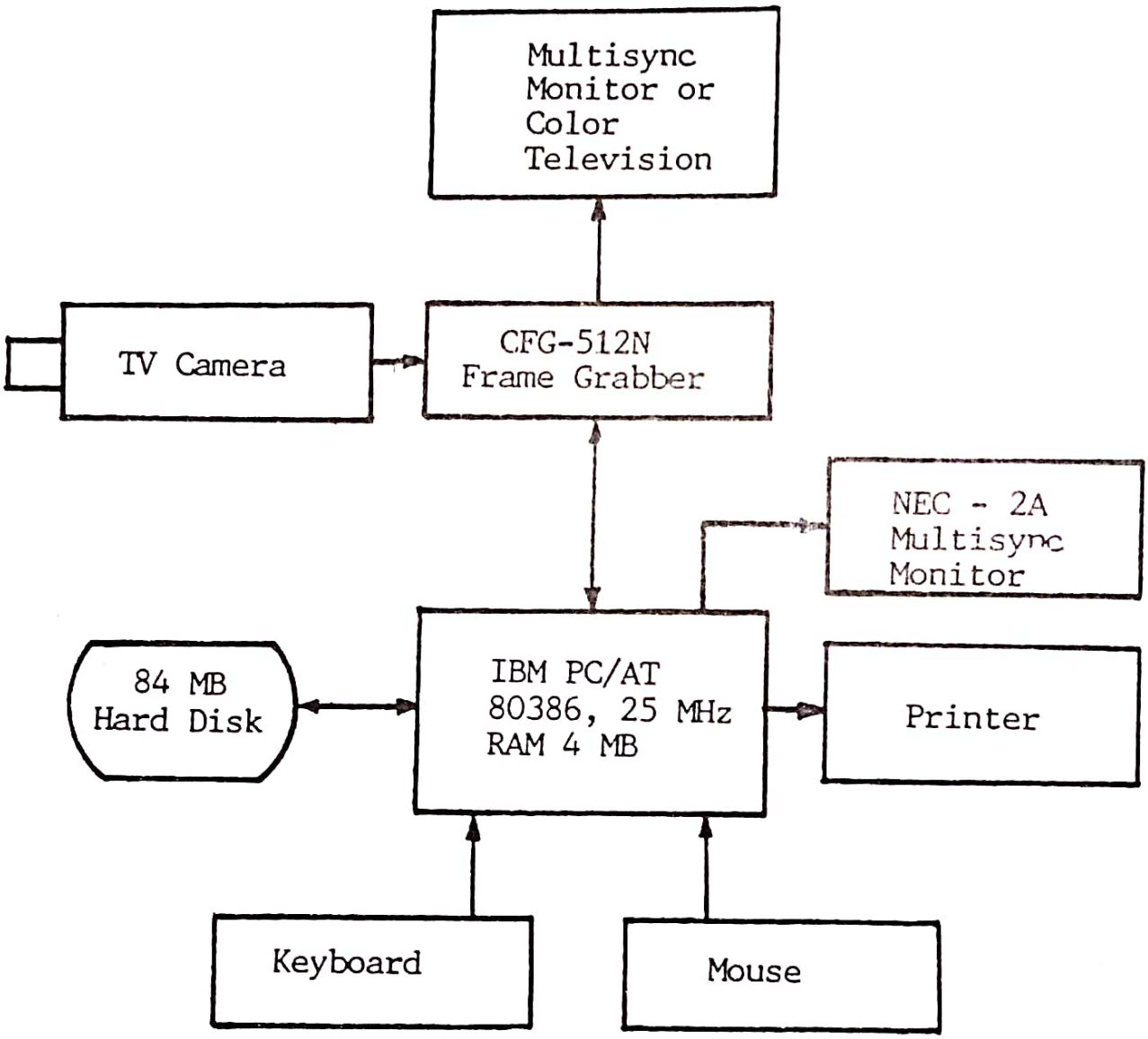

Fig.5: System hardware organization

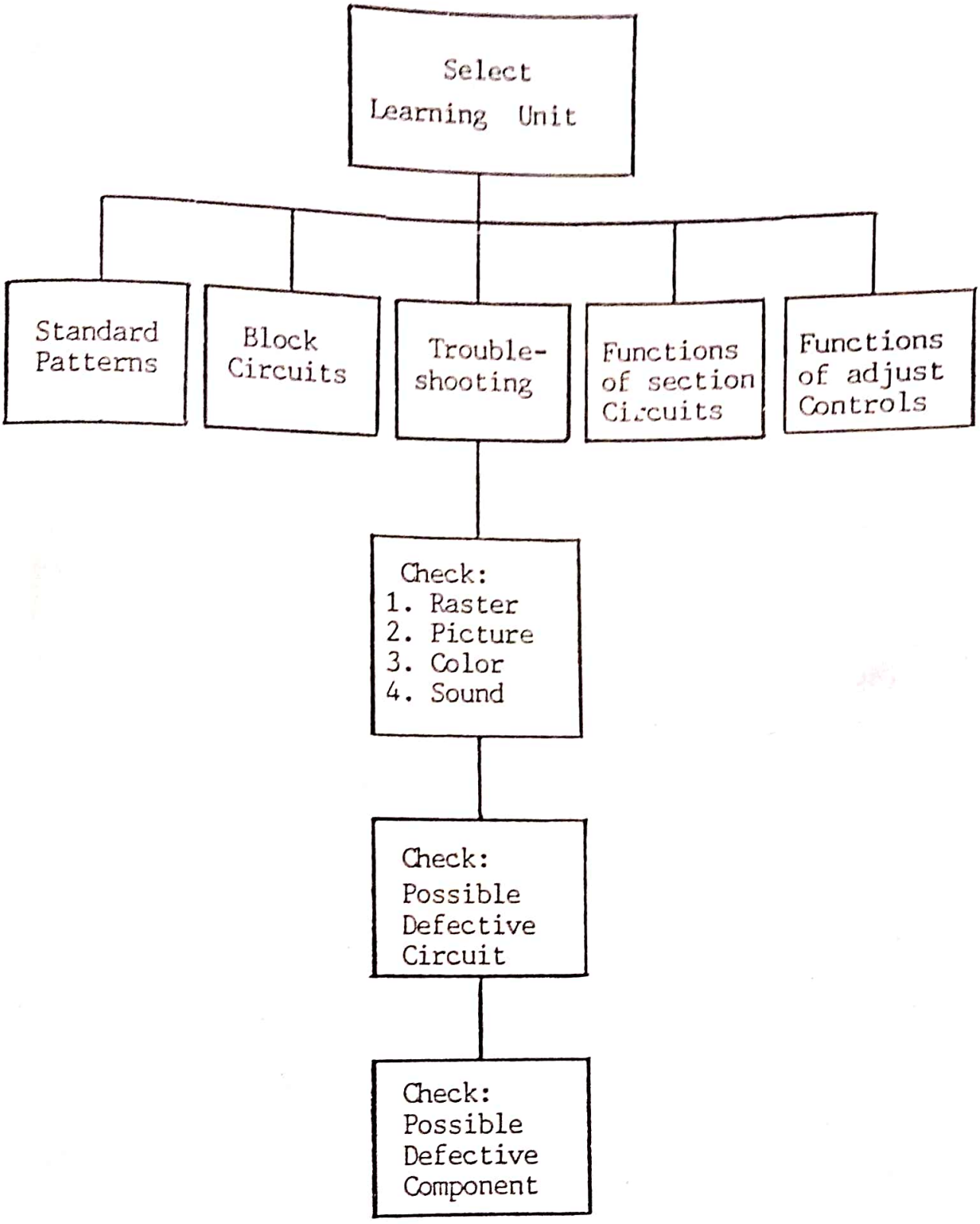

Fig.6: System software organization

4. The DVI method improves the troubleshooting accuracy about 18% more than the traditional method. (For Hypothesis 5)

5. The DVI method saved 25% time for making decisions in diagnosing a televison trouble. It saved 7.38 minutes for troubleshooting each color television symptom. (For Hypothesis 6)

6. The DVI method can be used in lower grade student classes for learning television troubleshooting. If students have learned the television theory. (For Hypothesis 8)

7. Most students preferred DVI teaching method in contrast to the traditional method. (For Hypothesis 8)

8. The editing time for a teaching unit can be reduced from traditional 3 hours to 1 hour by DVI method.

The comparison between traditional teaching method and DVI method is shown in Table.1. If the microcomputer can be shared with other purposes, the total price of DVI method must be lower than 4000 U.S. dollars.

Conclusion

It is a major trend to apply new technology production to improve the effeciency of education. One of the most useful methods for teaching complicated technical course such as television troubleshooting is to systemize and simplify teaching material and procedure.

The key to reach this goal is to find the control rules of the system. Once the rule is found, the simplification of the system can be organized. It is apparent that any symptom in a color television can be diagnosed with the four factors: raster, picture, color and sound after completing this experiment. Using these factors to classify

Table 1. The Comparison of Traditional TV Troubleshooting Instruction Versus DVI Instruction

	TRADITIONAL METHOD	DVI METHOD
ACCURACY	60.51	77.82
SPEED	39'	31.22'
KNOWLEDGE ACHIEVEMENT (POST-PRE)	17.00	27.89
EQUIPMENT USED	MULTIMETER OSCILLOSCOPE PATTERN GENERATOR SIGNAL GENERATOR MARKER SWEEPER TV ANALYST	MULTIMETER OSCILLOSCOPE PATTERN GENERATOR MICROCOMPUTER DVI FRAME GRABBER SOFTWARE
PRICE	US$ 5,500	US$ 7,000
EDITING TIME (one unit)	ABOUT 3 HOURS	ABOUT 1 HOUR

the symptoms can simplify the troubleshooting procedure.

The image database used in this study has also proved to be useful for displaying every picture at the right time. It is available for a faster paced television troubleshooting experience. And it can be applied to other technical courses in which the processing of a lot of pictures or procedures is necessary.

Perhaps the strength of DVI rests on quality repeat system, ease of image editing, relatively low cost, immediate feedback to students and reduce time in troubleshooting.

To improve this system, an automatic trobleshooting strategy can be further constructed with a direct image comparison technique. The result of the diagnosis can be known directly through the high capacity and high resolution computer system.

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The Link between Management Style and Innovation: The Japanese Experience

TAKASHI UEMATSU

ABSTRACT

This paper describes the link between management style and innovativeness of industries. The concept of "KAIZEN" is explained as the importance of "KAIZEN" effort, which is constantly carried out in industries in Japan. A case study of a productivity development project implemented in Singapore in collaboration with Singaporean and Japanese Governments is incorporated to demonstrate some special features of Japanese style of management.

I Introduction

Change is something which everybody takes for granted now in industry. Successful companies have shown that it is possible to anticipate change and to meet the challenges whilst they are still manageable. After successfully assimilating foreign technology and then achieving very high productivity and top quality, Japanese industries are now focusing on flexible manufacturing in a very short time to changing customer and market requirements. The key words are mechanization, automation, robotization and related systems. There are supposedly many interesting things which Western companies want to know about the Japanese industrial environment. In trying to understand Japan's "economic miracle", scholars, journalists and business people alike have dutifully studied such factors as the productivity movement, total quality control (TQC), Small-group activities, the suggestion schemes, and labour relations. They have given much attention to some of Japan's unique management practices, among them the lifetime employment system, seniority-based wages, and in-house labour union. Yet the author feels most of them have failed to grasp the very simple but essential truth that lies behind the many myths concerning Japanese management.

In 1541 a Portuguese ship destined for China was wrecked by a typhoon and happened to drift ashore at a very isolated small island located in the western part of Japan called "Tanegashimaa". Villagers of the island found that the then-unknown aliens had several strange iron bars which made roaring sounds and violent lights, and killed enemies from a far distance. This was the first introduction of guns to Japan. Japanese blacksmiths were keenly interested in this new weapon, and voluntarily started to study how to reproduce the equivalents. Since then guns have for a long time been called Tanegashima in Japan. At this time Japan was undergoing the hardship of the age of civil war. Many families of Samurai (Warriors) were trying to gain hegemony in Japan. In 1571, only 30 years later, the fatal

"Battle in Nagashino" occurred between the Tokugawa and the Takeda. Until then about 2,000 guns had already been produced in Japan without any active technology transfer activity from the Portuguese, and 1,200 of them were possessed by the Tokugawa. Consequently the Tokugawa gained a crushing victory in the battle, and this greatly influenced the history of Japan since then. This episode shows the keen curiosity of the Japanese and their single-minded pursuit for new things.

QCC (Quality Control Circle) is one of the most famous specialities of Japanese management, but it was only in 1950 that the modern concepts and principles of quality control were introduced in Japan. W.E.Deming was invited to Japan to teach statistical quality control at an eight-day seminar organized by the Union of Japanese Scientists and Engineers (JUSE). Deming visited Japan several times in the 1950s, and it was during one of those visits that he made his famous prediction that Japan would soon be flooding the world market with quality products. He introduced to Japan statistical quality control, but the Japanese did not want to accept every thing as it was. As soon as they were taught, JUSE started their work on how to adapt it to the industrial environment in Japan, and finally developed the so-called "Seven Tools in QC", some of which were introduced by Deming, but some others were quite newly developed by the Japanese. A few years later when Deming visited Japan again for his second visit, he was said to be quite surprised at seeing that his concepts and principles were fairly widespread in industries throughout Japan, but modified and adapted to Japanese ways.

Masaaki Imai introduces in his book "KAIZEN" an interesting concept on innovation. In his concept the innovation strategy is supposed to bring about in a staircase progression, as depicted in Figure-1.

But in reality, actual progress achieved through innovation generally follows the pattern shown in Figure-2

This happens because a system, once it has been installed as a result of an innovation, is subject to steady deterioration unless continuing efforts are made first to maintain it and then to improve on it. When such effort is lacking, decline is inevitable. (See Figure-3).

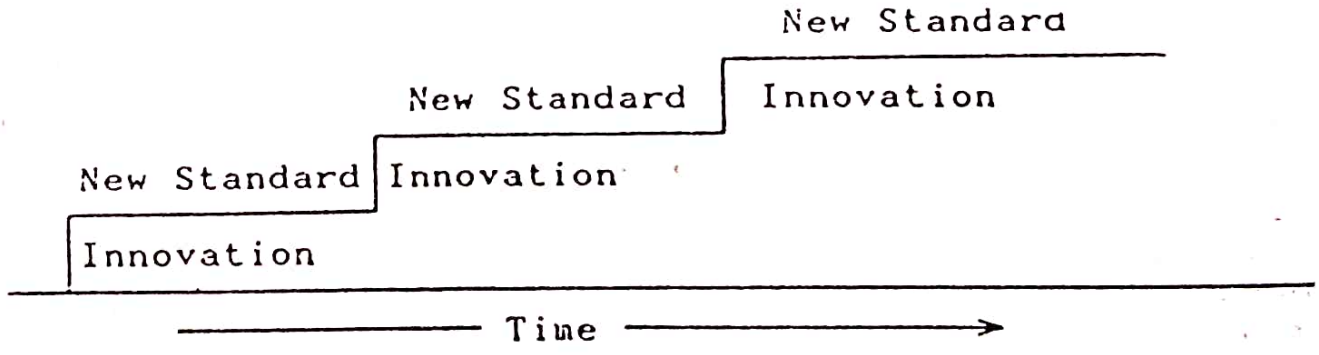

Figure-1 Ideal Pattern from Innovation

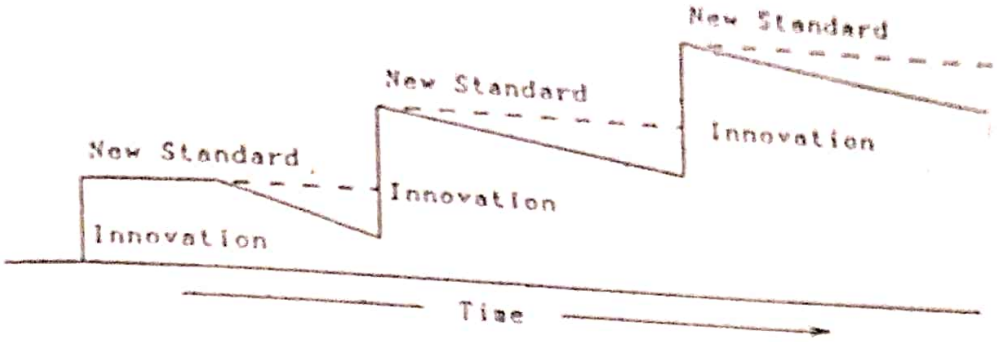

Figure-2 Actual Pattern from Innovation

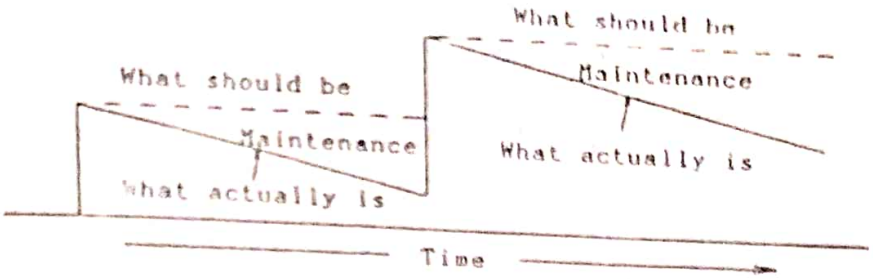

Figure-3 Innovation Alone

Therefore, even when an innovation makes a revolutionary standard of performance attainable, the new performance level will decline unless the standard is constantly challenged and upgraded. Thus, whenever an innovation is achieved, it must be followed by a series of KAIZEN efforts to maintain and improve it, and Imai pointed out that Japan's success mostly depends upon the fact that this kind of KAIZEN is constantly done in most Japanese industries as a very natural and obvious thing to do. (See Figure-4). In his concept, he introduces a new technical term "KAIZEN" which is supposedly not very familiar to most of readers.

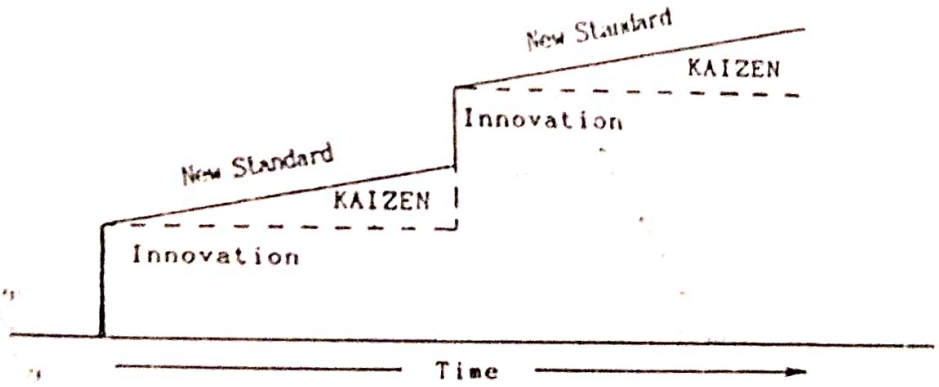

Figure-4 Innovation plus KAIZEN

KAIZEN is a very common Japanese word which means improvement. Moreover, by his definition, it means continuing improvement in personal life. When applied to the work place, KAIZEN means continuing improvement involving every one, managers and workers alike. The English term "improvement" as used in the Western context often means nothing more than improvement in equipment. Thus excluding the human elements. By Imai's theory, improvement can be broken down between KAIZEN and innovation.

KAIZEN is an accumulation of small daily improvements, including many human factors, whilst innovation involves a result of a large investment in new technology and/or equipment.

Any further discussion about terminology and definition of words is not mentioned now in this discussion, but all improvement including any human factors involved is discussed in the term "innovation" at least here in this paper.

Apart from the argument about definition of words, the author quite agrees from his 26-year experience of working in an industry in Japan with the fact the at this kind of innovation or improvement has constantly been done in industries in Japan as a very natural and obvious thing to do.

In Japan when a plant is completed and starts its commercial operation, every one concerned, manager, staff, operators, maintenance men and laboratory staff, immediately start to work on how to improve the efficiency of the plant, how to cut the production cost, and how to improve the product quality: consequently plant capacity will usually increase year by year even beyond the originally designed capacity without any new big investment. Engineers at Japanese plants are often warned. There will be no progress if you keep on doing things exactly the same way all the time." And now the author wants to discuss why and how these kinds of innovation have constantly been done in industries in Japan as a very natural and obvious thing to do, referring to a project of JICA in Singapore.

II. Background of Japanese Management

1. JICA's Experience in Singapore

1. Background of Japanese Management

Like many other philosophies, concepts and ways of life, so-called Japanese management was not intentionally created by the Japanese, but happened to be born as a result of our daily social activities, it was Western industry which first pointed out that in Japan there was a management system quite different from that of any other Western developed countries, and it functioned very well in promoting its rapid industrial development. Until then no one in Japan was aware of it at all!

The most developed and best-known country in the world in the area of management until then was the United States. After World War II, when Japan was trying hardest to achieve economic recovery, our best model of management was that of the United States. It is not an exaggeration to say that we learnt every thing about modern management system and philosophy from the United States. Industrial Engineering, Production Management, Value Analysis, Marketing Theory, Job Analysis, Task Analysis and other techniques and methodologies which are now used in Japanese industries in a very common way were all learnt and introduced from the

United States in this period. Even in this period, however, Japan did not accept all of them as they were, but tried to select some which did not damage harmony with other systems already existing in industries in Japan at first, and then some others were quite modified and adapted to the environment of the industries when introduced. There were still some others which Japanese industries wanted to learn and introduce but finally they were obliged to give up their introduction to Japan. It is very natural that most of them were systems about personnel and labour management. By the irony of fate these systems and philosophies which Japan totally adapted to Japan on introduction, or systems inherited from the past which remained unchanged became reputable as the excellent Japanese management later. The most famous of them are QCC, Life-Time Employment, Seniority Wage System and In-House Labour Union.

2. Singaporean's Views on the Japanese Management

In 1982 the Singapore Government requested the Japanese Government to collaborate with them in their national project for Productivity Development. The project started by sending experts on management from Japan through JICA (Japan International Cooperation Agency) to Singapore to develop human resources in Singapore concerning productivity management.

In June 1981 the National Productivity Board in Singapore made a report on productivity which indicated the direction of the productivity movement which occurred later in Singapore, and in which they proposed to adopt the Japanese management as a mode of future Singapore management. The report raised nine points as characteristics of Japanese management as follows:

* Way of Involvement in and Conduct of Work
* Participation of Management in Small Group Activities
* In-House Welfare System
* Loyalty and sense of Total Involvement in Enterprises
* Decision Making by Bottom-Up
* In-House Labour Union
* Broad and Flexible Job Assignment
* Seniority Wage System
* Life-time Employment

According to this report in addition, the order of these characteristics from top to bottom shows the order of difficulty of introduction to Singaporean industry and they thought that degree of difficulty increases downward. The aim of the National Productivity Board was to improve the working attitude of Singaporean employees and to change the labour relation to a collaborative one by introducing Japanese management to Singapore, and finally to develop productivity there.

All three major things, Life-Time Employment, Seniority Wage System and In-House Labour Union, were listed there, and they were thought to be the most difficult systems to be introduced to Singaporean industry. Small Group Activity and In-House Welfare System were thought to be relatively easy factors to introduce, perhaps because they were visible activities and each of them was thought to be substantially an independent activity from

others. Also Singaporeans thought that loyalty and Sense of Total Involvement in Enterprises should be the product of careful welfare system, and once a careful in-house welfare system was introduced, consequently loyalty of employees must be raised. During the process of decision making and making the final decision to be implemented in an enterprise in Japan, exchange of information is done among wide areas of job and ranks of hierarchy frequently and repeatedly to obtain understanding and consent of higher hierarchy step by step and the final decision is returned to persons in charge of execution.

Singaporeans thought this system can be easily applied in Singaporean industries. But the way of job rotation from one job to another and the way of conducting several jobs at the same time which are very common practices in Japan were considered to be rather difficult to be done in Singapore.

These discussions, however, seem to contain several confusions about the nature of these items. Life-Time Employment. Seniority Wage System and In-House Labour Union are systems, but Way of Involvement and Small Group Activity and Decision Making by Bottom-up are ways how to conduct work in enterprises, and In-House Welfare System and Job Rotation are general social customs in Japan. Loyalty and Total Involvement in Enterprise are the results of the effects brought by a combination of all these mentioned above.

3. Japanese Views on the Japanese Management

Japanese experts on management sent by JICA to the project in Singapore studied hard to grasp what was meant by the Japanese management which they had not identified clearly themselves, and finally they reached a conclusion, illustrated in Figure-5 as the Japanese Management Tree.

Further details about the tree are explained here.

1. The Japanese management is not a mere mixture of independent methodologies and techniques but it should be understood as a whole picture closely related with management environment, various systems and customs peculiar to Japan. That is to say that each methodology and technique can not function independently, but functions in a total management system closely influencing each other.

2. As it is discussed very often, the life-time employment is the fundamental matter of Japanese management, and it is also true that all activities in so-called Japanese style management are designed more or less based on the existence of life-time employment. However, it is not an employment "from the cradle to the grave" as sometimes misunderstood outside of Japan, but it should be understood as a "long-time" employment, and it is not always applicable to all employees in all enterprises in Japan, but only applicable to employees of a certain level of position in mainly large and middle-scale enterprises.

3. This life-time employment is supported by a special management environment in Japan, composed of various factors, such as a closed labour market system in which recruitment of employee is not done within a general labour market, but in a special closed market directly connecting enterprises with schools, colleges and universities, seniority wage system, highly educated manpower and sense of social equality. Especially in seniority wage system, wage and salary are calculated based on age,

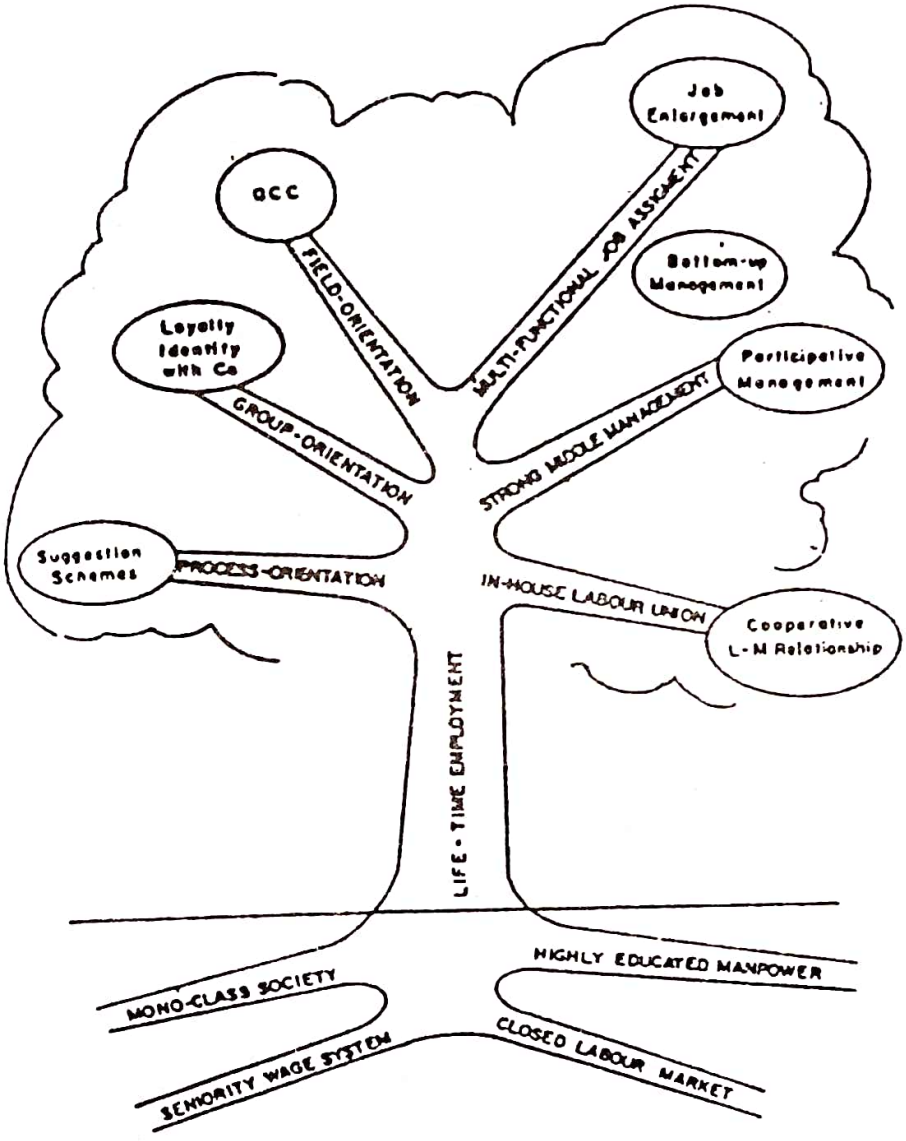

Figure-5 Japanese Management Tree

length of employment and educational career of each employee, and it is intentionally designed so that the labour condition becomes more advantageous to employees of longer-length employment in order to motive employees for long-time employment in respect of labour circumstance. Thus, the life-time employment and the seniority wage are two wheels of a cart, supporting each other and indispensable to each other.

4. The trunk of the tree of life-time employment is supported by widely spread roots of the Japanese management environment, with many branches of systems, peculiarities of Japanese enterprises and unique ways of conducting work, all of them contribute to make flowers of Japanese style phenomena and activities in full bloom. Cooperative Labour management relationship and participative management function on the basis of in-house labour unions, and the existence of the strong middle management makes bottom-up management possible. Way of conducting various jobs simultaneously and flexible job assignment are the necessary conditions of job enlargement. Small group activities such as QCC, loyalty-identity with company and suggestion schemes are closely related to the group-oriented, field-oriented and process-oriented nature of the Japanese people. The facts mentioned above are so natural and obvious to many Japanese managers and very often even to workers that they often do not realize that they possess them.

4. Further Comparisons on the Social Environment in Japan and the West

1. Sense of Equality and Field-Orientation

One of the important differences in social environment between Japan and the West is the sense of equality. Most of the Western societies, even in the United States are rank-oriented. They believe that the only persons judged as elite by their scholarship can receive higher education, and lead their society. For example, all university graduates do not join any labour union. They are treated as candidates for future managers and enjoy quite different working conditions from other workers, whilst in Japan all employees are treated as equal regardless of their educational career and hierarchy rank in the work place.

When a Japanese company wants to recruit some employees according to their manpower planning, they send certain invitation letters to schools, colleges and universities of their own choice. No other schools, colleges or universities of their own choices are invited to the recruitment. As for the selection of the applicants, standards and criteria of selection differ naturally according to their academic career, say their grade of education and category of major in the university. But classification of majors is only a clerical or a technical detail. No other information concerning their future assignment is given to applicants. They never know in which geographical area and business area they are assigned in the future after having been employed. Assignment is usually made after they have had some adaptation training, and after they have been judged by the company managers on their behaviour and performance during the training.

All university graduates join the labour union of the company after finishing their probationary employment period (generally after three months) and they start their business career in the same working conditions as workers in general. Fresh university graduates who majored in

technical areas and engaged by a production company have to work in three shifts in the same way as one of the operators at a plant for some period of time. Some who studied computer technology, and join a car dealer, start their work by selling cars.

These facts show that Japanese enterprises recruit a person with future potential and persons who already have a specific capability to perform a certain job are rather kept at a distance. However, in the West, not a person but his actual knowledge and skills are bought, and the employer looks for a person who can perform his job immediately after having been employed. This Japanese philosophy is based on the life-time employment and it is one of the most important duties of Japanese managers to find out and develop capabilities of his subordinates and assign them to 'the most appropriate posts and positions for them and for the company. They are rated according to their achievement how they made efforts to develop the capabilities of their subordinates, and how efficiently they have brought up their successors to replace them in their posts after they are promoted to a higher post or transferred to another post by job rotation planning of the company later on.

The facts are also related to the sense of equality and field-oriented nature of the Japanese. Japan is rather a mono-class society. In a Japanese factory, there is no such clear distinction like "officers" and "rank and file" among working people there. All men and women working there, managers, staff and workers alike wear uniforms of quite the same design, and have the same lunch in the same canteen. They have to observe the same rules and regulations of the company. As for a university graduate, an experience of working as a worker for a period of time at the initial stage of employment gives him an invaluable chance to learn many important things about the actual work as a manager in the future, and for an operator he can feel in this circumstance having equal possibility of getting promoted to a higher rank of hierarchy in the future, even to the rank of member of the executive board depending on his efforts and becomes very willing to serve the company and actively participate in various activities such as QCC and ZD (Zero Defect) Movement.

One of the most important aspects of the suggestion schemes is that each suggestion, once implemented, leads to a revised standard. For instance, when a special time-saving device has been installed on a machine at a worker's suggestion, this may require the worker to work differently and, at times more attentively. However, in as much as the new standard has been set up by the worker's own volition, he takes pride in the new standard and is willing to follow it. If, on the contrary, he is told to follow a standard imposed by management, he may not be willing to follow it. One of the features of the Japanese workers is that they use their brains as well as their hands. The suggestion schemes were also at first brought from the United States to Japan by TWI (Training Within Industries) and the U.S.Air Force, but the American-style suggestion system soon gave way to Japanese-style schemes. Whereas the American-style stressed the suggestion's economic benefits and provided financial incentives, the Japanese-style stressed the morale-boosting benefits of positive employee participation.

The secret of success of QCC in Japanese industries resides in the working attitude of each Japanese worker who has relatively higher education, is strongly conscious of his responsibility on the quality of final products and pays keen attention even to the preceding and succeeding processes beyond his own duty area.

In the West if someone suggests that the working place should always be kept clean, management may react by employing a new worker to clean it. They may say that jobs and duties of a mechanic are to manipulate machines and produce products, but not to clean the working place, we can employ another worker for that purpose with much cheaper wage than a mechanic.

However, by Japanese working ethics it is a mechanic himself who should clean his working place, because cleaning of his working place is his own duty as well as cleaning and maintenance of his machines. Every craftsman and artisan both in the East and the West take good care of their tools and maintain them themselves. With tools always well maintained he can produce products of high quality. This fact can be applied to factory work also. The mechanic can grasp well the peculiarity of the machine, and manipulate it better by cleaning it and maintaining it himself.

In the West managers often tend to fancy that it is necessary to increase the number of inspectors and train them well to keep the high quality of their products. By increasing and training inspectors they can raise the detection rate of defective products, but they cannot reduce their production rate. It is absolutely necessary for each working personnel to have firm resolution and try hard not to give any defective product under his responsibility to the succeeding process. Finding a defective product at the final stage is too late. High quality products can always be produced when every working personnel work as if they themselves were inspectors.

2. Process-orientation vs Result-Orientation

Another important feature of Japanese management is that it is rather process-oriented, because processes must be improved before we get improved results. In the United States, generally speaking, no matter how hard a person works, lack of results will result in a poor personal rating and lower income or status. The individual's contribution is valued only for its concrete results. Only the results count in a result-oriented society.

QC-circle activities are usually directed toward improvements in the work place, yet the supporting system is crucial. It is reported the QC-circles formed in the West are often short-lived. This appears to be attributable mostly to the lack of a system that addresses the real needs of the QC-circle members. If the management is interested only in the results, it will be looking only at result-oriented criteria for QC-circle activities. The result-oriented criteria in this case put importance on the money saved as a result of their activities. Accordingly, management's interest and support will be geared directly to the savings made by members of the QC-circle.

On the other hand, if management is interested in supporting the QC-circle's efforts for improvement, the first thing management has to do is to establish process-oriented criteria, such as the number of meetings held per month, the participation rate, the number of problems solved, and the number of reports submitted in order to

measure the effort made by QC-circle members.

At one of Matsushita's plants, the waitresses in the cafetaria formed QC-circles and studied the tea consumption during the lunch period. When large tea pots were placed on the tables with no restrictions on use, the waitresses noticed, tea consumption differed greatly from table to table. Therefore, they collected data on the tea-drinking behaviour of employees during lunch. For one thing, they found that the same people tended to sit at the same table. After taking and analyzing data for days, they were able to establish an expected consumption level for each table. Using their findings, they started putting out different amounts of tea for each table, with the result they were able to reduce tea-leaf consumption to half. How much were their activities worth in terms of the actual amount of money saved? Probably very little. However, they were awarded the Presidential Gold Medal for the year.

III. Conclusion

The main features of Japanese management are a sense of social equality, group-orientation, field-orientation and process-orientation.

Now some others should be added to them also. They are broad job description and flexible job assignment. In the Western context of management, job description indicates the job area covered by each employee and it should not overlap with that of any others. But in Japanese enterprises job descriptions are so loose and vague (in some cases even job description itself does not exist) that employee can help each other and cover each other according to the heaviness of the work, and extend their job areas according to his ability. Management can assign an employee to a quite different post when the necessity arises and the employee accepts it as very natural. It seems to the author that the Western system of job assignment is based on distrust in human nature; it seems the Westerner feels that since the human being is foolish in nature, and since we have to ask him to work, his jobs and responsibilities should be clearly described in order to let him make no excuse for his mistakes. On the contrary, the Japanese are rather optimistic and think that since the human being is capable in nature, he can develop his capabilities as far as possible. If proper environment is given and if he is well motivated and stimulated.

Anyway it can be said with confidence that the most fundamental feature of Japanese management is the trust in human nature and the success of Japanese industries is based on its success in human capabilities development. Successful Japanese managers have not treated their employees as one of their resources for production, but treated them like human beings as they are. It is very easy to learn how to conduct QC circle, ZD movement or suggestion schemes. There are quite a number of books, references, seminars or courses available for this purpose. But the question is always how to motivate employees to make them actively participate in these activities. Innovation can not be achieved only by learning physical techniques or methodologies, but it necessarily requires innovation in human behaviors of mind. Each country has its own culture. Ways of living, ways of thinking and value systems are different from country to country.

The paper has shown here an example of Japanese success in innovation, but it is

very natural that all that mentioned here are not immediately applicable to other countries without adequate adaptation. At the same time, however, another interesting concept which Atsuo Ishiwara proposed in his paper in Singapore should be suggested.

Taking A as: local/traditional cultures/ values

B as: foreign/new foreign cultures /values.

it seems that there could be the following four patterns of interaction when different cultures/values meet.

1. When new values are rejected:

   $A + B - B = A$

2. When new values overtake traditional values

   $A + B - A = B$

3. When new visitors behave like the host
   (when in Rome do as Romans do)

   $A + O = A$

4. When new values added extra values to traditional values:

   $A + B = AB,\ AB > (A + B)$

Since we are all same human beings, we can do anything what other person can do after an elaborate study on it and suitable adaptation as readers saw in Japanese experience.

There is an old saying in Japan that "if a man has not been seen for three days, he must have been quite changed so his friends have to open their eyes wide in spite of themselves."

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RESEARCH ABSTRACTS

S. MUTHU CHIDAMBARAM, Professional Women: A Comparative Study of Women Doctors and Engineers, Mother Teresa Women's University, Madras.

Objectives :

The objectives of the study are :

1. To study the social conditions affecting women's entry into medicine in a historical perspective and to compare that with women engineers who entered into the profession at a later period.

2. To study the sex-typing and sex-role expectations affecting
   a. Career choice and development and
   b. Career role performance
   of women doctors historically and to compare that with that of women engineers at a later period.

3. To study in a historical perspective the impact of the profession of women doctors on their marriage and family life and to compare the same with that of women engineers at a later period.

4. To suggest solutions to improve the contributions of women doctors and engineers.

Methodology

Viewed from the perspective of the respondents the study emphasises the conflicting role expectations of women's traditional and professional roles. Hence structural functionalism combined with interactionalism is used as the approach for the study. The area of study is limited to Madurai District. Systematic random sampling is used to select the women doctors. The total universe is studied in the case of women engineers. The individual respondents form the units for analysis. The data is collected through unstructured and structured interviews. This is supplemented by a few case studies for indepth analysis. After collecting the data, the period of entry into the profession is used as the main variable for analysis. Statistical tools are used in order to interpret the data.

Findings:

The following are the main findings of the study:

1. Medical as well as engineering education for women is an elite phenomenon.

2. Apart from the socio-economic condition of a group, the social attitude of a group regarding its women's education and employment affects women's entry into the two professions.

3. The necessity to provide medical service to Indian women and to elevate the social status of women through employment are the main reasons for women's entry into medicine in the earlier period. Later, the prestige associated with the profession and the desire to maintain the family tradition of doctors are the reasons which govern the choice. Prestige and employment

opportunities associated with engineering are the only reasons for women's entry into engineering.

4. A large majority of women doctors in the earlier period were in specialities associated with the treatment of women and children. As for engineering, women choose specialities that are less manly and are compatible with feminine attributes.

5. Another guiding principle in the choice of occupation of women doctors and engineers is the compatibility of occupational roles with family roles. Compared to women doctors, more women engineers are in occupations of fixed hours of work.

6. The sense of dependence inculcated in the minds of women determines the career choice and development of women doctors and engineers.

7. Indispensability of marriage and orientation towards their husbands and children force women doctors and engineers to adjust their career to the demands of their husbands and children.

8. The principal orientation of women doctors and engineers in their family and career is of secondary importance to them.

9. On the other hand, the moral support the women doctors receive from their husbands and the desire to provide a better future for their children work as additional incentives to develop their career in the long run. Compared to the career development of married women doctors, the career development of spinster doctors is not high.

10. There is lack of accepted role model for women to work outside their homes and to establish contact with men, colleagues and clients. Though women doctors gained confidence in course of time, the social conditions have changed endangering women's security. These problems are more for women engineers. Hence both women doctors and engineers cluster round a few specialities and occupations that are compatible with sex-typing and sex-role expectations of women.

11. Both women doctors and engineers are preferred as wives because of their professional qualifications.

12. Their status in the family is high.

13. In spite of dwindling household help both women doctors and engineers do not expect their husbands to share their house-hold chores.

14. The feeling that they neglect their children because of their profession is very strong in the minds of both women doctors and engineers.

PILLAI.S.S., and R.SRINIVASAN, "Student Achievement in Autonomous Polytechnics", TTTI: Madras, 1991.

OBJECTIVES:

The major objectives of this study were:

1. To identify the number of students who underwent different courses in the autonomous polytechnics
2. To identify the pass ratio of students in the various courses
3. To rank the institutions on the basis of their overall achievement

METHODOLOGY:

The scheme of autonomous polytechnics is in vogue only in the state of Tamilnadu in the southern region. Seven polytechnics function as autonomous polytechnics. A questionnaire designed for this purpose was sent to all the autonomous polytechnics with a request to furnish the relevant data for the three year period 1986-89.

FINDINGS:

The main findings of the study were:

1. In terms of overall achievement the first three positions were retained by private institutions.
2. Among all the branches of specialization available in these institutions textile technology reaped the maximum achievement and is also consistent with more than 87% success throughout the period covered.
3. One private institution which enjoys partial autonomy recorded 100% pass ratio in textile technology in two years, i.e., 1986-87 and 1988-89.
4. Another private institution also achieved a similar performance in textile/man-made fibre technology courses in the years 1987-88 and 1988-89 respectively.
5. The average pass ratio of the Diploma course in civil engineering was the lowest and it was found to be 68.5% in 1989.
6. The average pass ratio of all branches put together when considered independently institutewise revealed that only in the case of two private polytechnics it stood at 90% over the period 1986-89.
7. In the year 1987-88 the pass ratio of one institution in the Refrigeration and Air Conditioning course showed a poor outturn of 36%. It needs to be studied further as to why this course alone suffered a serious setback which is not conducive for the academic atmosphere of the institution concerned.

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